

SPECIFICATION MANUAL
BID PACKAGE 'A' - VOLUME I
Division 1 through Division 12
ORANGE COUNTY
HOLDEN HEIGHTS COMMUNITY
CENTER



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Bid Documents

February 22, 2013



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Division 1

General Requirements

**ORANGE COUNTY CAPITAL PROJECTS DIVISION
STANDARD DIVISION 1 SPECIFICATIONS**

SECTION NUMBER	SECTION TITLE
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**SECTION 01005
ADMINISTRATIVE PROVISIONS**

PART I GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work of this Contract comprises building, site work and related construction work to produce a complete and functional facility including but not limited to plumbing, mechanical, and electrical.

1.02 CONTRACT METHOD

- A. Construct the work as follows:
Part A: community center, parking, site work: Lump Sum
Part B: 19th Street Improvements: Unit Pricing
Part C: Sanitary Sewer Improvements: Unit Pricing

1.03 COORDINATION

- A. Coordinate work of the various Sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items installed later.
- B. Verify characteristics of elements of interrelated operating equipment are compatible; coordinate work of various Sections having interdependent responsibilities for installing, connecting to and placing in service, such equipment. Differences shall be brought to the Owner's attention during bid process or remain the responsibility of the Contractor.
- C. Coordinate space requirements and installation of items, such as, but not limited to, mechanical and electrical work which are indicated diagrammatically or otherwise on drawings. Follow routing shown for pipes, ducts and conduits, as closely as practicable; make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.
- D. In finished areas (except as otherwise shown), conceal pipes, ducts, and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Execute cutting and patching to integrate elements of work, uncover ill timed, defective and nonconforming work, provide openings for penetrations of existing surfaces and provide samples as specified in individual sections for testing. Seal penetrations of existing surfaces and provide samples as specified in individual sections for testing. Seal penetrations through floors, walls and ceilings, and fire safe where necessary as part of the lump sum price.

1.04 FIELD ENGINEERING SURVEYING

- A. Provide field engineering surveying services; establish grades, lines and levels, by use of engineering survey practices recognized as standard by the survey industry. Said work shall be required to be provided by a Professional Land Surveyor, registered as such in the State of Florida.

- B. Control datum for survey is that shown on Grading and Drainage Plan. Locate and protect control and reference points, per requirements stated in Part F, Article 6 of the GENERAL CONDITIONS.

1.05 REFERENCE STANDARDS

- A. For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. The date of the standard is that in effect when a specified date is specified.
- C. Obtain copies of referenced standards listed in individual specification sections. Maintain copy at job site during progress of the specific work.

END OF SECTION 01005

**SECTION 01010
SUMMARY OF WORK**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 PROJECT DESCRIPTION

- A. Performance of all tasks specified in the contract documents shall be the responsibility of the contractor unless specified otherwise.
- B. This project has three components.
 - A) The Base Bid consists of a newly constructed 12,000 square foot building using tilt wall construction. The building includes a warming kitchen, large multi-purpose room, reception/waiting, training and administrative areas. The project includes parking, site work with underground storm water storage tanks, patio deck, etc. This component will be a lump sum price.
 - B) 19th Street Improvements consists of road improvements, curbs, gutters, sidewalks, etc. This component will be priced using unit pricing.
 - C) Sanitary Sewer Improvements consists of sanitary sewer upgrades beginning on 19th Street and running across construction site to 20th Street. This component will be priced using unit pricing.
- C. Contractor is responsible for all permit fees. The Owner is responsible for impact and connection fees.

1.03 BUILDING/SITE SECURITY

- A. The construction site currently has a 4' chain link fence around the entire perimeter of the construction site. Modifications may be made by the contractor as needed. The fence and all components will be removed by the contractor.

1.04 CONTRACTOR USE OF PREMISES

- A. General: During the construction period, the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor's use of the premises is limited only by the Owner's right to perform construction operations with its own forces or to employ separate contractors on portions of the project.
- B. General: Limited use of the premises to construction activities in areas indicated within the limit of the premises. The Contractor may use any portion of the site for storage or work areas or any legal purpose.
 - 1. Confine operations to areas within Contract limits indicated on the Draw-

ings. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

2. Keep driveways and entrances serving the premises clear and available to the Owner and the Owners' employees at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
3. Burial of Waste Materials: Do not dispose of organic and hazardous material on site, either by burial or by burning.

1.05 DISTRIBUTION OF RELATED DOCUMENTS

- A. The Contractor is solely responsible for the distribution of ALL related documents/drawings to ALL appropriate vendors/subcontractors to ensure proper coordination of all aspects of the project and its related parts during bidding and construction.

1.06 CONSTRUCTION BULLETIN BOARD

- A. The Contractor shall erect and maintain a weather protected bulletin board of sufficient size to display all permits, notices and other documents required to be posted for the Project. Said bulletin board shall be in a location that provides unobstructed access for inspection by the Architect, the Project Manager, County Representatives, and authorities having jurisdiction over the project.

PART 2 PRODUCTS

2.01 ASBESTOS FREE MATERIAL

- A. Contractor shall provide a written and notarized statement on company letterhead(s) to certify and warrant that ONLY ASBESTOS FREE MATERIALS AND PRODUCTS were provided as required by the Architect in Section 01400, QUALITY CONTROL. Such statement shall be submitted with the final payment request. Final payment shall not be made until such statement is submitted. Contractor agrees that if materials containing asbestos are subsequently discovered at any future time to have been included in the construction, the Contractor shall be liable for all costs related to the redesign or modification of the construction of the project so that materials containing asbestos are removed from the facility. If construction has begun or has been completed pursuant to a design that includes asbestos containing materials, the Contractor shall also be liable for all costs related to the abatement of such asbestos.

PART 3 EXECUTION (Not applicable).

END OF SECTION 01010

**SECTION 01027
APPLICATION FOR PAYMENT**

PART I GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
- B. The Contractor's Construction Schedule and Submittal Schedule are included in Section 01300 – SUBMITTALS

1.03 SCHEDULE OF VALUES

- A. Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Submit the Schedule of Values to the Owner at the earliest feasible date, but in no case later than Preconstruction Meeting. Refer to Section 01200.
 - 2. Sub-Schedules: Where the Work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.
 - 1. Identification: Include the following project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of the Architect
 - c. Project Number
 - d. Contractor's name and address
 - e. Date of submittal

2. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:
 - a. Generic name
 - b. Related Specification Section
 - c. Change Orders (numbers) that have affected value
 - d. Dollar Value
 - e. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items:
 - a. A value will be given for at least every major specification section (subsections can logically be grouped together).
 - b. A single material subcontractor (i.e. sod, window blinds) will not be required to be broken down into labor and material unless it is anticipated the materials will be stored and invoiced prior to installation.
 - c. All multiple item subcontracts or work items (i.e. concrete, roofing, painting, mechanical, electrical items, etc.) will be shown broken down at least in labor and material (all taxes, burden and overhead and profit included).
 - d. Mobilization (move-on, bond, insurance, temporary office and sanitary service installation) shall not exceed 2 1/2% of contract price.
 - e. For multi-story work all items broken down per floor.
 - f. Concrete broken down at least into foundation slab on grade, columns, beams and suspended slabs.
 - g. Masonry divided into C.M.U. brick, stem walls, exterior walls, interior walls and elevator shaft.
 - h. Plumbing broken down at least into underslab rough-in, vents and stacks supply piping, equipment items (each listed separately), fixtures and trim.
 - i. HVAC: Typically shown per specification section, labor and material, per floor.
 - j. Electrical: same as HVAC.
 - k. Fire protection broken down at least into underground, rough-in and trim. All per building and labor and material.
 - l. Logical grouping of specification subsections is permitted.

4. Round amounts off the nearest whole dollar, the total shall equal the Contract Sum.

5. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

6. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.
 - a. At the Contractors' option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.
7. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the contract sum.

1.04 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as reviewed by the Owner representative and paid for by the Owner.
 1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the Final Application for Payment involve additional requirements. See items G, I, J and K of this section.
- B. Payment Application Times: The period of construction work covered by each Application of Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use the County's most updated form as the form for Application for Payment. Form given at the Preconstruction Conference.
- D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.
 1. Entries shall match data on the Schedule of Values and Contractors' Construction Schedule. Use updated schedules if revisions have been made.
 2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.
- E. Transmittal: Submit four (4) original executed copies of each Application for Payment to the Project Manager; one copy shall be complete, including waivers of lien and similar attachments, when required.
 1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Project Manager.

- F. Payment will be processed once a month. Payment for item will be based on percentage completed as determined and approved by the County Project Manager or invoice for stored materials. Retainage (10%) will be held for all applications.
- G. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work. Application shall also include all items listed in Part H. above.
- H. Final Payment Application: Administrative actions and submittals, which must precede or coincide with submittal of the final payment. Application for Payment includes the following:
 - 1. Completion of Project Close-Out requirements
 - 2. Completion of items specified for completion after Substantial Completion (Punch List)
 - 3. Contractor's release of lien (on Owner's form)
 - 4. Subcontractor and material supplier release of lien
 - 5. Consent of Surety
 - 6. Power of attorney
 - 7. Asbestos-free letter

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01027

**SECTION 01035
MODIFICATION PROCEDURES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

1.02 SUMMARY

- A. This section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.03 MINOR CHANGES IN THE WORK

- A. Supplemental instructions authorizing minor changes in the work, not involving an adjustment to the Contract Sum or Contract Time, will be issued by the Project Manager.

1.04 CHANGE ORDER PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Proposed changes in the work that will require adjustment to the Contract Sum or Contract Time will be issued by the Project Manager, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.
 - 1. Proposal requests issued by the Project Manager are for information only. Do not consider them instruction either to stop work in progress, or to execute the proposed change.
 - 2. Unless otherwise indicated in the proposal request, within 7 days of receipt of the proposal request, submit to the Project Manager from the Owner's review, an estimate of cost necessary to execute the proposed change.
 - a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include a statement indicating the effect the proposed change in the work will have on the Contract Time.
 - d. Contractor and subcontractors will provide a complete detailed labor and material breakdown to justify change order request amount.

- B. Contractor-Initiated Change Order Proposal Requests: When latent or other unforeseen conditions in mutual accord with the Owner Representatives findings require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Architect.
 - 1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
 - 2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - 3. Comply with requirements in Section 01631 Product Substitutions- if the proposed change in the work requires that substitution of one product or system for a product or system not specified.
 - 4. Contractor and subcontractors will provide a complete detailed labor and material breakdown to justify change order request amounts.

1.05 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: When the Owner and Contractor are not in total agreement on the terms of a Change Order Proposal Request, the Project Manager may issue a Construction Change Directive instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.07 CHANGE ORDER PROCEDURES

- A. Upon the Owner's approval of a Change Order Proposal Request, the Project Manager will issue a Change Order for signatures of the Owner and Contractor on County's Change Order form, as provided in the Conditions of the Contract.

END OF SECTION 01035

SECTION 01040
PROJECT COORDINATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and supervisory requirements necessary for project coordination including, but not necessarily limited to:
 - 1. Coordination
 - 2. Administrative and supervisory personnel
 - 3. General installation provisions
 - 4. Cleaning and protection
- B. Progress meetings, coordination meetings And Pre-installation conferences are included in Section 01200 Project Meetings .
- C. Requirements for the Contractor s Construction Schedule are included in Section 01300 Submittals .

1.03 COORDINATION

- A. Coordination: Coordinate construction activities included under various Sections of these Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specification that are dependent upon each other for proper installation, connection, and operation.
 - 1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
 - 2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required: notices, reports, and attendance at meetings.
1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Schedules
 2. Installation and removal of temporary facilities
 3. Delivery and processing of submittals
 4. Progress meetings
 5. Project close-out activities
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment (if any) involved in performance of, but not actually incorporated in, the Work.
- E. Lack of coordination as specified in this and other sections of the contract documents are in grounds for assessment of back charges and/or termination in order to remediate the situation.

1.04 SUBMITTALS

- A. Coordination Drawings: Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
1. Show the interrelationship of components shown on separate Shop Drawings.
 2. Indicate required installation sequences.

3. Comply with requirements contained in Section Submittals .
 4. Refer to Division-15 Section Basic Mechanical Requirements, and Division-16 Section Basic Electrical Requirements for specific coordination Drawing requirements for mechanical and electrical installations.
- B. Staff Names: At the Preconstruction Conference submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.
1. Post copies of the list in the project meeting room, the temporary field office, and each temporary telephone.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 GENERAL INSTALLATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- D. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.
- E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to Project Manager for final decision.
- F. Recheck measurements and dimensions, before starting each installation.

- G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- H. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect/Project Manager for final decision.

3.02 CLEANING AND PROTECTION

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- B. Clean and maintain completed construction as directed by the Project Manager and as frequently as necessary to ensure its integrity and safety through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where the applicable, such exposures include, but are not limited to, the following:
 - 1. Excessive static or dynamic loading
 - 2. Excessively high or low temperatures
 - 3. Excessively high or low humidity
 - 4. Air contamination or pollution
 - 5. Water
 - 6. Solvents
 - 7. Chemicals
 - 8. Soiling, staining and corrosion
 - 9. Rodent and insect infestation
 - 10. Combustion
 - 11. Destructive testing
 - 12. Misalignment

13. Excessive weathering
14. Unprotected storage
15. Improper shipping or handling
16. Theft
17. Vandalism

END OF SECTION 01040

SECTION 01045 CUTTING AND PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for cutting and patching.
- B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - 1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division-15 and Division-16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.03 SUBMITTALS

- A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
 - 2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
 - 3. List products to be used and firms or entities that will perform Work.
 - 4. Indicate dates when cutting and patching is to be performed.
 - 5. List utilities that will be disturbed or affected, including those that

will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.

6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
7. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.04 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load carrying capacity or load-deflection ratio.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements.
 - a. Foundation construction
 - b. Bearing and retaining walls
 - c. Structural concrete
 - d. Structural steel
 - e. Lintels
 - f. Timber and primary wood framing
 - g. Structural decking
 - h. Miscellaneous structural metals
 - i. Stair systems
 - j. Exterior curtain wall construction
 - k. Equipment supports
 - l. Piping, ductwork, vessels and equipment
 - m. Structural systems of special construction in Division 13.
- B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety. Refer to Divisions 15 and 16 regarding Fire Rated Penetrations.
 1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems.

- a. Shoring, bracing and sheeting
 - b. Primary operational systems and equipment
 - c. Air or smoke barriers
 - d. Water, moisture, or vapor barriers
 - e. Membranes and flashings
 - f. Fire protection systems
 - g. Noise and vibration control elements and systems
 - h. Control systems
 - i. Communication systems
 - j. Conveying systems
 - k. Electrical wiring systems
 - l. Special construction specified by Division-13 Sections
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.
- 1. If possible retain the original installer or fabricator to cut and patch the following categories of exposed work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:
 - a. Processed concrete finishes
 - b. Preformed metal panels
 - c. Window wall system
 - d. Stucco and ornamental plaster
 - e. Acoustical ceilings
 - f. Carpeting
 - g. Wall covering
 - h. HVAC enclosures, cabinets or covers
 - i. Roofing systems

PART 2 PRODUCTS

2.01 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect unless otherwise indicated by Architect/Owner. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 EXECUTION

3.01 INSPECTION

- A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
 - 1. Before proceeding, meet at the site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed.
- C. Avoid interference with use of adjoining areas and interruption of free passage to adjoining areas.
- D. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

- A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or diamond core drill.
 4. Comply with requirements of applicable Sections of Division-2 where cutting and patching required excavating and backfilling.
 5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance.
- Remove existing floor and wall coverings and replace with new materials if necessary to achieve uniform color and appearance.
- a. Where patching occurs in a smooth painted surfaces, extend final coat over entire unbroken surfaces containing the patch, after the patched area has received primer and second coat.

3.04 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils,

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putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged materials to their original condition.

END OF SECTION 01045

SECTION 01095
REFERENCE STANDARDS AND DEFINITIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. Indicated: The term *indicated* refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as shown, noted, scheduled and specified are used, it is to help the reader locate the reference; no limitation on location is intended.
- C. Directed: Terms such as directed, requested, authorized, selected, accepted, required, and permitted mean directed by the Project Manager, requested by the Architect/Project Manager and similar phrases.
- D. Approved: This term approved means accepted, where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- E. Regulations: The term Regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. Furnish: The term furnish is used to mean supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. Install: The term install is used to describe operations at project site including the actual unloading, unpacking, assembly, erection,

- placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations
- H. Provide: The term provide means to furnish and install, complete and ready for the intended use.
- I. Installer: An Installer is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
1. The term experienced, when used with the term Installer, means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
 2. Trades: Use of titles such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.
- J. Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. Testing Laboratories: A testing laboratory is an independent entity engaged to perform specific inspections or tests, either at the Project sites or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.03 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 16 Division format and MASTER FORMAT numbering system.

B. Specification Content: This Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Words and meaning shall be interpreted as appropriate. Words that are implied, but not stated shall be interpolated as the sense required. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the context of the Contract Documents so indicates.
2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
 - a. The words, shall be shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.04 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copies directly into the Contract Documents to the extend reference. Such standards are made part of the Contract Documents by reference.
- B. Publication Dates: Comply with the standard in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliances with two or more standards are specified, and the standards may establish different or conflicting requirements for minimum quantities or quality levels. Refer requirements that are different, but apparently equal, and uncertainties to the Architect for a decision before proceeding.
 1. Minimum Quantity or Quality Levels: The quantity of quality level shown or specified shall be the minimum provided or performed.

The actual installation may comply exactly with the minimum

quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Architect/Owner for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed for performance of a required construction activity. The Contractor shall obtain copies directly from the publication source or any other authorized source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. See Trade Reference List at the end of this Section refer to the Encyclopedia of Associations, published by Gale Research Co., available in most libraries.

1.05 GOVERNING REGULATIONS/AUTHORITIES

A. The Architect has contacted authorities having jurisdiction where necessary to obtain information necessary the preparation of Contract Documents. Contact authorities having jurisdiction directly for information and decisions having a bearing on the work.

1.06 SUBMITTALS

A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulation bearing upon performance of the Work.

1.07 TRADE REFERENCES

Acronyms for abbreviations used in the Specifications or other Contract Documents mean the recognized name of the trade association, standards generating organization, authority that have jurisdiction or other entity applicable to the context of the text provision.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturer s Association
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIL	American Council of Independent Laboratories
ACPA	American Concrete Pipe Association
ADC	Air Diffusion Council
AGA	American Gas Association
AHA	American Hardboard Association
AI	Asphalt Institute
AIHA	American Industrial Hygiene
Association AISC	American Institute of Steel
Construction AISI	American Iron and Steel
Institute	
AMCA	Air Movement and Control
Association ANSI	American National

Standards Institute APA American

Plywood Association

ARI Air Conditioning and Refrigeration Institute

ASA Acoustical Society of America

ASC Adhesive and Sealant Council

ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers

ASME American Society of Mechanical Engineers

ASPE American Society of Plumbing Engineers

ASSE American Society of Sanitary Engineers

ASTM American Society of Testing of Materials

AWI Architectural Woodwork Institute

AWPB American Wood Preservers Bureau

AWS American Welding Society

AWWA American Water Works Association

BHMA Builders Hardware Manufacturers Association

CISPI Cast Iron Soil Pipe Institute

CRSI Concrete Reinforcing Steel Institute

DHI Door and Hardware Institute

DLPA Decorative Laminate Products Association

EIMA Exterior Insulation Manufacturers Association

FGMA Flat Glass Marketing Association

FM Factory Mutual Engineering and Research

GA Gypsum Association

ICBO International Conference of Building Officials IEEE
Institute of Electrical and Electronic Engineers

IESNA Illuminating Engineering Society of North America

MBMA Metal Building Manufacturer s Association

ML/SFA Metal Lath/Steel Framing Association

MSS Manufacturers Standardization Society of the Valve and Fittings Industry

NAAMM National Association of Architectural Metal

Mfgs. NAPA National Asphalt Pavement Association

NAPF National Association of Plastic Fabricators (Now
DLPA) NBHA National Builder's Hardware Association (Now
DHI) NCMA National Concrete Masonry Association

NEC National Electric Code

NECA National Electric Contractors Association

NEII National Elevator Industry, Inc. NFPA
National Fire Protection Association

NHLA National Hardwood Lumber
Association NPA National Particle board
Association NPCA National Paint and Coatings
Association

NRCA National Roofing Contractors Association

NSF National Sanitation Foundation

NWMA National Woodwork Manufacturers Association (Now NWWDA)

NWWDA National Wood Window and Door Association (Formerly
NWMA) PDI Plumbing and Drainage Institute
RFCI Resilient Floor Covering Institute
RMA Rubber Manufacturers
Association SDI Steel Deck Institute
S.D.I. Steel Door Institute
SGCC Safety Glazing Certification Council
SHLMA Southern Hardwood Lumber Manufacturers Association (Now HMA)
SIGMA Sealed Insulating Glass Manufacturers Association
SMACNA Sheet Metal and Air Conditioning Contractors National Association
SJI Steel Joist Institute
SPRI Single Ply Roofing Institute
SSPC Steel Structures Painting Council
SWI Steel Window Institute
TCA Tile Council of America
UL Underwriters Laboratories
WCMA Wall Covering Manufacturers Association
WRI Wire Reinforcement Institute
WSFI Wood and Synthetic Flooring Institute

1.08 FEDERAL GOVERNMENT AGENCIES

A. Names and titles of federal government standard or Specification producing agencies are frequently abbreviated. The following acronyms or abbreviations referenced in the Contract Documents indicate names of standard of Specification producing agencies of the federal government. Names and addresses are subject to change but are believed to be, but are not assured to be, accurate and up-to-date as of the date of the Contract Documents.

CE	Corps of Engineers (US Department of the Army) Chief of Engineers - Referral Washington, DC 20314	(202) 272-0660
CFR	Code of Federal Regulations Available from the Government Printing Office North Capitol St. Between G and H Street, NW Washington, DC 20402	(202) 783-3238

(MATERIAL IS USUALLY FIRST PUBLISHED IN THE FEDERAL REGISTER)

CPSC	Consumer Product Safety Commission 5401 Westbard Avenue Washington, DC 20816	(800) 638-2772
CS	Commercial Standard (US Department of Commerce) Government Printing Office Washington, DC 20402	(202) 377-2000
DOC	Department of Commerce 14th Street and Constitution Ave., NW Washington, DC 20230	(202) 377-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590	(202) 426-4000
EPA	Environmental Protection Agency 401 M. St., SW Washington, DC 20460	(202) 382-2090

FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Avenue SW Washington, DC 20590	(202) 366-4000
FCC	Federal Communications Commission 1919 M. Street NW Washington, DC 20554	(202) 632-7000
NBS	National Bureau of Standards (U.S. Department of Commerce) Gaithersburg, MD 20899	(301) 921-1000
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) Government Printing Office Washington, DC 20402	(202) 523-7001
PS	Product Standard of NBS (U.S. Department of Commerce) Government Printing Office Washington, DC 20402	(202) 783-3238
USDA	U.S. Department of Agriculture Independence Avenue Between 12th and 14 Street, SW Washington, DC 20250	(202) 447-8732

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTION

(Not Applicable)

END OF SECTION 01095

**SECTION 01200
PROJECT MEETINGS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
 - 1. Pre-Construction Conference
 - 2. Pre-Installation Conference
 - 3. Coordination Meetings
 - 4. Progress Meetings
- B. Construction schedules are specified in Section 01300 Submittals.

1.03 PRE-CONSTRUCTION CONFERENCE

- A. Schedule a pre-construction conference and organizational meeting at the project site or other convenient location no later than 20 days after execution of the agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attends: The OWNERS Representative, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work.
- C. Agenda: Discuss items of significance that could affect progress including such topics as:
 - 1. Tentative construction schedule
 - 2. Critical Work sequencing and/coordinating
 - 3. Designation of responsible personnel
 - 4. Procedures for processing field decisions and Change Orders
 - 5. Procedures for processing Applications for Payment
 - 6. Distribution of Contract Documents

7. Submittal of Shop Drawings, Product Data and Samples
8. Preparation of record documents
9. Use of the Premises
10. Office, Work and storage areas
11. Equipment deliveries and priorities
12. Safety procedures
13. First aid
14. Security
15. Housekeeping
16. Working hours

D. Contractor must submit at the time of the meeting at least the following items:

1. Schedule of Values
2. Listing of key personnel including project superintendent and subcontractors with their addresses, telephone numbers, and emergency telephone numbers.
3. Preliminary Construction Schedule
4. Submittal Schedule

1.04 PRE-INSTALLATION CONFERENCE

A. Conduct a Pre-installation conference at the site before each construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise at least 48 hours in advance the Project Manager of scheduled meeting dates.

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
 - a. Contract Documents
 - b. Options
 - c. Related Change Orders
 - d. Purchases
 - e. Deliveries
 - f. Shop Drawings, Product Data and Quality Control Samples
 - g. Possible conflicts
 - h. Compatibility problems
 - i. Time schedules
 - j. Weather limitations

- k. Manufacturer's recommendations
- l. Comparability of materials
- m. Acceptability of substrates
- n. Temporary facilities
- o. Space and access limitations
- p. Governing regulations
- q. Safety
- r. Inspection and testing requirements
- s. Required performance results
- t. Recording requirements
- u. Protection

2. Record significant discussions and agreements and disagreements of each conference along with and approved schedule. Distribute the record of the meeting to everyone concerned promptly including the Owner and Architect.
3. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.05 COORDINATION MEETINGS

- A. Conduct project coordination meeting at weekly intervals on day and time as established by the Project Manager or more frequently, if necessary convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.
- B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved, to include subcontractors and representatives.
- C. Contractor shall record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.06 PROGRESS MEETINGS

- A. Conduct progress meetings at the Project site at bimonthly intervals or more frequently if necessary as directed by the Project Manager. Notify

the Owner at least 48 hours in advance of scheduled meeting time and dates. Coordinate dates of meetings with preparation of the payment request.

- B. Attendees: In addition to representatives of the Owner and Architect, each subcontractor, supplier or other entity concerned with current progress of involved in planning, coordination or performance of future activities with the project and authorized to conclude matters relating to progress.
- C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.
 - 1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time, ahead, or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 2. Review the present and future needs of each entity present, including such items as:
 - a. Interface requirements
 - b. Time
 - c. Sequences
 - d. Deliveries
 - e. Off-site fabrication problems
 - f. Access
 - g. Site utilization
 - h. Temporary facilities and services
 - i. Hours of work
 - j. Hazards and risks
 - k. Housekeeping
 - l. Quality and work standards
 - m. Change Orders
 - n. Documentation of information for payment requests.
- D. Reporting: No later than 3 days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary or progress since the previous meeting and report.

END OF SECTION 01200

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SECTION 01300 SUBMITTALS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:
 - 1. Contractor's Construction Schedule
 - 2. Submittal Schedule
 - 3. Daily Construction Reports
 - 4. Shop Drawings
 - 5. Product Data
 - 6. Samples
- B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
 - 1. Permits
 - 2. Applications for Payment
 - 3. Performance and Payment Bonds
 - 4. Insurance Certificates
 - 5. List of Subcontractors with start and finish dates (update as necessary)
 - 6. Schedule of Values
 - 7. Construction Schedule
- C. The Schedule of Values submittal is included in Section 01027 Applications for Payment .
- D. Inspection and test reports are included in Section 01044 Quality Control Services .

1.03 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Project Manager reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.
 - a. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Project Manager will promptly advise the Contractor when a submittal being processed must be delayed for coordination.
 - b. If an intermediate submittal is necessary, process the same as the initial submittal.
 - c. Allow two weeks for reprocessing each submittal.
 - d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.
- B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.

2. Include the following information on the label for processing and recording action taken.
 - a. Project name
 - b. Date
 - c. Name and address of Architect
 - d. Name and address of Contractor
 - e. Name and address of subcontractor
 - f. Name and address of supplier
 - g. Name of manufacturer
 - h. Number and title of appropriate Specification Section
 - i. Drawing number and detail references, as appropriate.

- C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Project Manager using transmittal form as provided by the Project Manager. Submittals received from sources other than the Contractor will be returned without action.
 1. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitation. Include Contractor's certification that information complies with Contract Document requirements.

 2. Transmittal Form: As provide by the Project Manager

- D. Contractor shall be responsible for cost of re-review of rejected submittals, shop drawing, etc. Costs for re-review shall be reimbursed to the County by deducting the cost from the Contractors monthly progress payments. Costs to be determined by applying the consultants standard billing rates, plus 10% handling by the County.

- E. Substitution request to specified products will be made within 30 days of Notice to Proceed. After the 30 day period, no requests for substitutions from the Contractor will be considered.
 1. Substitution submitted within the first 30 days will have product data from specified and requested substitute submitted together and demonstrate better quality, cost savings if of equal quality, or show benefit to the County for excepting the substitute.

- F. Once submittals are approved or approved as noted, they will be scanned and converted to PDF documents with OCR (optical character recognition) and given to the owner.

1.04 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Critical Path Method (CPM) Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule. Submit in accordance with Section 01200 Project Meetings.
1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the work as indicated in the Schedule of Values.
 2. Within each time bar, indicate estimated completion percentage in 10 percent increments. As work progresses, place a contrasting mark in each bar to indicate Actual Completion.
 3. Prepare the schedule on a sheet, series of sheets, stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
 4. Secure time commitments for performing critical elements of the work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the work.
 5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment request and other schedules.
 6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.
- B. Phasing: Provide notations on the schedule to show how the sequence of the work is affected by requirements for phased completion to permit work by separate Contractors and partial occupancy by the Owner prior to Substantial Completion.
- C. Work Stages: Indicate important stages of construction for each major portion of the work, including testing and installation.
- D. Area Separations: Provide a separate time bar to identify each major

construction area for each major portion of the work. Indicate where each element in an area must be sequenced or integrated with other activities.

- E. Cost Correlation: At the head of the schedule, provide a two item cost correlation line, indicating pre-calculated and actual costs. On the line show dollar-volume of work performed as the dates used for preparation of payment requests.
 - 1. Refer to Section Applications for Payment for cost reporting and payment procedures.

- F. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the project meeting room and temporary field office.
 - 1. When revision are made distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

- G. Schedule Updating: Revise the schedule monthly or activity, where revisions have been recognized or made. Issue the updated schedule concurrently monthly pay request.

1.05 SUBMITTAL LOG

- A. After development and acceptance of the Contractor's construction schedule, prepare a complete log of submittals.
 - 1. Coordinate submittals log with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.

 - 2. Prepare the log in chronological order; include all submittals required. Provide the following information:
 - a. Scheduled date for the first submittal
 - b. Related Section number
 - c. Submittal category
 - d. Name of subcontractor
 - e. Description of the part of the work covered
 - f. Scheduled date for resubmittal
 - g. Scheduled date the Architect's final release or approval.

3. All submittals must be received within the first 25% of contract time.
- B. Distribution: Following response to initial submittal, print and distribute copies to the Project Manager, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.
1. When revision are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
- C. Log Updating: Revise the log after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.06 DAILY CONSTRUCTION REPORTS

- A. Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Project Manager at weekly intervals:
1. List of subcontractors at the site
 2. Approximate count of personnel at the site
 3. High and low temperatures, general weather conditions
 4. Accidents and unusual events
 5. Meetings and significant decisions
 6. Stoppages, delays, shortages, losses
 7. Meter readings and similar recordings
 8. Emergency procedures
 9. Orders and requests of governing authorities
 10. Change Orders received, implemented
 11. Services connected, disconnected
 12. Equipment or system tests and start-ups
 13. Partial completions, occupancies
 14. Substantial Completions authorized

1.07 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered a Shop Drawings and will be rejected.
- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
 - 1. All required dimensions
 - 2. Identification of products and materials included
 - 3. Compliance with specified standards
 - 4. Notation of coordination requirements
 - 5. Notation of dimensions established by field measurement
 - 6. Sheet Size: Except for templates, patterns and similar full-size Drawings on sheets at least 8 " x 11" but no larger than 24" x 36".
 - 7. Initial Submittal: Submit one correctable translucent reproducible print and one blue-or black-line print for the Project Manager's review; the reproducible print will be returned.
 - 8. Initial Submittal: Submit 2 blue-or black-line prints for the Architect's review; one will be returned.
 - 9. Final Submittal: Submit 5 blue-or black-line prints; submit 7 prints where required for maintenance manuals. 3 prints will be retained; the remainder will be returned.
 - 10. Final Submittal: Submit 3 blue-or black-line prints; submit 5 prints where required for maintenance manuals. 2 prints will be retained; the remainder will be returned.
 - a. One of the prints returned shall be marked-up and maintained as a Record Documents.
 - 11. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connections with construction.
- C. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.

1. Preparation of coordination Drawings is specified in section Project Coordination and may include components previously shown in detail on Shop Drawings or Product Data.
2. Submit coordination Drawings for integration of different construction elements. Show sequence and relationships of separate components to avoid any conflict including conflicts in use of space.
3. Contractor is not entitled to additional payments due to lack of compliance with this Section.

1.08 PRODUCT DATA

- A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as Shop Drawing .
 1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations
 - b. Compliance with recognized trade association standards
 - c. Compliance with recognized testing agency standards
 - d. Application of testing agency labels and seals
 - e. Notation of dimensions verified by field measurement
 - f. Notation of coordination requirements
 - g. Manufacturer's local representative and phone number.
 2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
 3. Preliminary Submittal: Submit a preliminary single-copy of Product Data where selection of options is required.

4. Submittals: Submit six (6) copies of each required submittal. The Project Manager will return two (2) sets to the Contractor marked with action taken and corrections or modifications required.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
5. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - a. Do not proceed with installation until an applicable copy of Product Data applicable is in the Installer's possession.
 - b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.09 SAMPLES

- A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of materials, color range sets, and swatches showing color, texture and pattern.
 1. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect's/Owner's Sample. Include the following:
 - a. Generic description of the Sample
 - b. Sample source
 - c. Product name or name of manufacturer
 - d. Compliance with recognized standards
 - e. Availability and delivery time
 2. Submit Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.
 - b. Refer to other Specification Sections for requirements for

Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.

3. Preliminary submittals: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.
 - a. Preliminary submittals will be reviewed and returned with the Architect's/Owner's mark indicating selection and other action.
 4. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; one will be returned marked with the action taken.
 5. Maintain sets of Samples, as returned, at the project site, for quality comparisons throughout the course of construction.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 - b. Sample sets may be used to obtain final acceptance of the construction associated with each set.
- B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.
1. Field Samples specified in individual sections are special types of Samples. Field Samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the work will be judged.
 - a. Comply with submittal requirements. Process transmittal forms to provide a record of activity.

1.10 ARCHITECT'S ACTION

- A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect/Project Manager will review each submittal, mark to indicate action taken, and return promptly.
- B. Action Stamp: The Architect/Project Manager will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, similarly as follows, to indicate the action taken:
 - 1. Final Unrestricted Release: Where submittals are marked No Exceptions Taken, that part of the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 - 2. Final-But-Restricted Release: When submittals are marked Made Corrections Noted that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
 - 3. Returned for Resubmittal: When submittal is marked Revise and Resubmit, do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - a. Do not permit submittals marked Revise and Resubmit to be used at the Project site.
 - 4. Rejected: Submittal does not comply with requirements of the Contract Documents. Submittal must be discarded and entirely new submittal shall be forward to the Project Manager without delay.

END OF SECTION

01300

01400-2

SECTION 01400
QUALITY CONTROL SERVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division -1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for quality control services.
- B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and test, cover production of standard products as well as customized fabrication and installation procedures.
 - 2. Inspection, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitates compliance with Contract Document requirements.
 - 3. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.03 GENERAL QUALITY CONTROL

- A. The Contractor shall be responsible for maintaining and ensuring quality control over subcontractors, suppliers, manufacturers, materials, equipment, products, services, site conditions and workmanship to product work of specified quality. The completed work shall be of high quality throughout.

1.04 WORKMANSHIP

- A. Comply with well-known standards recognized by each trade except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality. Said qualifications shall be determined by well-known standards recognized by the trade for each respective portion of contract work.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration and racking.

1.05 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Architect before proceeding.

1.06 MANUFACTURER'S CERTIFICATES

- A. When required by individual Specifications Section, submit manufacturer's certificate and supporting documentation, in duplicate, that products meet or exceed specified requirements.
- B. ASBESTOS FREE MATERIALS - Manufacturer and/or supplier shall provide a written and notarized statement on manufacturer's company letterhead to certify and warrant that product (s) utilized on project are asbestos free.

1.07 MOCKUPS

- A. When required by individual Specifications Section, erect complete, full scale mockup of assembly at Project Site.

1.08 MANUFACTURER'S FIELD SERVICES

- A. When specified in respective Specification Sections, require supplier and/or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, test, adjust and balance of equipment as applicable and to make appropriate recommendations.
- B. Representative shall submit written report to Owner listing observations, recommendations, and certifying full conformance and compliance with manufacturers standards or requirements.

1.09 TESTING LABORATORY SERVICES

- A. The County shall employ and pay for services of an Independent Testing Laboratory to perform inspections, tests for construction materials (soils, concrete) and threshold inspections.
- B. Services will be performed in accordance with requirements of governing authorities and with specified standards.
- C. Reports will be submitted to the County, Contractor and Architect giving observations and results of tests, indicating compliance or noncompliance with specified standards and with Contract Documents.
- D. Contractor shall cooperate with testing laboratory personnel; furnish tools, samples of materials, design, mix equipment, storage and assistance as requested.
 - 1. The contractor shall be responsible for notifying the testing laboratory at least 24 hours prior to expected time for operations requiring testing services. Longer length of notice to testing laboratory shall be provided by Contractor when required by the testing laboratory to ensure the timely scheduling and performance of all tests required.
 - 2. The Contractor is responsible for obtaining and paying tests including but not limited to test and balance, portable water bacteriological tests and test required in Divisions 7 through 16.

- E. The costs of any tests which fail will be paid for by the Contractor. The amount to be reimbursed to the County by the Contractor, will be the amount invoiced to the County by the testing laboratory in accordance with the testing services fees set forth in its contract with the County.

1.10 TEMPERATURE/HUMIDITY LOG

- A. The Contractor shall be responsible for preparing rain, temperature and humidity measuring devices at the project site and maintaining a log of temperature and humidity measurements.
- B. Said log shall contain a daily record of exterior temperature, rainfall amount and humidity conditions and where environmental conditions are specified in individual sections, a daily record of the temperature and humidity conditions where the work of those sections is stored and installed.
- C. The Temperature/Humidity Log shall be available to the Project Manager as part of the Contract Documents.

1.11 RESPONSIBILITIES

- A. The Owner shall provide inspections, tests and similar quality control services, specified in individual Specification Sections and these services include those specified to be performed by an independent agency and not by the Contractor.
- B. The Contractor shall cover all costs of tests or inspections to evaluate means and methods of installation performed as a substitution and not as originally specified.
 - 1. Re-testing: The Contractor is responsible for re-testing where results of required inspections, test or similar services prove unsatisfactory and do not indicate compliance with Contract Documents requirements, regardless of whether the original test was the Contractor's responsibility.
 - a. Cost of re-testing construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

2. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to:
 - a. Providing access to the work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
 - b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
 - c. Providing facilities for storage and curing the test samples.
 - d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 - e. Security and protection of samples and test equipment at the Project site.
- C. Duties of the Testing Agency: The independent testing agency engages to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
1. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
 3. The agency shall not perform any duties of the Contractor.
- D. Coordination: The Contractor and each agency engaged to perform inspection, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition, the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.12 SUBMITTALS

- A. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are pre-qualified as complying with Recommended Requirements for Independent Laboratory qualification by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
 - 1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for Cutting and Patching.
- B. Protect construction exposed by or for quality control service activities, and protects and repaired construction.
- C. Repair and protection in the Contractor's responsibility regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 01400

SECTION 01410
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selection and payment
- B. Contractor Submittals
- C. Laboratory responsibilities
- D. Laboratory reports
- E. Limits on testing laboratory authority
- F. Contractor responsibilities
- G. Schedule of inspections and tests

1.02 RELATED SECTIONS

- A. Information Available to bidders: Soil Investigation Data.
- B. General Conditions: Inspections, testing, and approvals required by public authorities.
- C. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.03 REFERENCES

- A. ANSI/ASTM D3740 or as required in Specifications Divisions 2-16 - Practice for Evaluation of Agencies Engages in testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ANSI/ASTM E329 or as required in Specifications Divisions 2-16 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.04 SELECTION AND PAYMENT

- A. Owner will employ and pay for services of an independent testing laboratory to perform specified inspection and testing.
- B. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of ANSI/ASTM E329 and ANSI/ASTM D3740
- B. Laboratory: Authorized to operate in state in which Project is located.
- C. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
- D. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards (NBS) Standards or accepted values of natural physical constants.

1.06 CONTRACTOR SUBMITTALS

NOT USED

1.07 LABORATORY RESPONSIBILITIES

- A. Test samples of mixes
- B. Provide qualified personnel at site when required. Cooperate with Orange County and Contractor in performance of services.
- C. Perform specified inspection, sampling, and testing of Products in accordance with specified standards.
- D. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- E. Promptly notify Orange County and Contractor of observed irregularities or non-conformance of Work or Products.

- F. Perform additional inspections and test required by Orange County.
- G. Attend preconstruction conferences and progress meetings.

1.08 LABORATORY REPORTS

- A. After each inspection and test, promptly submit four copies of laboratory report to Orange County, and to Contractor.
- B. Include:
 - 1. Date issued
 - 2. Project title and number
 - 3. Name of inspector
 - 4. Data and time of sampling or inspection
 - 5. Identification of product and Specifications Section
 - 6. Location in the Project
 - 7. Type of inspection or test
 - 8. Date of test
 - 9. Results of tests
 - 10. Conformance with Contract Documents
- C. When requested by Orange County, provide interpretation of test results.

1.09 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the work.
- C. Laboratory may not assume any duties of Contractor
- D. Laboratory has no authority to stop the work.

1.10 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel, and provide access to the work.
- B. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.

- C. Notify Orange County and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.
- D. Arrange with laboratory and pay for additional samples and tests required by Contractor beyond specified requirements.

1.11 SCHEDULE OF INSPECTIONS AND TESTS

- A. Section 02223 - Backfilling: Requirements for sampling and testing backfilled materials.
- B. Testing required:
 - 1. Modified proctor maximum density determination tests for each soil type.
 - 2. Field in-place density tests at intervals not to exceed 300 ft. on sub-base and base material.
 - 3. Thickness test for asphaltic concrete surfacing and concrete parking. Cores shall be taken at a maximum of 250 ft. The minimum thickness allowed shall be 1/4" less than the required average thickness.
 - 4. Extraction stability and gradation of combine aggregate - one test per 500 tons or part with minimum of one per day. Bitumen content, stability and gradation of aggregate to conform to intent of job mix formula.
 - 5. Provide concrete mix designs as required under Specifications Sections 02520 and 03000.
 - 6. Strength test for each 50 cubic yard of concrete placed.

END OF SECTION 01410

**SECTION 01500
TEMPORARY FACILITIES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.
- B. Temporary utilities required include but are not limited to:
 - 1. Water service and distribution
 - 2. Temporary electric power and light
 - 3. Telephone service
 - 4. Sanitary facilities
- C. Temporary construction and support facilities required include but are not limited to:
 - 1. Temporary heat and ventilation as required to facilitate construction process and personnel.
 - 2. Field office and storage sheds.
 - 3. Sanitary facilities, including drinking water.
 - 4. Temporary enclosures.
 - 5. Hoists and temporary elevator use.
 - 6. Temporary project identification signs and bulletin boards
 - 7. Waste disposal services.
 - 8. Rodent and pest control
 - 9. Construction aids and miscellaneous services and facilities.
- D. Security and protection facilities required include but are not limited to:
 - 1. Temporary fire protections
 - 2. Barricades, warning signs, lights
 - 3. Sidewalk bridge or enclosure fence for the site.
 - 4. Environmental protection
 - 5. Fencing

6. Barriers
 - a. Contractor shall be responsible for providing a temporary 6' high chain link construction fence around the front perimeter of the construction site and tie into existing Fence shall be removed upon completion of the job. Limits of construction fence indicate on the site plan drawings.
 - b. Contractor shall be responsible for providing security measures as required to prevent public entry to construction areas and adjacent properties from damage from construction operations.
 - c. Contractor shall be responsible for providing a protective barrier around trees and plants designated to remain as indicated in plans. Project against vehicular traffic, stored materials, dumping, chemically injurious materials and puddling or continuous running water.
7. Enclosures
 - a. Provide temporary weather-tight closures of openings in exterior surfaces to provide acceptable working conditions and protection for materials, in allow for temporary heating, and to prevent entry of unauthorized persons. Provide temporary doors with self-closing hardware and locks.
8. Protection of Installed Work
 - a. Provide temporary protection for installed products. Control work and traffic in immediate area to avoid damage.
 - b. Provide protective coverings at walls, projections, jambs, sills and soffits of openings. Provide barriers or coverings to protect roof and finished floors and stairs from work and traffic, movement of heavy objects and storage.
 - c. Prohibit work, traffic and storage on waterproofed and roofed surfaces, and on lawn and landscaped areas that is not a part of the work for those surfaces and areas.
9. Security and Maintenance
 - a. Vehicular and pedestrian gates, when indicated or required, shall be securely locked at all times when no work is in progress and when not required for construction activities. During all work hours, gates which must be open shall be continuously monitored by the contractor to prevent unauthorized personnel or vehicles from entering the construction site.
 - b. Fencing shall be as specified in 1.02 D above and shall prevent pedestrian travel through the site for any reason.

- c. Temporary fencing shall be removed only for construction reasons. If temporary fencing removal is required for non-construction reasons, fencing shall be immediately replaced and secured as soon as the activity for which its removal was required is completed, or if the activity cannot be completely by the end of the work day, temporary security measures shall be taken by the Contractor to ensure that there is no breach of security even during off-work periods.
- d. No Trespassing and similar signs shall be posted at gates and along fencing adjacent to public areas to inform non-construction personnel of the reason for the fence and potential hazards of entering the construction site. Said signs shall be of a size and spacing to be legible from any point along the entire perimeter of the construction site.

1.03 SUBMITTALS

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

1.04 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:
 - 1. Building Code requirements
 - 2. Health and safety regulations
 - 3. Utility company regulations
 - 4. Police, Fire Department and Rescue Squad rules
 - 5. Environmental Protection regulations
- B. Standards: Comply with NFPA Code 241, Building Construction and Demolition Operations, ANSI-A10 Series standards for Safety Requirements for Construction and Demolition, and NECA Electrical Design Library Temporary Electrical Facilities.
 - 1. Refer to Guidelines for Bid Conditions for Temporary Job Utilities and Services, prepared jointly by AGC and ASC, for industry recommendations.
 - 2. Electrical Services: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NEC 70).
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test

each temporary utility before use. Obtain required certifications and permits.

1.05 PROJECT CONDITIONS

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use for the permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, nor permit them to interfere with progress. Do not allow hazardous dangerous, unsanitary conditions, nor public nuisances to develop or persist on the site.
- C. Water Control: Grade site to drain. Maintain excavations free of water. Provide and operate pumping equipment if necessary. Provide silt barriers required by the Florida Department of Transportation St. Johns and any other authority having jurisdiction over the Project.
- D. Cleaning During Construction: Control accumulation of waste materials and rubbish so as to maintain a neat, clean and orderly and safe project; periodically dispose of off-site as needed.

Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

- E. Project Identification: Provide a sign if outlined in SECTION 01580 PROJECT SIGN. Locate to provide an unobstructed view from adjoining roadway. Remove project sign upon final completion acceptance.
- F. Field Office and Sheds: Office: Weather-tight with lighting, electrical outlets, heating, cooling, and ventilating equipment, and equipped with furniture.

Storage Sheds for Tools, Materials, and Equipment: Weather-tight with adequate space for organized storage and access, and lighting for inspection of stored materials.

Contractor provide 10 x 8 minimum size office with plan table, telephone, heat, a/c for projects exceeding 10,000 sq. ft. building area.

- G. Protection of Adjacent Properties: Locate on site construction operations that will generate noise and/or dust as far as practical from occupied structures on adjacent properties so as to minimize disturbances to the occupants of these structures or properties.

Prevent dust or other contaminants caused by construction operations for this Project from being carried to adjacent properties by installation of protective barriers and/or suspension of construction operations during high winds.

Dispose of all construction debris which may be carried to adjacent properties by winds. Remove debris daily and/or more often as required to prevent contamination of adjacent properties.

- H. Removal: Remove temporary materials, equipment and construction facilities prior to Substantial Completion inspection.

Remove temporary utility services prior to Final Completion Inspection.

Clean and repair damage caused by installation or use of temporary facilities. Remove underground installations; grade and complete all work on site as indicated.

- I. Conversion to Public Utilities: General Contractor is to coordinate and arrange with the appropriate utility service providing agencies and make arrangements for the installation and connection to final utilities prior to Final Completion inspection.

General Contractor shall provide any and all coordination, scheduling and layouts as may be required by the service utilities.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General: Provide new materials; of acceptable to the Project Manager, undamaged previously used materials in serviceable condition maybe used. Provide materials suitable for the use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section Rough Carpentry .

1. For job-built temporary offices, shops and sheds within the construction area, provide UL labeled, fire treated lumber and plywood for framing, sheathing and siding.
 2. For signs and directory boards, provide exterior type, Grade B-B High Density Concrete Form Overlay Plywood conforming to PS-1 of sizes and thickness indicated.
 3. For fences and vision barriers, provide exterior type, minimum 3/8" thick plywood.
 4. For safety barriers, sidewalk bridges and similar uses, provide minimum 5/8" thick exterior plywood.
- C. Paint: Comply with requirements of Division 9 Section Finish Painting .
1. For job-built temporary offices, shops, sheds, fences and other exposed lumber and plywood, provide exterior grade acrylic-latex emulsion over exterior primer.
 2. For sign panels and applying graphics, provide exterior grade alkyd gloss enamel over exterior primer.
 3. For interior walls of temporary offices, provide two coats interior latex flat wall paint.
- D. Tarpaulins: Provide waterproof, fire-resistant, UL labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosure provide translucent nylon reinforced laminated polyethylene or polyvinyl chloride fire retardant tarpaulins.
- E. Water: Provide portable water approved by local health authorities.
- F. Open-Mesh Fencing: Provide 11-gage, galvanized 2-inch, chain link fabric fencing 6-feet high with galvanized barbed wire top strand and galvanized steel pipe post, 1 " I.D. for line posts and 2 " I.D. for corner posts.

2.02 EQUIPMENT

- A. General: Provide new equipment: if acceptable to the Project Manager, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

- B. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. Long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shut-off nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset bottom and pilot light, for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords; use hard-service cords where exposed to abrasion and traffic. Provide water proof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.
- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
- G. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockage entrances, operable windows and serviceable finished. Provide heated and air-conditioned units on foundations adequate for normal loading.
- H. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.
- I. First Aid Supplies: Comply with governing OSHA and any other regulations.
- J. Fire Extinguishers: Provide hand-carried, portable UL-rated, class A fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable UL-rated, class ABC dry chemical extinguishers, or a combination of extinguishers of NEPA recommended classes for the exposures.

1. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the project adequately and result in minimum interference with performance of the work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

3.02 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
 1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.
 4. Use Charges: Cost of use charges for temporary facilities are not chargeable to the Owner or Architect, and will not be acceptable as a basis of claims for a Change Order.
- B. Water Service: Install water service and distribution piping of sized and pressures adequate for construction until permanent water service is in use.

- C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switch gear.
- D. Temporary Lighting: Whenever overhead floor or roof deck has been installed, provide temporary lighting with local switching.
 - 1. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.
- E. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period. Install telephone on a separate line for each temporary office and first aid station. Where an office has more than two occupants, install a telephone for each additional occupant or pair of occupants.
 - 1. At each telephone, post a list of important telephone numbers.
- F. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge or effluent, provide containers to remove and dispose of effluent off the site in a lawful manner.
 - 1. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.
- G. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by run-off of storm water from heavy rains.

3.03 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

- A. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access.
 - 1. Maintain temporary construction and support facilities until Substantial Completion. Personnel remaining after Substantial

Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

- B. Provide incombustible construction for offices, shops and sheds located within the construction area or within 30 feet of building lines. Comply with requirements of NFPA 241.
- C. Temporary Heat: Provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
- D. Heating Facilities: Except where use of the permanent system is authorized, provide electric vented self-contained LP gas or fuel oil heaters with individual thermostatic control.
 - 1. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.
- E. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds maybe open shelters or fully enclosed spaces with the building or elsewhere on the site.
- F. Temporary Paving: Construct and maintain temporary roads and paving to support the indicated loading and to withstand exposure to traffic during the construction period. Locate temporary paving the roads, storage areas and parking where the same permanent facilities will be located. Review proposed modifications to permanent paving with the Architect.
 - 1. Paving: Comply with Division 2 Section Asphalt Concrete Paving for construction and maintenance of temporary paving.
 - 2. Coordinate temporary paving development with subgrade grading, compaction, installation and stabilization of sub-base, and installation of base and finish courses of permanent pavings.
 - 3. Install temporary paving to minimize the need to rework the installations and to result in permanent reads and paved areas that are without damage or deterioration when occupied by the Owner.
 - 4. Delay installation of the final course of permanent asphalt concrete

paving until immediately before Substantial Completion.
Coordinate with either conditions to avoid unsatisfactory results.

5. Extend temporary paving in and around the construction area as necessary to accommodate delivery and storage of materials, equipment usage, administration and supervision.
- G. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.
- H. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted. Provide one toilet for each 15 workers on site and have serviced weekly as a minimum.
- I. Wash Facilities: Install wash facilities supplied with portable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition.
1. Provide safety showers, eye-wash fountains and similar facilities for convenience, safety and sanitation of personnel.
- J. Drinking Water Fixtures: Provide drinking water fountains including paper supply.
1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 degree F (7 to 13 degree C).
- K. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations and construction free of water.
- L. Temporary Enclosures: Provide temporary enclosure for protection of

construction in progress and completed, from exposure, foul weather, other construction operations and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.
 3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood-framed construction.
 4. Where temporary wood or plywood enclosure exceeds 100 square feet in area, use UL-labeled fire-retardant treated material for framing and main sheathing.
- M. Temporary Lifts and Hoist: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting material are considered tools and equipment and not temporary facilities.
- N. Temporary Elevator Use: Refer to Division 14 Elevator Sections.
- O. Project Identification and Temporary Signs: Prepare project identification and other signs of the size indicated install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood or steel. Do not permit installation of unauthorized signs.
1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.
 2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.
- P. Temporary Exterior Lighting: Maintain exterior yard and sign lights so that signs are visible when work is being performed.
- Q. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days

when the temperature is expected to raise above 80 degree F (27 degree). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of materials in a lawful manner.

- R. Rodent and Pest Control: Before foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches and other pests. Employ this service to perform extermination and control procedures at regular intervals so the project will be relatively free of pests and their residues at Substantial Completion. Perform control operations in a lawful manner using environmentally safe materials.

3.04 SECURITY AND PROTECTIONS FACILITIES INSTALLATION

- A. Except for use of permanent fire protection as soon as available do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer as requested by the Project Manager.
- B. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 Standard for Portable Fire Extinguishers, and NFPA 141 Standard for Safeguarding Construction, Alternations and Demolition Operations.
 - 1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
 - 2. Store combustible materials in containers in fire-safe locations.
 - 3. Maintain unobstructed access in fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
 - 4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
- C. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

- D. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting including flashing red or amber lights.
- E. Enclosure Fence: When excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs and other animals from easily entering the site, except by the entrance gates.
 - 1. Provide open-mesh, chain-link fencing with posts set in a compacted mixture of gravel and earth.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.
 - 1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of materials to minimize the opportunity for theft and vandalism.
- G. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possible that air, waterways and sub-soil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which product harmful poise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.05 OPERATION, TERMINATION AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24 hour day

basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Prevent water filled piping from freezing. Maintain makers for underground lines. Protect from damage during excavation operations.
- C. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than substantial completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.
 2. Remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances which might impair growth of plant materials or lawns. Repair or replace street pavings, curbs and sidewalks at the temporary entrances, as required by the governing authority.
 3. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
 - a. Replace air filters and clean inside of ductwork and housings.
 - b. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
 - c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use as noted by the Owner's representative.

END OF SECTION 01500

SECTION 01600 MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's selection of products for use in the Project.
- B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section 01300 -Submittals.
- C. Standards: Refer to Section Definitions and Standards for applicability of industry standards to products specified.
- D. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Section 01300 Product Substitution .

1.03 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents such as specialties , systems , structure , finishes , accessories , and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.
 - 1. Products are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term product includes the term material , equipment , system and terms of similar intent.
 - a. Named Products are items identified by manufacturer s product name, including make or model designation, indicated in the manufacturer s published product literature, that is current as of the date of the Contract Documents.

- b. Foreign Products , as distinguished from domestic products , are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens nor living within the United States and its possessions.
2. Materials are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the work.
3. Equipment is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.04 SUBMITTALS

- A. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Project Manager. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.
 1. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.
 - a. Related Specification Section Number
 - b. Generic name used in Contract Documents
 - c. Proprietary name, model number and similar designations.
 - d. Manufacturer's name and address
 - e. Supplier's name and address
 - f. Installer's name and address
 - g. Projected delivery date, or time span of delivery period.
 2. Initial Submittal: Within 30 days after date of commencement of the work, submit 3 copies of an initial product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.
 - a. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.

3. Complete Scheduled: Within 45 days after date of commencement of the Work, submit 3 copies of the completed product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.
4. Architect's Action: The Architect will respond in writing to the Contractor within 2 weeks of receipt of the completed product list schedule. No response within this time period constitutes no objection to listed manufacturers on products, but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include the following:
 - a. A list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.05 QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
- B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
- C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.
 1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on accessible surface that is not conspicuous.
 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data.

- a. Name of product and manufacturer
- b. Model and serial number
- c. Capacity
- d. Speed
- e. Ratings
- f. Additional pertinent information

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deteriorating and loss, including theft.
 - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
 - 3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
 - 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 - 6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
 - 7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 PRODUCTS

2.01 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.
1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situation on other projects.
- B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous project experience. Procedures governing product selection include the following:
1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
 - a. Where products or manufacturers are specified by name, accompanied by the term or equal or or approved equal comply with the Contractor Document provisions concerning substitutions to obtain approval for use of an unnamed product.
 2. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of those products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning substitutions to obtain approval for use of an unnamed product.
 3. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

4. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated.
 - a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
5. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
6. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
 - a. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning substitutions for selection of a matching product in another product category, or for noncompliance with specified requirements.
7. Visual Selection: Where specified product requirements include the phrase "... as selected from manufacturer's standard colors, pattern, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.
8. Asbestos free materials: No products containing asbestos shall be used for any part of the work for this product. Provide verification.

PART 3 EXECUTION

3.01 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for

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installation of products in the applications indicated. Anchor each project securely in place, accurately located and aligned with other work.

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01600

SECTION 01631 PRODUCTS SUBSTITUTIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling request for substitutions made during bidding and after award of the Contract.
- B. The Contractor's Installation Schedule and the Schedule of Submittals are included under Section Submittals .
- C. Standards: Refer to Section Definitions and Standards for applicability of industry standards to products specified.
- D. Procedural requirements governing the Contractor's selection of products and product options are included under Section Materials and Equipment.

1.03 DEFINITIONS

- A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Requests for changes in products, materials, equipment, and methods of installation required by Contract Documents proposed by the Contractor during and bidding after award of the Contract are considered requests for substitutions . The following are not considered substitutions:
 - 1. Only substitutions requested by Bidders during the bidding period, and accepted prior to bid opening and award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in Section for substitutions.

2. Revisions to Contract Documents requested by the Owner or Architect.
3. Specified options of products and installation methods included in Contract Documents.
4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.04 SUBMITTALS

- A. Substitution Request Submittal: Request for substitution will be considered if received within thirty five (30) days after commencement of the Work. As long as this time allowance will not impact the construction schedule.
1. Submit three (3) copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals.
 2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitution, and the following information, as appropriate:
 - a. Product Data, including Drawings, and descriptions of products, fabrication and installation procedures.
 - b. Samples, where applicable or requested.
 - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
 - d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.
 - e. A statement indicating the substitution's effect on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including a proposal of the net change, if any in the Contract Sum.

- g. Certification by the Contractor that the Substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.
3. Architect's Action: Within two weeks of receipt of the request for substitution, the Architect will request additional information or documentation necessary for evaluation of the request if needed. Within two (2) weeks of receipt of the request, or one week of receipt of the additional information or documentation, whichever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the project specified by name. Decision on the use of a product substitution or its rejection by the Architect is considered final. Acceptance will be in the form of a Change Order.

2.01 SUBSTITUTIONS

- A. Conditions: The Contractor's substitution request will be received and considered by the Architect when one or more of the following conditions are satisfied; otherwise request will be returned without action except to record noncompliance with these requirements.
 1. Extensive revisions to Contract Documents are not required.
 2. Proposed changes are in keeping with the general intent of Contract Documents.
 3. The request is timely, fully documented and properly submitted.
 4. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the work promptly or coordinate activities properly.
 5. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

6. A substantial advantage is offered to the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar consideration.
 7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 8. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
 9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.
- B. The Contractor's submittal and Project Manager's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.
- C. Substitution request constitutes a representation that the Contractor:
1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.
 2. Will provide the same warranty for substitution as for specified product.
 3. Will coordinate installation and make other changes which may be required for work to be complete in all respects.
 4. Waives claims for additional costs which may subsequently become apparent. All costs associated with the substitution will be paid by the Contractor regardless of approvals given, and regardless of subsequent difficulties experienced as a result of substitutions.

END OF SECTION 01631

**SECTION 01700
PROJECT CLOSE-OUT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements for project close-out, including but not limited to:
 - 1. Inspection procedures
 - 2. Project record document submittal. (substantial completion requirements)
 - 3. Operating and Maintenance Manual Submittal (substantial completion requirements).
 - 4. Submittal of warranties (substantial completion requirement).
 - 5. Final cleaning
- B. Close-out requirements for specific construction activities are included in the appropriate Sections in Divisions 2 through 16.
- C. Final Payment to be made when the County has received all required close-out documents.

1.03 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for Certification of Substantial Completion, complete the following: List exceptions in the request.
 - 1. In the Application for Payment that coincided with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

- a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the work is not complete.
 2. Advise Owner of pending insurance change-over requirements.
 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
 4. Obtain and submit releases enabling the Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
 5. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
- B. Inspection Procedures: On receipt of a request for inspection, the Project Manager will either proceed with inspection or advise the Contractor of unfilled requirements. The Project Manager will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
1. Results of the completed inspection will form the basis of requirements for final acceptance.
 2. Should the project fail to meet the standards required for Substantial Completion as defined in the documents, the Contractor will pay the expense of a second inspection by the Architect/Consultants and the Owner. Cost will be deducted from the Contractor's retainage.

1.04 FINAL ACCEPTANCE

- A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following list exceptions in the request:
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and complete operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
 3. Submit a certified copy of the Architect or Owner's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Project Manager.
 4. Submit final meter readings for utilities, a measured record of stored fuel and similar data as of the date of Substantial Completion, or when the Owner took possession of the responsibility for corresponding elements of the Work.
 5. Submit consent of surety to final payment.
 6. Submit a final liquidated damages settlement statement
 7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Reinspection Procedure: The Architect will reinspect the work upon receipt of notice that the work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.
1. Upon completion of reinspection, the Architect will prepare a certification of final acceptance, or advise the contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

1.05 RECORD DOCUMENT SUBMITTALS

- A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Architect's reference during normal working hours.
- B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation; where the installation varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the

Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Provide for project photographs if deemed necessary by Owner's representative.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.
 2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
 3. Note related Change Order numbers where applicable.
 4. Organize record drawing sheets, and print suitable titles, dates and other identification on the cover of each set.
 5. Provide three (3) additional sets of black line drawing sets of As-Built Drawings.
- C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual work performed in comparison with the text of the specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Project Data.
1. Upon completion of the Work, submit record Specifications to the Architect for the Owner's records.
- D. Record Project Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variation in actual work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned later by direct observation. Note related Change Orders and mark-up of record drawings and Specifications.
1. Upon completion of mark-up, submit complete set of record Product Data in the three ring binder (indexed) to the Architect for the Owner's records.

- E. Record Sample Submitted: Immediately prior to the date or dates of substantial completion, the Contractor will meet at the site with the Architect and the Owner's personnel to determine which of the submitted Samples that have been maintained during progress of the work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area.
- F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the work. Immediately prior to the date or dates of substantial completion, complete miscellaneous record and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Project Manager for the Owner's records.
- G. Maintenance Manuals: Organize operating and maintenance data into five (5) suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:
1. Emergency instructions
 2. Spare parts list
 3. Copies of warranties
 4. Wiring diagrams
 5. Recommended turn-around cycles
 6. Inspection procedures
 7. Shop Drawings and Product Data
 8. Fixture lamping schedule

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 CLOSE-OUT PROCEDURES

- A. Operating and Maintenance Instructions: Arrange for each installer of equipment that required regular maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. All items to be provided or completed prior to Certificate of Substantial Completion being issued by the Owner. Include a detailed review of the following items:
1. Maintenance manuals
 2. Record documents
 3. Spare parts and materials

4. Tools
5. Lubricants
6. Fuels
7. Identification systems
8. Control sequences
9. Hazards
10. Cleaning
11. Warranties and bonds
12. Maintenance agreements and similar continuing commitments
13. On site instructions to County maintenance personnel on major systems operations such as HVAC as per technical specifications.

B. As part of instruction for operating equipment, demonstrate the following procedures, prior to the Owner issuing Certificate of Substantial Completion:

1. Start-up
2. Shutdown
3. Emergency operations
4. Noise and vibration adjustments
5. Safety procedures
6. Economy and efficiency adjustments

3.02 PROJECT CLOSE-OUT MANUALS AT SUBSTANTIAL COMPLETION

A. Submit Project Close-out Manuals prior to issuance of final application for payment. Provide three (3) copies.

B. Bind in commercial quality 8 x 11" three ring binder, indexed with hardback, cleanable, plastic covers.

C. Label cover of each binder with typed title PROJECT CLOSE-OUT MANUAL, with title of project; name, address, and telephone number of Contractor and name of responsible Principal.

D. Provide table of contents: Neatly typed, in the following sequence:

1. Final Certificate of Occupancy
2. Warranty Service Subcontractors Identification List
3. Final Lien Waivers and Releases
4. Warranties and Guarantees
5. Systems Operations and Maintenance Instruction
6. Manufacturer's Certificates and Certifications
7. Maintenance Service Contracts
8. Spare Parts Inventory List

9. Special Systems Operating Permits or Approvals
 10. Asbestos free materials notarized statement
- E. Provide all documents for each section listed. List individual documents in each section in the Table of Contents, in the sequence of the Table of Contents of the Project Manual.
 - F. Identify each document listed in the Table of Contents with the number and title of the specification section in which specified, and the name of the product or work item.
 - G. Separate each section with index to sheets that are keyed to the Table of Contents listing.
 - H. Warranty Service Subcontractors List shall identify subcontractor supplier, and manufacturer for each warranty with name, address and emergency telephone number.

3.03 FINAL CLEANING

- A. General: General cleaning during construction is required by the General Conditions and included in Section - Temporary Facilities.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
 1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
 - a. Remove labels that are not permanent labels.
 - b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 - c. Clean exposed exterior and interior hard-surfaced finished to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.

- d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
 - e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface. Remove waste and surplus materials from the site in an appropriate manner.
- C. Pest Control: Engage an experienced exterminator to make a final inspection, and rid the Project of rodents, insects and other pests.
- D. Removal of Protection: Remove temporary protection and facilities installed for protection of the work during construction.
- E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.
- 1. Where extra materials of value remaining after completion of associated work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 01700

SECTION 01740 WARRANTIES AND BONDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contractor Documents, including manufacturers standard warranties on products and special warranties.
 - 1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
 - 2. General close-out requirements are included in Section Project Close-Out .
 - 3. Specific requirements for warranties for the work and products and installations that are specified to be warranted, are included in the individual Sections of Division 2 through 16.
 - 4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties to not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.03 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- B. Reinstatement of Warranty. When work covered by a warranty has failed

and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

- C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligation, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligation, rights, or remedies.
 - 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- E. The Owner reserves the right to refuse to accept work for the Project where a special warranty, certification, or similar commitment is required on such work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.04 WARRANTY PERIOD

- A. The Contractor shall participate with the County and the Architect's representative, at the beginning of the tenth month of the warranty period, in conducting an on site review and evaluation of all items of equipment, materials and workmanship covered by the warranties and guarantees. Contractor shall act promptly and without cost to the County to correct all defects, problems, or deficiencies determined as such by the Architect/Owner during on the site review.
- B. All warranties and guarantees shall commence on the date of Substantial Completion except for items which are determined by the County to be incomplete or a non-comply status at the time of Substantial Completion. The coverage commencement date for warranties and guarantees of such work shall be the date of the County's acceptance of that work.
- C. Warranty period shall be manufacturer's standard for product specified except where specific warranty periods are specified in individual sections. But in no case less than one year.

1.05 SUBMITTALS

- A. Submit written warranties to the Owner prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the work, submit written warranties upon request of the Project Manager.
 - 1. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Project Manager within fifteen days of completion of that designated portion of the work.
- B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepared a written document that contains appropriate terms and identification, ready for executing by the required parties. Submit a draft to the Architect for approval prior to final execution.
 - 1. Refer to individual Sections of Division 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.
- C. Form of Submittal: At Final Completion compile two (2) copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- D. Bind (3) three sets of warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8 by 11" paper.
 - 1. Provide heavy paper dividers with Celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.

2. Identify each binder on the front and the spine with the typed or printed title WARRANTIES AND BONDS , the Project title or name, and the name of the Contractor.
3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01740

Project Close-out DVD - Additions

SECTION 01300-SUBMITTALS

1.03-

- F. Once submittals are approved or approved as noted, they will be scanned and converted to PDF documents with OCR (optical character recognition) and given to the owner.

SECTION 01700-PROJECT CLOSE-OUT

3.02-

- I. Electronic Close-out DVD: At the completion of the project, submit one copy of a DVD with entire project close out information below in PDF format. All letter, legal and brochure size sheets shall be portrait and the As-build drawings will be landscape. All fonts will be Arial. All items will be in PDF with OCR (Optical Character Recognition). This will enable a search engine to identify words on the scanned documents.
 - 1. Contacts: Set up a separate PDF for the contacts. No bookmarks are needed for this section.
 - 2. As-Built: All as-built drawings will be landscape.
 - 3. Submittals: All technical submittal items (approved and approved as noted) will be provided and sorted by the 16 standard divisions. Bookmarks will be needed for the appropriate divisions.
 - 4. Operations and Maintenance Manual: Specify the division name only in the bookmarks (1-16). Please note that all items will be in PDF with OCR (Optical Character Recognition). This will enable a search engine to identify works on the scanned documents.
 - 5. Permitting: This should include the Certificate of Occupancy and any other document that the Project Manager may include pertaining to the permitting for the project.

01740-5

**Information Available to
Bidders**

Geotechnical Report and Threshold Inspection Plan bound herein.

Threshold Inspection Plan for Holden Heights Community Center

PART 1 – Administration

1.1 Explanation of the Structural Inspection Plan

- A. This is a Threshold Building as defined by chapter 553 of the Florida Statutes and requires the Owner to retain a Special Inspector.
- B. The Special Inspector shall inspect the framing shown on the Structural Drawings in accordance with this plan to verify that the work is constructed in substantial accordance with the Contract Documents, except for accepted variations
 - 1. The Contract Documents are defined as the Permitted Drawings, Project Specifications and Recorded Addenda and Amendments.
 - 2. Except as noted, work of this Plan excludes the inspection of elements that are not Structural. This includes, but is not limited to: fire protection, roofing, glazed window systems, mechanical/electrical systems, architectural components, site work, and OSHA safety provisions or other safety standards that apply during the construction period.
- C. Proposals for Special Inspection services shall be separate and independent from proposals for all other Materials Testing and Quality Assurance services.
- D. The Owner or Building Code Compliance Office may supplement this plan with additional inspection requirements as deemed necessary during the course at the work.

1.2 Qualifications of the Special Inspector

- A. The Special Inspector may send an authorized representative under his responsible charge to undertake inspections and site visits. As used in this plan, the term Special Inspector includes his representative, UON.
- B. Both the Special Inspector and the representative shall meet the qualifications and standards set forth by Rule Chapter 61g15-35 and Chapter 471 of the Florida Statutes. Resumes of both the Special Inspector and the representative(s) shall be submitted to the Architect and Structural Engineer for review.
- C. The Special Inspector shall provide to the Owner Insurance Certificate for all applicable coverages, including General Liability, Automobile, Workmen's Compensation, and Professional Liability specifically covering the inspections described in this Plan.

1.3 Responsibilities and Limitations of the Special Inspector

- A. The Special Inspector is responsible to the Owner and the Building Code Compliance Office. The Special Inspector and the authorized representative shall:
 - 1. Become familiar with the specific structural components and systems they will be inspecting.
 - 2. Develop a thorough knowledge of the applicable Contract Documents, accepted submittals, and governing codes.
 - 3. Exercise good judgment.

- B. Prior to starting work, the Special Inspector shall provide to the Owner and Structural Engineer a certified affidavit attesting that:
 - 1. He is competent to provide the engineering services for the specific type of structure.
 - 2. He has reviewed the Contract Documents and understands their content and the support conveyed therein.
 - 3. He has the Structural Inspection Plan, understands the intent and intends to comply with its requirements.
- C. The Special Inspector is responsible for inspecting the structure as previously described. Reports shall identify work performed in general conformance with the Contract Documents, as well as the location and description of any deviations.
- D. The Special Inspector is responsible for verifying that the work of the Testing Agency complies with the requirements of the Contract Documents.
- E. The Special Inspector shall visit the site at frequency to satisfy himself that his representative's inspections comply with this Plan.
- F. The Special Inspector shall dedicate his entire time on-site to the requirements of this plan and shall not perform other work, such as material testing.
- G. The Special Inspector shall call the Structural Engineer at least once each week to discuss details of the project and to confirm that he has up-to-date sketches and RFI responses.
- H. The presence of the Special Inspector does not relieve the Building Code Compliance Office, the Architect or the Structural Engineer of their responsibilities. The Special Inspector shall not make design decisions or interpretations of the Contract Documents.

1.4 Reporting

- A. The Special Inspector shall record progress, working conditions, observations, testing, deviations from the Contract Documents, and any required corrective action. He shall retain the records for a minimum of 7 years after completion of the project.
- B. The Special Inspector shall immediately notify the Contractor in person, and the Architect and Structural Engineer by email, of materials tests, equipment, workmanship or construction that:
 - 1. Does not conform to the Contract Documents, or
 - 2. Is not inspected or tested and cannot be inspected or tested in place.
- C. The Special Inspector shall keep an exceptions file and review it on a daily basis, updating as exceptions are rectified. If any exceptions are not resolved in a timely manner, the Special Inspector shall issue a non-compliance notice to the Contractor and shall copy the Building Code Compliance Office, Owner's representative, Architect and Structural Engineer.
- D. After each inspection, the inspector shall write and sign on Inspection Report. The Report shall include the following:

1. The name and location of Project; name of Inspector; Permit Number; date; working conditions; including weather and temperature; and type and location of work being performed.
2. Details of each inspection, including the presence and activities of the Testing Agency.
3. Note deficiencies in the work and any unusual circumstances affecting the performance of work, including changes in materials or work sequence. Place emphasis on recurring deficiencies.
4. Identify corrections to deficiencies listed in previous reports.

Since the Special Inspector does not certify that the Contract Documents are in compliance with the Governing Codes, all statements issued shall refer to whether or not completed work is in substantial accordance with the Contract Documents.

1.5 Contractor Requirements

- A. The Contractor shall provide the Special Contractor with an office at the construction site that includes, as a minimum, a desk, chair, plan table, plan rack, filing cabinet, telephone, utilities, air conditioning, janitorial service, and access to a fax machine.
- B. The Contractor shall furnish to the Special Inspector copies of all reviewed and approved submittals for structural elements, excluding calculations, in a timely manner.
- C. The Contractor shall cooperate with and assist the Special Inspector in performing his inspection duties and shall provide him with free access to the work at all times.
- D. The Inspector shall make spot inspections of work in progress in an effort to detect deviations early. However, this does not relieve the contractor of responsibility for correcting deviations from the Contract Documents discovered at any time.
- E. In order to assure timely and appropriate inspections, the Contractor shall notify the Special Inspector of construction schedules and planned operations a minimum of 24 hours prior to the time of the inspection. Reinforcing steel inspections shall be scheduled for at least 24 hour prior to concrete delivery.
- F. If any of the Contractor's work is not in compliance with the Contract Documents, he may either correct it or submit to the Architect/Engineer a request for acceptance of the deviation.
- G. Construction that is not inspected and that cannot be inspected may require testing or removal as determined by the Structural Engineer.
- H. If work is not substantial in accordance with the Contract Documents, or if any construction is not inspected and cannot be inspected, the Special Inspector will not be able to issue a completion statement and the building will not receive a certificate of occupancy.
- I. Special Inspections do not relieve the Contractor of his responsibility for compliance with the Contract Documents, any statutory or contractual obligations, nor his responsibilities to carry out Quality Control Inspections and Testing. The Contractor has the sole responsibility for any deviations from the Contract Documents and shall bear the cost of any required corrections. While the Special Inspector shall cooperate with the Contractor, he shall neither direct the Contractor's work nor be responsible for his construction means and methods.

1.6 Owner Requirements

- A. The Owner shall arrange for the Special Inspector to receive all appropriate Contract Documents, including two complete sets of all Architectural and Structural Documents, including Drawings and Specifications, and the Geotechnical Report at the start of construction. He shall also ensure that the Special Inspector receives in a timely manner all Material Test Reports and two copies of all structural changes, revisions, addenda, etc.
- B. The owner shall retain a Geotechnical Consultant and Testing Agency as required by the Contract Documents.

PART 2 – Inspections

2.1 General

The following is a general Inspection Plan describing work to be performed by the Special Inspector. The intent is to describe the minimum requirements necessary to confirm that work complies with the Contract Documents. The following are not inspector check lists but point out some critical areas requiring specific attention by the Special Inspector.

2.2 Special Conditions/Critical Components

- A. The existing structure is to be modified to incorporate the additions and modifications shown on the Contract Documents.

2.3 Shallow Foundation Preparation

- A. The Geotechnical Consultant or Testing Agency retained by the Owner shall monitor and test backfill and compaction operations and shall confirm that subgrade preparation of all shallow foundations complies with the Geotechnical Report and the Contract Documents. He shall furnish the Special Inspector with Daily Reports as well as the Completion Report required by the Contract Documents.

2.4 Slab-on-Grade Preparation

- A. The Geotechnical Consultant or Testing Agency retained by the Owner shall monitor and test all slab-on-grade backfill and compaction operations to confirm that subgrade preparation complies with the Geotechnical Report and the Contract Documents. He shall furnish the Special Inspector with Daily Reports.
- B. Verify that subgrade disturbed by other trades is properly recompacted.

2.5 Cast-In-Place Concrete and Concrete Repair

- A. The Contractor shall notify the Special Inspector a minimum of 24 hours prior to the placement of any structural concrete.
- B. Verify that the slab thickness is maintained at slab depressions and steps.
- C. Inspect reinforcing steel per the Structural Drawings, supplemented by the Approved Shop Drawings, to verify the following:
 - 1. Reinforcing steel grade, size, quantity, configuration and spacing.
 - 2. Reinforcing steel is adequately supported and tied to resist displacement during concrete pour and that concrete cover is proper.
 - 3. Hooked bars are placed properly.

4. Embedment lengths splice locations and lap splice lengths are acceptable.
 5. Report all slab openings larger than 12" and not shown on the Contract Documents to the Architect/Engineer. Check placement of additional reinforcement around openings. Openings through beams are prohibited without prior approval of the Architect/Engineer.
 6. Confirm that reinforcing steel surfaces are free of excess rust or other coatings that may adversely affect bonding capacity. Verify that form oil, where used, is applied before reinforcing steel is placed.
 7. Verify that the epoxy type is proper for the application, such as paste for horizontal holes. Verify that epoxy mixing and installation comply with manufacturer's requirements.
- D. Inspect welded wire reinforcement to verify the following:
1. Wire size and spacing in each direction comply with the Structural Drawings.
 2. WWR is adequately supported and tied to resist displacement during concrete pour and that concrete cover is proper.
 3. Splices are adequate length and properly tied.
 4. WWR surfaces are free of excess rust or other coatings that may adversely affect bonding capacity.
- E. Check that anchors, embedded conduits, and load carrying embedded items are properly positioned and secured to resist displacement during concreting. Relocation of or modification to structural items due to conflict with reinforcing is prohibited without the approval of the Structural Engineer.
- F. Verify that sawcut joints are:
1. Provided only where indicated.
 2. The proper depth, spacing and location.
 3. Provided in the time frame indicated in the Contract Documents.
- G. Check that all foreign material is removed from forms or excavations prior to concreting.
- H. Be on site at the start of each concrete pour requiring inspection by this Plan. Remain on site for a sufficient time to confirm that concreting practices are proper and comply with ACI 301, ASTM C94 and other recognized industry standards, including the following:
1. All reinforcing steel corrections are completed prior to casting concrete.
 2. The first concrete truck of each type of concrete pour has the proper concrete mix number and strength and that the batch time leaves sufficient time to pour all concrete from the truck. Spot check future trucks.
 3. The Testing Agency is on site for each type of concrete pour to test concrete as required by the Contract Documents, including mixing time, temperature, slump, and air content, and reports any concrete delivered that is not as specified. Check that addition of water to the concrete mix in the field complies with the guidelines in the Contract Documents.
 4. Concrete is being conveyed from mixer to place of final deposit by recognized industry standards. Concrete is being placed continuously, or in a manner to avoid placing concrete against hardened concrete, resulting in the formation of seams or planes of weakness.

5. Concrete is being consolidated and thoroughly worked around reinforcement, embedded items and into corners of forms, eliminating air or stone packets that may cause honeycombing, pitting or planes of weakness.
 6. Spot check that during procedures comply with the contract documents, ACI 308, "Standard Practice for Curing Concrete" and other recognized industry standards.
- I. Inspect Expansion Anchors and Chemical Adhesive for Anchoring Reinforcing Steel and Threaded Rods used to support work described in this plan as follows:
 1. Verify hole diameter, depth, location spacing and edge distance and confirm that hole has been thoroughly cleaned as required by manufacturer.
 2. Verify that expansion anchors are properly tightened.
 3. Verify that the epoxy type is proper for the application, such as paste for horizontal holes. Verify that epoxy mixing and installation comply with manufacturer's requirements.
 - J. Tilt-up wall panels:
 1. Inspect both bearing and non bearing panels.
 2. Inspection prior to casting panel.
 - a. Check configuration of panels; other incorporated materials, openings, blockouts, embedded plates, etc.
 - b. Check reinforcing steel for proper size, quantity, spacing, location, and clearance from forms. Ensure that reinforcing designated "each face" in the drawings are not simply tied to the center mat. They should be chaired separately. Additional reinforcing for lifting and lifting inserts should be checked for proper size, quantity, spacing, and should be secured in place prior to placement of concrete.
 - c. Verify the approved concrete mix design is provided.
 - d. Inspect conveying, placing, consolidating, finishing and curing of concrete.
 - e. Embeds should be checked for size, spacing, and locations against approved structural steel and joist shop drawings and should be secured in place prior to placement of concrete.
 3. Inspection after casting panels:
 - a. Verify that the panels are erected at the proper place in the structure by confirming the mark number with that shown on the shop drawings. Check that all required bracing, including but not limited to, temporary bracing and supports, is installed properly and in accordance with the submittals. Verify that temporary bracing is not removed prematurely.
 - b. Review and verify all connection details. Check that all connections are completed properly. Verify that all welders are AWS certified. Inspect welded connections for size, configuration, and quality. Verify that all welded connections are properly cleaned and protected after completion. Check that panels are solid grouted to their base. Refer to details on shop drawings and structural drawings.

2.6 Steel framing and members

- A. Inspect all steel members and framing as required by the contract documents. Use both the contract documents and the shop drawings for all inspections. Verify that all field welders are AWS certified for the type of welds being made.
- B. Structural steel shop inspections:
 - 1. The contract documents place responsibility for shop inspection and testing with the fabricator's quality control program. The special inspector shall become familiar with this program.
 - 2. Review the test reports; verify welder's certificates, and spot check specific conditions. Issue a report of all findings.
- C. Field inspection of steel construction: provide all inspection required by the contract documents. Complete all inspections and verify compliance prior to concreting or concealment.
 - 1. Check steel as received for possible damage during shipping.
 - 2. Check structural steel member sizes and grades.
 - 3. Spot check member straightness, finish, and camber. Confirm that paint is only applied on appropriate surface.
 - 4. Inspect setting of anchor bolts, embeds, and other miscellaneous structural items for sizes, quantity and finish. Check the installation of column base plates for proper leveling, grout type and grout application.
 - 5. Inspect all field connections and spot check shop connections. Verify connection material, sizes, configurations, and fit-up.
 - a. Visually examine all field welds and spot check all shop welds for type, size, length, and quality. Verify that specified testing is performed by the testing agency. Verify that welds are clean and free from slag and that rust protection has been applied as per specifications.
 - b. Verify the type, size, and quantity of bolts in all bolted connections. Check that bolts are clean and lubricated, have proper washers, and conform to the specifications. Check that bolt holes are the specified type and size. Spot check the bolt tightened sequence.
 - 6. Check headed stud anchor for size, length, spacing and welding as required by the contract documents. Verify that shear connectors are tested by testing agency.
- D. Check all steel decks per SDI specifications and as follows:
 - 1. Deck type, size, gage, finish, accessories and reinforcement around openings.
 - 2. Spacing and type of all connections.
 - 3. Welding procedures.
 - 4. Weld size, shape, quality, rust protections and weld washers, where applicable.
 - 5. Screws size, type and finish and other connection to support.
- E. Open web steel joists and joist girders:

1. Inspect steel joists to verify type, size, spacing, connections, straightness and finish. Inspect from construction documents and shop drawings.
2. Check that bearing conditions conform to requirements of S.J.I. and contract documents.
3. Verify that the temporary bracing and permanent cross-bridging are being implemented per requirements of the construction documents and erection drawings.
4. Inspect setting of shelf angles, bearing plates and miscellaneous structural items to verify size, quantity, location and finish.
5. Visually examine all field welds. Verify that welders are AWS certified.

2.7. Masonry

A. Inspect all reinforced masonry per ACI 530, ACI 530.1 and as follows:

1. Spot check that materials are properly stored.
2. Workmanship
3. Unit size, strength, and weight
4. Mortar and grout type, mixing and placement.
5. Placement of reinforcing steel and joint reinforcing, inserts, and anchors and other structural aspects.
6. Check cleanout areas to confirm that cells to be reinforced are clean and free of all foreign material and that vertical bar is tied to dowel.
7. Control joint construction.
8. During grouting, verify that all cells are filled solid and that grout is consolidated as required by the contract documents. if in doubt after completion, check using a hammer.
9. Check connection of side or top of wall to supporting elements.

2.8. Cold formed metal framing

A. Inspect cold formed metal structural members for proper profile and material gauge, location of splices, reinforcement when studs and plates are cut and adequate bearing on supporting members.

B. Review the construction documents and make sure all the drawings, specifications, shop drawings, addendums, sketches are available and approved by design engineers.

C. Verify proper fastener size, quantity, and locations.

1. Verify that bracing of studs and joists conforms to contract documents and/or shop drawings.

PART 3 - Testing and Submittals

3.1. Material testing

A. The testing agency retained by the owner shall perform all tests described in the contract documents and shall provide a report of each test of work described in this plan to the

Building Code Compliance Office, owner, contractor, architect/engineer and special inspector.

- B. The special inspector shall review all material test reports upon receipt and shall include in his report any results that do not comply with the contract documents.
- C. The special inspector may request the owner's representative to authorize additional tests when appropriate.

3.2 Structural submittals

- A. The special inspector shall review and become familiar with all submittals. The contractor shall provide the special inspector with one copy of all structural submittals, excluding calculations, and all accepted alternates for his record and use. All shop drawings and other submittals referenced in this plan shall contain evidence of review and acceptance by the Building Code Compliance Office, contractor, architect and structural engineer.

END OF SECTION

Division 2

Site Construction

SECTION 02210
SITE PREPARATION AND EARTHWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Furnish all necessary labor, equipment, material, transportation and performing all work necessary to clear the construction site and bring the site, including roads, drives, building sites, paved areas and open areas to the lines and grades shown on drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02221 - Excavating, Backfilling and Compacting
 - 2. Section 02230 - Soil Treatment
 - 2. Section 02480, - Sodding, Seeding, Mulching
 - 3. Section 02500 - Asphalt Concrete Pavement and Resurfacing
 - 4. Section 02650 - Water Distribution System
 - 5. Section 02710 - Concrete Sidewalk
 - 6. Section 02720 - Storm Drainage System
 - 7. Section 02730 – Sanitary Sewerage System
 - 8. Section 02810 – Chain Link Fences and Gates
 - 9. Section 03100 - Concrete Formwork

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SITE PREPARATION
AND EARTHWORK

CTHA Project No. 1204.00

10. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCED STANDARDS AND TESTS

- A. AASHTO T180 (ASTM D1557), Moisture-Density Relations of soils Using a 10 lb. Rammer and an 18 in. Drop.
- B. AASHTO T191 (ASTM D1556), Density of soils in Place by Sand-Cone Method.
- C. AASHTO T238 (ASTM D2922), Density of Soils and Soil-Aggregates in Place by Nuclear Method.
- D. AASHTO M 145 (ASTM D3282), Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

1.04 QUALITY ASSURANCE

- A. Field Engineering: Provide the services of a Professional Land Surveyor registered in the State of Florida to establish all vertical and horizontal controls required for layout of the work and for preparation of a certified survey showing recorded finish elevations and dimensions upon completion of site preparation and earthwork.
- B. Water Pollution: Comply with the applicable provisions of permits issued by Water Management District and Orange County Public Works. Protect adjacent waterways from contamination and increased turbidity due to Contractor's operations by all means necessary, including the installation of silt or turbidity screens, filter blankets, temporary dikes and ditches, etc., and limit runoff water from disturbed areas as necessary to meet requirements and restrictions of the agencies having jurisdiction.
- C. Fill Materials: Submit certifications that fill materials furnished meet the specified requirements and standards.
- D. Compaction: During the filling operation, and unless otherwise required by Owner, take at least one density test per 5,000 square feet in pavement/roadway areas and building sites for each lift above water level and one density test per 25,000 square feet for each lift in other areas. If any test fails, rework and recompact the area and retest, until satisfactory compacting meeting the specified requirements are achieved.

PART 2 - PRODUCTS

Holden Heights Community Center 02210-2

SITE PREPARATION
AND EARTHWORK

CTHA Project No. 1204.00

2.01 MATERIALS FOR FILLS

- A. Suitable for Fills: Material classified as A-1, A-3, or A-2-4 under AASHTO M 145 (ASTM D3282), free from vegetation and organic material, and with not more than 10 percent by weight passing the No. 200 sieve.
- B. Suitable For Place In Water: Material classified as A-1 or A-3 under AASHTO M-145 (ASTM D 3282).
- C. Unsuitable For Fills: Materials classified as A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7 and A-8 under AASHTO M 145 (ASTM D3282).
- D. Select Material: suitable material containing no pieces or rock fragments larger than will pass a 3-inch diameter ring.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clearing and Grubbing:
 - 1. Completely remove and dispose of all trees, brush, stumps, roots, grass, weeds, rubbish and all other obstructions resting on or protruding through the surface of the existing ground and the surface of excavated areas.
 - 2. Clear and grub within all areas of the roadway right-of-way, and all areas designated for site grading except where selective clearing will be transformed in some areas by retaining selected trees as designated on the Drawings or directed by Owner. Protect from damage by construction equipment and in a manner approved by Owner, all trees selected by the Owner for saving.
 - 3. Within building sites and paved areas, remove to a depth of not less than 2-feet below the surface all stumps, roots, etc., protruding through or appearing on the surface of the existing ground and completed excavations, and replace with compacted backfill before the area is filled.
 - 4. Within all other areas designated for clearing and grubbing, remove to a depth of 1-foot below the completed surface all stumps, roots, and other debris projection

through or appearing on the surface of the ground.

5. Strip grass and roots to a depth of 4-inches from all areas to be excavated or filled upon. Stockpile for later use stripped material suitable for topsoil and dispose of all other material as directed by Owner.

- B. Debris Disposal: Prior to excavation and/or filling, remove from the project site and dispose of all clearing and grubbing debris and other accumulated trash.

3.02 PERFORMANCE

A. Excavation:

1. Perform excavation to the limits indicated on the plans or specified herein, including shaping and sloping and other work necessary in bringing the earthwork to the required grades, alignment and cross sections.
2. As far as practicable, use all suitable materials removed from the excavation in the formation of the embankments, subgrades, shoulders, building sites and other places as directed. Remove unsuitable material to the required depth and replace it with suitable material to the satisfaction of Owner. Unsuitable material existing in open areas may remain, and these open areas may be used for disposal areas for the unsuitable material as directed by Owner.
3. Dispose of excess excavated suitable material as directed by Owner and excess unsuitable excavated material outside the limits of the project.
4. In the event materials containing toxic substances, oil products or other pollutants are encountered during excavation, immediately cease operations and notify Owner. Proceed with the excavation only when so directed by Owner, using additional procedures and precautions, if any, as necessary to contain and dispose of the contaminated material in compliance with all applicable laws and regulations.

B. Fills:

1. Construct fills of suitable material placed in layers of not more than 8-inches in depth measured loose and rolled and/or vibrated with suitable equipment until compacted. Thickness of layers may be increased provided the equipment and methods used are proven by field density testing to be capable of compacting thicker layers to specified densities. Decrease layer thickness if equipment and methods used prove to be incapable of compacting layers to specified densities.

2. Place no material that will not pass through a 6-inch diameter ring within the top 12-inches of the surface of the completed fill, and none that will not pass through a 3-inch diameter ring within the top 4-inches of the completed fill. Do not use broken concrete or asphaltic pavement in fills.
3. Compact fill within the roadways, walkways, parking areas, and building sites to a density of not less than 95 percent of its maximum density as determined by AASHTO T 180 (ASTM D 1557), and fill within other areas to a density of not less than 90 percent.
4. Muck, marl or other unsuitable material may be used in open areas designated in the Drawings or as directed by Owner, disc and harrow this layer to break up large pieces of material. Compaction of unsuitable material will not be required.
5. Place and compact fills to within 0.1-foot of the required elevations and slope surfaces to drain as shown on the Drawings.

C. Subgrades:

1. Construct subgrades for paved areas to conform to the grades, lines and cross sections shown on the drawings, of uniform density, ready to receive the base course.
2. Stabilize, in accordance with Section 02240, Stabilized Subgrade, all materials of the subgrade which provide a Limerock Bearing Ratio of less than 40.
3. After the subgrade has been properly shaped, and stabilized if required, bring the surface to a firm, unyielding surface by rolling the entire area with an approved vibratory roller. Compact all areas inaccessible to the roller with hand tampers weighing not less than 50 pounds, and with face area not more than 100-square-inches. Unless the subgrade material at the time of the rolling contains sufficient moisture to insure proper compaction, add water as directed before compacting. Allow subgrade material containing excess moisture, as determined by Owner, to dry to the proper consistency before being compacted.
4. Compact the top 12-inches of the subgrade, including cut and fill sections, to a density of not less than 95 percent of the maximum density as determined by the AASHTO T 180 (ASTM D 1557).
5. After the subgrade has been prepared, maintain it free of ruts, depressions and damage resulting from the hauling and handling of any material, equipment, tools, etc. Provide and maintain ditches or drains along the completed subgrade

section to prevent damage by storm water. Just before the base course is laid, check the subgrade to conform with designed crown and elevation. Complete the subgrade to provide a final elevation within 0.1-foot of the required elevation.

END OF SECTION

SECTION 02220
EXCAVATING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. The work included under this Section consists of clearing, excavating, grading and backfilling as required for the construction of building pads, roadways, and utility systems consisting of, but not limited to, water mains, sanitary sewers, manholes, drainage structures, ponds, swales and appurtenances and irrigation lines as shown on Drawings and specified herein.

- B. Related Sections: The following sections contain requirements that related to this section.

- 1. Section 02210 – Site Preparation and Earthwork

- C. Definitions:

- 1. Maximum Density: Maximum weight in pounds per cubic foot of a specific material.
- 2. Optimum Moisture: Percentage of water in a specific material at maximum density.
- 3. Suitable: Suitable materials for fills shall be a non-cohesive, non-plastic granular local sand and shall be free from vegetation, organic material, marl, silt or muck. The Contractor shall furnish all additional fill material required.
- 4. Unsuitable: Unsuitable materials are highly organic soil (peat or muck) classified as A-8 in accordance with AASHTO Designation M 145.

- D. Plan for Earthwork: The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrate, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the work, the

general and local conditions and all other matters which can in any way affect the work under this Contract.

1.03 QUALITY ASSURANCE

- A. A Testing Laboratory employed by Owner will make such tests as are deemed advisable. The Contractor shall schedule his work so as to permit a reasonable time or testing before placing succeeding lifts and shall keep the laboratory informed of his progress. Costs for all testing shall be paid by the Owner. However, any and all test which have to be repeated because of the failure of the tested materials to meet specification shall be paid for by Contractor and the cost of any tests shall be deducted from payments due to Contractor.

1.04 JOB CONDITIONING

- A. Test borings made on the site and the surface exploration data are available upon request and are for the Contractor's information only.
- B. If, in the opinion of Owner, conditions encountered during construction warrant a change in footing elevations, or in the depth of removal of unsuitable material from that indicated on the Drawings, an adjustment will be made in the contract price.

1.05 PROTECTION

- A. Sheeting and Bracing:
 - 1. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, power poles, etc. from undermining, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other approved methods. If Owner is of the opinion that at any points sufficient or proper supports have not been provided, he may order additional supports put in at the expense of Contractor, and compliance with such order shall not relieve or release Contractor from his responsibility for the sufficiency of such supports. Where soils cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to Owner.
 - 2. The Contractor shall construct the sheeting outside the neat lines of the foundation unless indicated otherwise to the extent he deems it desirable for his

method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressure to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected by Contractor at his own expense so as to provide necessary clearances and dimensions.

3. Where sheeting and bracing is required to support the sides of excavations for structures, Contractor shall engage a Professional Geotechnical Engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design, and certification of this shall be provided by the Professional Engineer.
4. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
5. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which Owner may direct in writing to leave in place at any time during the progress of the work for purpose of preventing injury to structures, utilities, or property, whether public or private. Owner may direct that timber used for sheeting and bracing be cut off at any specified elevation.
6. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed by Owner.
7. The right of Owner to order sheeting and bracing left in place shall not be construed as creating any obligation on this part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
8. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than 1 foot above the top of any pipe.

B. Pumping and Drainage:

1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such an extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. The Contractor shall engage a Geotechnical Engineer registered in the State of Florida, to design the dewatering systems for all structures. The Contractor shall submit to Owner for review a plan for dewatering systems prior to commencing work. The dewatering system installed shall be in conformity with the overall construction plan, and certification of this shall be provided by the Professional Engineer. The Professional Engineer shall be required to monitor the performance of the dewatering systems during the progress of the work and required such modifications as maybe required to assure that the systems are performing satisfactorily.
2. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation and to preserve the integrity of adjacent structures. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soil from the surrounding ground.
3. Water entering the excavation from surfaces runoff shall be collected in the shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
4. The Contractor shall take all additional precautions to prevent uplift of an structure during construction.
5. The conveying of water in open ditches or trenches will not be allowed. Permission to use any storm sewers, or drains, for water disposal purposes shall be obtained from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. However, the Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by Owner or the authority having jurisdiction, at no cost to Owner.
6. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.
7. Removal of dewatering equipment shall be accomplished after the system is no longer required; the material and equipment constituting the system, shall be

removed by Contractor.

8. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on the groundwater quality.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. All fill material shall be subject to the approval of Owner.
2. All fill material shall be free of organic material, trash, or other objectionable material. Excess or unsuitable material shall be removed from the job site by Contractor.

B. Common Fill Material: Common fill shall be sand and shall not contain stones, rock, concrete to other rubble larger than two (2) inches in diameter. It shall have physical properties which allow it to be easily spread and compacted.

C. Structural Fill: Structural fill shall be reasonably well graded sand to gravelly sand having the following gradation:

<u>U.S. Sieve Size</u>	<u>Percent Passing By Weight</u>
1 - in	100
No. 4	75 - 100
No. 40	15 - 80
No. 100	0 - 30
No. 200	1 - 12

D. Class I Soils*: Manufactured angular, granular material, 1/4 to 1-1/2 inches (6 to 4 mm) size, including materials having significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells. Sieve analysis for crushed stone is given below separately.

Crushed Stone: Crushed stone shall consist of clean mineral aggregate free from clay, loam or organic matter, conforming with ASTM C33 stone size No. 89 and with particle size limits as follows:

<u>U.S. Sieve Size</u>	<u>Percent Passing By Weight</u>
------------------------	----------------------------------

1/2	100
3/8	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 50	0 - 5

E. Class II Soils** :

1. GW: Well-graded gravels and gravel-sand mixtures, little or no fines. Fifty (50) percent or more retained on No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.
2. GP: Poorly graded gravels and gravel-sand mixtures, little or no fines. Fifty (50) percent or more retained on No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.
3. SW: Well-graded sand and gravelly sands, little or no fines. More than fifty (50) percent passes No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.
4. SP: Poorly graded sand and gravelly sands, little or no fines. More than fifty (50) percent passes No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.

* Soils defined as Class I materials are not defined in ASTM D2487.

** In accordance with ASTM D2487, less than 5 percent pass No. 200 sieve.

F. Coarse Sand: Sand shall consist of clean mineral aggregate with particle size limits as follows:

<u>U.S. Sieve Size</u>	<u>Percent Passing By Weight</u>
No. 10	100
No. 20	0 - 30
No. 40	0 - 5

G. Other Material: All other materials, not specifically described, but required for proper completion of the work shall be selected by the Contractor and approved by Owner.

PART 3 - EXECUTION

Holden Heights Community Center

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EXCAVATING, BACKFILLING,
AND COMPACTING

CTHA Project No. 1204.00

3.01 PREPARATION

A. Clearing:

1. The construction areas shall be cleared of all obstructions and vegetation including large roots and undergrowth, within 10 feet of the lines of the excavation.
2. Strip and stockpile topsoil on the site at the location to be determined by Owner.

3.02 EXCAVATION

A. Excavating for Roadways and Utilities:

1. Immediately document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during the course of construction.
2. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Drawings and should anticipate the encounter of unknown obstructions during the course of the work.
3. Encounters with subsurface obstructions shall be hand excavated.
4. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support of structures as a result of inadequate dewatering or other construction methods, shall be removed and replaced by crushed stone as required by Owner at the Contractor's expense.
5. The bottom of excavation shall be rendered firm and dry before placing any structure. Excavated material not suitable for backfill shall be removed from the site and disposed of by the Contractor.
6. All pavements shall be cut prior to removal, with saws or approved power tools.
7. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered.
8. All locations and elevations as required herein must be permanently documented by the Contractor, on the Record Drawings prior to Owner's approval of the Application for Payment for that work.

9. When force main or sanitary sewer pipe crosses less than 10 feet from a water main, the depth of cover shall be increased to 5 feet or 18 inches below the water main, which ever is greater. When force mains or sanitary sewers are laid parallel to water main, the sanitary line is to be installed per Section 02730C.

3.03 DRAINAGE

- A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations, and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition. The dewatering method used shall prevent disturbance of earth below grade.
- B. All water pumped or drained from the work shall be disposed of in a suitable manner with our undue interference with other work, without damage to surrounding property, and in accordance with pertinent rules and regulations.
- C. No construction, including pipe laying, shall be allowed in water. No water shall be allowed to contact masonry or concrete within 24 hours after being placed. The Contractor shall constantly guard against damage due to water and take full responsibility for all damage resulting from his failure to do so.
- D. The Contractor will be required at this expense to excavate below grade and refill with approved fill material if the Owner determines that adequate drainage has not been provided.

3.04 UNDERCUT

- A. If the bottom of any excavation is below that shown on the Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due to the Contractor's excavation methods, he shall refill to normal grade with fill at his own cost. Fill material and compaction shall be as directed by Owner.

3.05 FILL AND COMPACTION

- A. Compact and backfill excavations and construct embankment according to the following schedule. Backfill schedule for pipes is listed in Table 02200-A. (Standard shall be ASTM D-1557):

STRUCTURES AND ROADWORK

<u>Area</u>	<u>Material</u>	<u>Compaction</u>
Beneath Structures	Structural Fill	12" lifts, compacted to 95% maximum density. Fill should not be placed over any in place soils until those deposits have been compacted to 95% maximum density.
Around Structures	Structural Fill	8" lifts, 95% of maximum density. Use light rubber-tired or vibratory plate compactors.
From Cleared Existing Surface to Subgrade for Paved and Gravel Surfaces	Common Fill	12" lifts, 95% of maximum density.

- B. Pipe shall be laid in open trenches unless otherwise indicated on the Drawings or elsewhere in the Contract Documents.
- C. Excavations shall be backfilled to the original grade or as indicated on the Drawings. Deviation from this grade because of settling shall be corrected. Backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard.
- D. Embankments shall be constructed true to lines, grades and cross sections shown on the plans or ordered by Owner. Embankments shall be placed in successive layers of not more than 8 inches in thickness, loose measure, for the full width of the embankment. As far as practicable, traffic over the work during the construction phase shall be distributed so as to cover the maximum surface areas of each layer.
- E. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified herein, such request shall be in writing to Owner. Approval will be considered only after Contractor has performed tests, at Contractor's expense, to identify the material used and density achieved throughout the backfill area utilizing the method of backfill requested. Owner's approval will be in writing.

END OF SECTION

SECTION 02232
LIMEROCK BASE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.02 SUMMARY

- A. This Section includes furnishing, providing all labor, materials, equipment, transportation and performing all work necessary to construct a base course composed of limerock upon the prepared subgrade in accordance with these Specifications and with the lines, grades, notes and typical cross sections shown on the Drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 - Site Preparation and Earthwork
 - 2. Section 02240 - Stabilized Subgrade
 - 3. Section 02500 - Asphalt Concrete Pavement and Resurfacing

1.03 QUALITY ASSURANCE

- A. Furnish complete laboratory analysis and obtain approval of the material by Owner prior to placement.
- B. Construct the base course in accordance with the applicable provisions to the Florida Department of Transportation Standard Specifications For Road and Bridge Construction, (FDOT Specifications) latest edition and as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Source: Miami Oolite Formation or Ocala Formation at the Contractor's option. Use only one formation on any project.

- B. Composition: Limerock material showing no significant tendency to air slake or undergo any chemical change under exposure to weather and containing:
 - 1. Not more than 0.5 percent of organic material or objectionable matter,
 - 2. Not less than 70 percent of carbonates of calcium and magnesium,
 - 3. Not more than 3 percent of water sensitive clay material.
- C. Gradation: Graded uniformly down to dust with at least 97 percent (by weight) passing the 3 1/2-inch sieve and the fine material consisting entirely of dust of fracture.
- D. Quality:
 - 1. Uniform in quality and not containing cherty or other extremely hard pieces or lumps, balls or pockets of sand or clay size material in sufficient quantity as to prevent proper bonding, finishing or strength of the limerock base.
 - 2. Nonplastic with liquid limit not exceeding 35.
 - 3. Average LBR value not less than 100.

PART 3 - EXECUTION

3.01 GENERAL

- A. Equipment: As necessary for the proper construction of the work, in first-class working condition, and as approved by Owner prior to its use.
- B. Limits Of Construction: Construct the base to the full dimensions shown on the Drawings.

3.02 PERFORMANCE

- A. Transporting limerock: Transport limerock to the point where it is to be used, over rock previously placed if practicable, and dump on the end of the preceding spread. No hauling over the subgrade or dumping on the subgrade will be permitted.
- B. Spreading Limerock:
 - 1. Spread limerock uniformly, and remove and replace all segregated areas of fine or coarse rock with well-graded rock.
 - 2. When the specified compacted thickness of the base is greater than 6-inches, construct the base in two courses with the first course approximately one-half the

total thickness of the finished base, but not less than the thickness required to bear the weight of the construction equipment without disturbing the subgrade.

C. Compacting And Finishing Base:

1. Single Course Base: After spreading is completed, scarify the entire surface and then shape to produce the required grade and cross section after compaction.
2. Double Course Base: After placing and compacting the first course, clean the first course of foreign material, blade and bring to a surface cross section approximately parallel to that of the finished base. Prior to the spreading of any material for the upper course, conduct the density tests for the lower course and determine that the required compaction has been obtained. After the spreading of material for the second course is completed, finish and shape its surface so as to produce the required grade and cross section after compaction, free of scabs and laminations.
3. Moisture Content: When the material does not have the proper moisture content to insure the required density, wetting or drying will be required. If the material is deficient in moisture, add water and uniformly mix in by discing the base course to its full depth. If the material contains an excess of moisture, allow to dry until the required moisture content is attained before being compacted. In wetting or drying operations manipulate the entire width and depth of the base as a unit.
4. Density Requirements: As soon as proper conditions of moisture are attained, compact the material to a density of not less than 98 percent of the maximum density as determined by AASHTO T 180.
5. Density Tests:
 - a. During final compacting operations, if blading of any areas is necessary to obtain the true grade and cross section, complete the compacting operations for such areas prior to making the density determinations on the finished base.
 - b. Make at least three density determinations on each day's final operations on each course, and at more frequent intervals if deemed necessary by Owner.
6. Correction Of Defects:
 - a. If at any time the subgrade material should become mixed with the base course material, dig out and remove the mixture, replace the materials removed with clean base material, and shape and compact the subgrade as specified above.
 - b. If cracks or checks appear in the base, either before or after priming, which in the opinion of Owner would impair the structural efficiency of the

base course, remove such cracks or checks by rescarifying, reshaping, adding base material where necessary and recompacting.

- D. Testing Surface: Check the finished surface with a template cut to required crown and cross section and with a 10-foot straightedge laid parallel to the centerline of the road. Correct all irregularities greater than 1/4-inch by scarifying and by removing or adding limerock as may be required, and recompacting the entire area as specified herein before.
- E. Thickness Determinations:
1. Measure the thickness of the compacted limerock base at intervals of not more than 100-feet at various points on the cross sections, prior to the application of the prime coat.
 2. Take the measurements in holes through the base of not less than 3-inches in diameter. Where the compacted base is deficient by more than 1/2-inch from the thickness called for on the Drawings, correct such areas by scarifying and adding limerock for a distance of 50-feet in each direction from the edge of the deficient area. Bring the affected areas to the required state of compaction and to the required thickness and cross section.
- F. Priming and Maintaining:
1. Apply the prime coat only when the base is firm and unyielding, meets the specified density requirements and the moisture content in the top half of the base does not exceed 90 percent of the optimum moisture content of the base material.
 2. Prior to applying the surface course, check that the crown and grade are true, with no rutting or other distortion, and that the base meets all the specified requirements.

END OF SECTION

SECTION 02234
SOIL CEMENT BASE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work specified in this Section consists of the construction of a base course composed of a combination of soil and Portland cement, uniformly mixed, moistened, compacted, finished, and cured, in accordance with these specifications, and shaped to reasonable close conformance with the lines, grades, thicknesses, and typical cross sections shown on the Drawings or established by Owner.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 - Site Preparation and Earthwork
 - 2. Section 02240 - Stabilized Subgrade
 - 3. Section 02500 - Asphalt Concrete Pavement and Resurfacing

1.02 QUALITY ASSURANCE

- A. Laboratory analysis shall be complete, and the material accepted by Owner prior to use.
- B. The storage building, bin or silo for cement shall be weatherproof and shall be located convenient to the work to be performed.
- C. Cement which has been damaged, which is partially set, or which is lumpy or caked, shall not be used, and the entire contents of the sack of cement or the container of bulk cement, which contains damaged, partially set, or lumps of caked cement, will be rejected for use. Cement salvages from discarded or used sacks shall not be used.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: The cement used in the work shall be domestic Portland cement that conforms to the requirements of AASHTO Designation M 85, Type I. The cement may be delivered in bags or in bulk.

B. Water:

1. Water for use with cement shall be clean and practically free of oil, acid, alkali, chlorides, organic matter, and other deleterious substances.
2. Water from city water supplies or other sources which are approved by a public health department may be accepted without being tested. Water from all other sources shall be tested and approved before use and shall impurities in excess of the following limits:

Acidity or alkalinity calculated in terms of calcium carbonate	0,05%
Total organic solids	0.05%
Total inorganic solids	0.08%
Total chlorides as sodium chloride	0.05%

C. Cut-Back Asphalt, Grade RC-70: Rapid-curing cut-back asphalt shall conform with the requirements of AASHTO Designation M 81 except that penetration range shall be from 60-120 instead of 80-120.

D. Emulsified Asphalt, Grade SS-1: Emulsified asphalt shall meet the requirements of AASHTO Designation M 140.

E. Soil: The soil for the base course shall consist of the natural material in the roadway or selected soil placed in the roadbed, as shown on the Drawings, or a combination of these materials, proportioned as directed. The soil shall not contain gravel or stone retained on a 2-inch sieve or more than 45% retained on a No. 4 sieve.

PART 3 - EXECUTION

3.01 GENERAL

A. Equipment: For performing the work specified in this Section the Contractor may use any machine, combination of machines, or equipment that are in good, safe working conditions and that will produce results meeting the requirements for cement

application, soil pulverization, mixing water application, compaction, finishing and curing, as required herein. Special attention is direct to the necessity for utilizing compaction equipment which will produce the required density in a particular soil-cement blend.

- B. Limits of Construction: The Contractor shall construct the base to the full width shown on the Drawings.

3.02 COMPOSITION AND PROPORTIONING

- A. Cement: Portland cement shall be applied at the rate determined by Owner for a particular soil used; therefore, no processing of the soil-cement mixture shall be started until all tests of the soil to be used to construct the base have been completed and the specified rate of application of Portland cement for the particular soil has been determined. In general, a period of approximately three weeks, subsequent the time that a particular section of the roadbed has been constructed substantially to grade, if required for such testing. The rate of application will be specified in terms of either pounds of Portland cement per square yards for the area to be mixed or pounds of cement per cubic yard of soil-cement mixture.
- B. Water: The quantity of water required will be the amount necessary to comply with Article 3.04 below.

3.03 PREPARATION

- A. Subgrade:
 - 1. Before base construction operations are begun, the subgrade shall have been completed. The subgrade shall be firm enough to support the equipment used in the soil-cement base operations without appreciable distortion or displacement. Any unsuitable material shall have been removed and replaced with suitable material.
 - 2. When the base is to be constructed of central plant-mix soil-cement, the subgrade shall be moist for a depth of at least one inch at the time the mixed base course material is placed thereon.
- B. Base Soil: The area over which base is to be constructed shall be graded and shaped to an elevation which will provide a base in conformance with the grades, lines, thicknesses, and typical cross section shown on the Drawings. All roots, sticks, and other deleterious matter shall be removed during processing.

3.04 PERFORMANCE

A. Mixing:

1. General:

- a. Mixing of the soil, cement and water shall be accomplished either by the mixed-in-place or the central plant-mix method.
- b. The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations. For clay soils it shall not exceed the optimum moisture content for the soil-cement mixture. For sandy soils the moisture content shall be within two percentage points above or below, the optimum moisture content. With certain type of soils, Owner may designate a moisture range other than those specified above.
- c. At completion of moist-mixing, the soil shall be so pulverized that 100 percent passes a one-inch sieve and a minimum of 80 percent passes a No. 4 sieve, exclusive of gravel and stone retained on the No. 4 sieve.
- d. The operation specified in this subparagraph and in subparagraphs 3.4B and C shall be continuous and shall be completed within a period of four hours starting from the time mixing commences.

2. Mix-In-Place

- a. Where feasible, the entire width of the base shall be processed as a single operation. The specified quantity of cement shall be spread uniformly on the soil at the required rate of application by means of an approved method. Spread cement that becomes displaced shall be replaced before mixing is started.
- b. After the cement has been applied, mixing shall begin within 60 minutes unless otherwise directed by Owner. The soil and cement shall be initially mixed until the cement has sufficiently blended with the soil to prevent formation of cement balls when additional water is applied; then water is added if necessary and the soil-cement mixture remixed.
- c. Processing may be to full depth in one course provided that satisfactory distribution of cement and water and the specified density can be obtained. If not, construction shall be in courses of such thickness that satisfactory results are obtained. Provisions shall be made to achieve

adequate bonding between courses.

- d. Immediately after mixing of the soil and cement, any additional water that is necessary shall then be added. If the moisture content exceeds that specified, the soil-cement mixture shall be manipulated by remixing or blading, as required to reduce the moisture content to within the specified range. Excessive concentrations of water shall be avoided. During the time of application of water and after all mixing water has been applied, mixing shall continue until a uniform and intimate mixture of soil, cement and water has been obtained.
- e. At the option of the Contractor, as an alternative to the above described procedure he may use an approved machine that will blend the cement and the soil and then add and mix-in any additional water that is necessary.

3. Central Plant-Mix:

- a. The soil, cement and water shall be mixed in a pugmill, of either batch or continuous flow type. The plant shall be equipped with feeding and metering devices which will accurately proportion the soil, cement, and water in the quantities specified. Soil and cement shall be mixed sufficiently to prevent cement balls from forming when additional water is added. Mixing shall continue until a uniform and intimate mixture of soil, cement and water is obtained. The materials shall be mixed a minimum of 30 seconds.
- b. The mixture shall be hauled to the roadway in trucks equipped with protective covers. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader. Not more than 30 minutes shall elapse between the placement of soil-cement in adjacent passes of the spreader at any location, except at longitudinal construction joints. The layer of soil-cement shall be uniform in thickness and surface contour, and in such quantity that the completed base will conform to the required grade and cross section. Dumping of mixture in piles or windrows upon the subgrade will not be permitted.

B. Compaction:

- 1. Compaction of the soil-cement mixture shall begin immediately after mixing is completed. In no case shall more than 60 minutes elapse between the last pass of moist-mixing and the start of compaction of the soil-cement mixture at a particular location.

2. At the start of the final compaction operation, the percentage of moisture in the mixture and in pulverized soil lumps, based on dry weights, shall not be more than two percentage points above or below the optimum moisture content.
3. The optimum moisture content and maximum density shall be determined in the field by the methods prescribed in AASHTO Designation T 134, on representative samples of the soil-cement mixture obtained from the area being processed.
4. The loose mixture shall be uniformly compacted to not less than 95 percent of the maximum density. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross section.

C. Finishing:

1. After compaction, the surface of the soil-cement shall be shaped to the required lines, grades, and cross section. In all cases where soil-cement mixture is added to any portion of the surfaces, the surface shall be lightly scarified with a spring tooth harrow, spike, drag, or other approved device, such that the surface is uniformly loosened prior to addition of material and prior to initial set of the soil-cement mixture. The resulting surface shall then be compacted to the specified density. Rolling shall continue until all rutting ceases and until the entire base conforms to the density requirements. With certain granular soils Owner may determine that minor tire marks are acceptable.
2. The moisture content of the surface material shall be maintained at not less than two percentage points below its specified optimum moisture content, during finishing operations. Surface compaction and finishing shall be done in such manner as to produce a smooth, dense surface, free of compacting planes, cracks, ridges, and loose materials.
3. If the time limits set forth herein are exceeded, the base shall be left undisturbed for a period of seven days, after which it will be examined by Owner to determine its suitability. If it is found suitable the Contractor shall be fully compensated providing the base meets all other requirements specified herein. If found unsuitable the base shall be removed and replaced by the Contractor without any additional compensation. The Contractor may, at his option, remove and replace the deficient base rather than wait the seven-day test cure.

- D. Construction Joints: At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face. The construction joint shall be located such as to exclude all of that part of the base at the end of the run which does not meet the requirements of the specifications and typical section.

E. Curing:

1. Surface Requirements: (Scalping and Hard planing): After compacting and finishing have been completed, and not later than the beginning of the next calendar day after the construction of any section of base, the surface shall be tested with a template cut to the required crown and with a 15-foot straightedge laid parallel to the center-line, and all irregularities greater than 1/4 inch shall be immediately corrected with a blade adjusted to the lightest cut which will ensure a surface that does not contain depressions greater than 1/4 inch under the template or straightedge. In the testing of the surface the measurements will not be taken in small holes caused by individual rocks having been pulled out by the blade. The material removed shall be wasted.
2. Protection Against Drying:
 - a. During the period when finishing and surface correction operations are being accomplished, the surface of the base shall be kept continuously moist by sprinkling as necessary. Subsequent to this period it shall be protected from drying for seven days, by application of either (1) cut-back asphalt, Grade RC-70, applied at a the rate of 0.15 to 0.20 gallon per square yard; or (2) a mixture containing equal parts of emulsified asphalt, Grade SS-1, and water, applied at the rate of 0.20 to 0.25 gallon of the diluted mixture per square yard. The actual rate of application shall be as directed and shall provide complete coverage without excessive runoff. At the time the bituminous material is applied, the soil-cement surface shall be dense and free of all loose and extraneous material, and shall contain sufficient moisture to prevent excessive penetration of the bituminous materials.
 - b. Should it be necessary to allow construction equipment or other traffic to use the completed base before the bituminous material has cured sufficiently to prevent pickup or displacement, the bituminous material shall be sanded, using approximately ten pounds of clean sand per square yard.
 - c. The curing material shall be maintained by the Contractor during the seven day protection period.

- F. Opening to Traffic: No traffic shall be permitted on the base subsequent to completion of the finishing operations specified in paragraph 3.4C article H for a period of seven days. As an exception to this requirement the equipment necessary for correction of surface irregularities, application of water and application of curing materials will be allowed provided that the tire contact pressures of such equipment do not exceed 45 pounds per square inch. After the seven day curing period the base may be opened to

traffic provided that it either is protected or has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

- G. Maintenance: The Contractor shall maintain the base to a true and satisfactory surface until the wearing surface is constructed. Should any repairs or patching be necessary they shall extend to the full depth of the base and shall be made in a manner that will assure restoration of a uniform base course conforming to the requirements of these specifications. In no case shall repairs be made by adding a thin layer of soil-cement to the completed work. The Contractor may at his option, make full depth repairs to small or minor areas, such as at manholes, inlets, or the like, with Class C concrete.
- H. Thickness;
1. During various stages of construction, test holes shall be dug in the mixture to determine the thickness. After the base is completed test holes shall be dug or drilled and the thickness of the base shall be determined from measurements made in these test holes.
 2. Where the base is deficient in thickness by more than $\frac{1}{2}$ inch, the area of deficient base shall be removed and replaced by base of the required thickness, at the Contractor's expense.
 3. As an exception to the above, if the deficiency is considered to not be sufficient to seriously impair the required strength of the base, the deficient area may be left in place. No payment will be made for the base or the theoretical amount of cement used in areas left in place without correction.

END OF SECTION

SECTION 02240
STABILIZED SUBGRADE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation necessary to construct stabilized subgrade for areas as shown on Drawings.
 - 1. Contractor to stabilize parking areas to a minimum depth of 6-inches below the bottom grade of the base material and to a width of 6 inches outside each pavement or concrete curb edge.
 - 2. Stabilize roadways and streets to 12 inches unless otherwise indicated on the Drawings. .
 - 3. Where it fails to meet the specified Limerock Bearing Ratio (LBR) 40, stabilize the subgrade to the uniformity, density and bearing ratio specified as FDOT Type B.
- B. Definitions: Use FDOT Type B stabilization as described in Florida Department of Transportation Standard Specifications For Road and Bridge Construction, (FDOT Specifications) latest edition and as specified herein to obtain the required bearing ratio by the addition and mixing in of suitable stabilizing material.
- C. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 – Site Preparation and Earthwork

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Use either Commercial Materials or Local Materials as defined hereunder, at the Contractor's option.
- B. Commercial Materials: Limerock, overburden or crushed shell meeting the following
Holden Heights Community Center 02240-1 STABILIZED SUBGRADE

requirements:

1. Limerock and Limerock Overburden: Material with at least 70 percent of carbonates of calcium and magnesium, plasticity index not exceeding 10 and 97 percent of passing a 1 1/2-inch sieve.
2. Crushed Shell: Mollusk shell (i.e., oysters, mussels, clams, cemented coquina, etc.) meeting the following requirements.
 - a. At least 97 percent by weight of the total material passing a 1-inch screen and at least 50 percent by weight of the total material retained on the No. 4 sieve.
 - b. Not more than 7.5 percent by weight of the total material passing the No. 200 sieve as determined by washing the material over the sieve.
 - c. In the event that the shell meets the above requirements without crushing, crushing will not be required. The use of steamed shell will not be permitted.
- C. Local Material: High-bearing-value soils or sand-clay material with the portion passing the 40-mesh sieve having a liquid limit not greater than 30 and a plasticity index not greater than 10. Blending of materials to meet these requirements will not be permitted unless authorized by Owner. When permitted, test and obtain approval for the blended material before using.
- D. Stabilization:
 1. Determine bearing value by the Limerock Bearing Ratio (LBR) Method.
 2. After grading operations are substantially complete, determine the quantity (if any) of selected stabilizing material to be added for compliance with the bearing value requirements.
 3. Ensure that the finished subgrade meets the bearing value requirements, regardless of the quantity of stabilizing materials necessary to be added.

PART 3 - EXECUTION

3.01 PREPARATION

A. General:

1. Prior to the beginning of stabilizing operations, complete the subgrade to the lines, grades and cross section shown on Drawings.

2. Stabilize the subgrade in one course, unless the equipment and methods being used do not provide the required uniformity, particle size limitation, compaction and other desired results, in which case, perform the processing in more than one course as approved by Owner.

3.02 APPLICATION

- A. **Stabilizing Material:** Spread the stabilizing material uniformly over the area to be stabilized by means of mechanical material spreaders, except that where use of such equipment is not practicable other means of spreading may be used, but only upon written approval of Owner.
- B. **Mixing:** By means of rotary tillers, or other equipment meeting the approval of Owner, thoroughly mix the subgrade throughout the entire depth and width of the area to be stabilized.
- C. **Maximum Particle size of Mixed Materials:** At the completion of mixing, check that all particles of material within the limits of the area to be stabilized pass a 3 1/2-inch ring. Remove from the stabilized area any particles not meeting this requirement or break them down so as to meet this requirement.
- D. **Compaction:** After the mixing operations have been completed and requirements for bearing value, uniformity and particle size have been satisfied, compact the stabilized area to a density of not less than 98% of maximum density as determined by AASHTO T 180. Compact the materials at a moisture content permitting the specified compaction. If the moisture content of the material is improper for attaining the specified density, either add water or allow drying until the proper moisture content for the specified compaction is reached.
- E. **Finish Grading:** Grade and shape the completed stabilized subgrade to conform with the finished lines, grades and cross-section indicated in the Drawings.
- F. **Quality Assurance:**
 1. After the stabilizing and compaction operations have been completed, check that the subgrade is firm and substantially unyielding, to the extent that it will support construction equipment and will have the bearing value required.
 2. Remove and replace with suitable material all soft and yielding material, and any other portions of the sub-grade which will not compact readily, and bring the whole subgrade to line and grade, with proper allowance for subsequent compaction.
- G. **Maintenance Of Completed Subgrade:** upon completion, maintain the subgrade free from ruts, depressions and any damage resulting from the hauling or handling of materials, equipment, tools, etc. Maintain the required density until the subsequent base or pavement is in place. Make any repairs, replacement of curb and gutter,

sidewalk, etc., which might become necessary in order to re-compact the subgrade in the event of under-wash or other damage. Construct and maintain ditches and drains as necessary to protect the completed subgrade from damage by storm water.

3.03 FIELD QUALITY CONTROL

A. Bearing Value Requirements:

1. General: Bearing value samples will be obtained and tested by Owner at completion of satisfactory mixing of the stabilized area. For any area where the bearing value obtained is deficient from the value indicated in the Drawings, in excess of the tolerances established herein, spread and mix in additional stabilizing material as specified above for the full width of the roadway being stabilized and longitudinally for a distance of 50-feet beyond the limits of the area in which the bearing value is deficient. Pay for all retesting required until subgrade meets the specified requirements.
2. Tolerances In Bearing Value Requirements: A under tolerance of 5.0 from the specified bearing value of LBR 40 will be allowed as based on tests performed on samples obtained after mixing operations have been completed.

END OF SECTION

SECTION 02361
TERMITE CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following for termite control:
 - 1. Soil treatment.

1.03 DEFINITIONS

- A. EPA: Environmental Protection Agency.
- B. PCO: Pest control operator.

1.04 SUBMITTALS

- A. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- B. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Brand name and manufacturer of termiticide.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes, and rates of application used.
 - 6. Areas of application.
 - 7. Water source for application.
- E. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: A PCO who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.
- B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.07 COORDINATION

- A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1.08 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
- C. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Termiticides:

- a. Aventis Environmental Science USA LP; Tribute.
- b. Dow AgroSciences LLC; Equity or Dursban TC.
- c. FMC Corporation, Agricultural Products Group; Dragnet, Talstar, Prevail FT, or Torpedo.
- d. Syngenta; Demon TC.

2.02 SOIL TREATMENT

- A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control. Proceed with application only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.
- C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.03 APPLICATION

- A. Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.04 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.
1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 2. Foundations: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers, piers; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 3. Masonry: Treat voids.
 4. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION

SECTION 02500
ASPHALT CONCRETE PAVING AND RESURFACING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation for the installation of asphalt concrete paving to the extent as shown on Drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02232 – Limerock Base
 - 2. Section 02234 – Soil Cement Base .

1.03 SUBMITTALS:

- A. Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with State Department of Transportation Standard Specifications, latest edition, and with local governing regulations if more stringent than herein specified.

1.05 SITE CONDITIONS

- A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg. F (10 deg. C), and when temperature has not been below 35 deg. F (1 deg. C) for 12 hours immediately prior to application. Do not apply when base is wet or

contains an excess of moisture.

- B. Construct asphalt concrete surface course when atmospheric temperature is above 40 deg. F (4 deg. C), and when base is dry. Base course may be placed when air temperature is above 30 deg. F (-1 deg. C) and rising.
- C. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Use locally available materials and gradations which exhibit a satisfactory record of previous installations.
- B. Base Course Aggregate: Limerock or cemented coquina shell meeting Florida Department of Transportation Specification Sections 911 or 915, respectively. See Soils Report.
- C. Surface Course Aggregate: Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand.
- D. Sand prepared from stone, blast-furnace slag, or gravel, or combinations thereof may be used if required to suit local material availability.
- E. Asphalt Concrete: Shall comply with Florida Department of Transportation Specifications, Section 331, Type S-1 for parking areas. See Soils Report.
- F. Prime Coat: Shall comply with Florida Department of Transportation Standard Specifications, Section 300.
- G. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form.
- H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Allied Chemical Corp.
Achem Products, Inc.
Ciba-Geigy Corp.
Dow Chemical U.S.A.

E.I. DuPont De Nemours & Co., Inc.
FMC Corp.
Thompson-Hayward Chemical Co.
U.S. Borax and Chemical Corp.

- I. Lane Marking Paint: Chlorinated rubber-alkyd type, AASHTO M 248 (FS TT-P-115), Type III.
- J. Wheel Stops: Precast of 3,500 psi air-entrained concrete, approximately 6" high, 9" wide, and 7'0" long, with chamfered corners and drainage slots on underside.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Remove loose material from compacted subbase surface immediately before applying herbicide treatment or prime coat.
- B. Proof roll prepared subbase surface to check for unstable areas and areas requiring additional compaction.
- C. Notify Owner of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
- D. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase prior to application of prime coat.
- E. Prime Coat: Apply at rate of 0.20 to 0.50 gal. per sq. yd., over compacted subgrade. Apply material to penetrate and seal, but not flood surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.
- F. Tack Coat: Apply to contact surfaces of previous constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface. Allow to dry until at proper condition to receive paving.
- G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

3.02 PLACING MIX

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ASPHALT CONCRETE PAVING
AND RESURFACING

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- A. General: Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 deg. F (107 deg. C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.
- B. Paver Placing: Place in strips not less than 10' wide, unless otherwise acceptable to Owner. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- C. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining works. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

3.03 ROLLING

- A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling or joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.04 TRAFFIC AND LANES MARKINGS

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- B. Striping: Use chlorinated-rubber base traffic lane-marking paint, factory-mixed, quick-drying, and non-bleeding. Apply paint with mechanical equipment to produce uniform straight edges. Apply in 2 coats at manufacturer's recommend rates.
- C. Color: Yellow.
- D. Do not apply traffic and lane marking paint until layout and placement has been verified with Owner.

3.05 WHEEL STOPS

- A. Secure wheel stops to asphalt concrete surface with not less than two 3/4" diameter galvanized steel dowels embedded in precast concrete at 1/3 points. Size length of dowel to penetrate at least 6" into asphalt concrete. Drill placement holes oversize and embed dowels in hot bituminous grout material.

3.06 FIELD QUALITY CONTROL

- A. General: Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Owner.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
 - 1. Surface Course: 1/4", plus or minus.
- C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness, using 10' straightedge applied parallel with, and at right angles to centerline of pave area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.
 - 1. Wearing Course Surface: 1/8".
 - 2. Check surface areas at intervals as directed by Owner.

END OF SECTION

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ASPHALT CONCRETE PAVING
AND RESURFACING

CTHA Project No. 1204.00

SECTION 02650
WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation necessary for the installation of a complete system of water distribution, consisting of pressure piping, valves and appurtenant items as shown on Drawings and specified herein.

- B. Related Sections: The following sections contain requirements that related to this section.

- 1. Section 02220 - Excavating, Backfilling, and Compacting
- 2. Section 15410 – Disinfection of Water Lines
- 3. Section 15415 – Hydrostatic Testing of Pressure Pipelines
- 4. Division 3 – Concrete

1.03 QUALITY ASSURANCE

- A. Design Requirements:

- 1. Install all water mains with a minimum cover of 36 inches below finished grade unless otherwise indicated.
- 2. Construct water mains of the materials indicated on the Drawings, unless otherwise directed by Owner.
- 3. When using PVC, provide only pipe and fittings bearing the approval seal of the National Sanitation Foundation (NSF) for potable water pipe.
- 4. For changes in horizontal alignment of 45 degrees or less, pipe deflection, not

exceeding limits set forth in applicable AWWA Standards, may be used in lieu of fittings, subject to approval of Owner.

5. Install all valves with a minimum cover of 12 inches below finished grade, and valve boxes flushed with finished grade unless otherwise indicated.
 6. Install valves and valve boxes of the type, size and model indicated on the Drawings, unless otherwise directed by Owner.
 7. Provide restrained joints conforming to the details shown on the drawings for all valves.
- B. Pipe Inspection: Obtain from the pipe manufacturer a certificate of inspection to the effect that the pipe and fittings supplied for this Contract have been inspected at the plant and that they meet the requirements of these specifications. Visually inspect all pipe and fittings at time of delivery and just before they are placed in the trench, and reject and remove joints or fittings that do not conform to these specifications.
- C. Prevention of Electrolysis: Prevent the contact of dissimilar metals by means of an insulating or dielectric coupling.

1.04 SUBMITTALS

- A. Submit shop drawing, product data, certifications, etc., in accordance with general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections..
- B. Submit shop drawings for the following items prior to construction:
1. Mill test certificates or certified test reports on pipe
 2. Details of restrained and flexible joints
 3. Meter vaults and boxes
 4. Valves and valve boxes
 5. Backflow preventer assemblies
 6. Service connection assemblies
 7. Joint lubricant
 8. Pipe laying schedule

9. Temporary plug and anchorage system for hydrostatic pressure test
10. Transition joints where required

1.05 JOB CONDITIONS

- A. Water in Excavation: Unless otherwise approved by Owner, water will not be allowed in the trenches while the pipes are being laid and/or tested. Excavated not more trench than the available pumping facilities are able to dewater. Dispose of all water so as not to injure or interfere with the normal drainage of the territory in which he is working. Do not use pipelines being installed as drains for such water, and properly and adequately block the ends of the pipe during construction by means of approved stoppers. Prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such material has entered the pipelines, flush out the entire system until clean and unobstructed.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. Pipe: Ductile iron pipe conforming to the requirements of AWWA C151, Class 54 for 4-inch lines, Class 53 for 6-inch, Class 52 for 8-inch and Class 50 for all larger sizes, unless otherwise specified. Use Class 53 minimum for all pipes having threaded flange or grooved end joints. Provide pipe interior with a bituminous seal coat over a cement mortar lining conforming to AWWA C104, and exterior of pipe with the manufacturer's standard bituminous coating applied by the airless spray method.
- B. Fittings: Ductile iron fittings with a minimum pressure rating of 350 psi, conforming to the requirements of AWWA C 110, cement lined, seal coated and outside coated as specified above for ductile iron pipe. Use fittings with mechanical joints for underground use and grooved or flanged joints for above ground use.
- C. Joints:
 1. Mechanical joints: Joints conforming to AWWA C 111, with bolts and nuts machined true and nuts tapped at right angle to a smooth bearing surface. Use bolts of high strength, annealed cast iron, or high strength low alloy steel, T-head type having hexagonal nuts.
 2. Push on Joints: Single seal gasket push on type joints conforming to the requirements of AWWA C 111 and equal to Tyton, Fastite, Super Bell Tite, Altite.

3. Restrained Joints: Types fabricated by the various manufacturers, and approved by Owner. Joints using set screws or that require field welding will not be acceptable. Restrain all underground pressure pipes. Factory restrained joints shall be used. Mechanical joints with megalugs by EBAA Iron Works, Field-flex or fast-grip by American Ductile Iron or equal by U.S. Pipe shall be allowed on approval by Owner on a case by case basis where the pipe must be cut in the field.
4. Thrust Blocks: To be approved by Owner.
5. Gaskets: Vulcanized crude rubber or polyvinyl chloride plastisol with plain tips unless otherwise specified.

2.02 POLYVINYL CHLORIDE PIPE AND FITTINGS:

A. Pipe:

1. 4 Inches and Larger: PVC pipe conforming to AWWA C900 with Cast-Iron-Pipe Equivalent Outside Diameters and minimum Dimension Ratios (DR) of 18 for pipe sizes through 12 inches diameter and AWWA C905 with minimum Dimension Ratio of 26 for pipes larger than 12 inches.
2. Smaller than 4 Inches: PVC pipe conforming to ASTM D 1785, Class 1120 or 1220, Schedule 80 for pipe 2 inches and smaller and Schedule 40 for pipe larger than 2 inches. Use only Schedule 80 for all threaded pipe.

B. Fittings:

1. 4 Inches and Larger: Fittings furnished by the manufacturer of the pipe with which they are used, with elastomeric joints conforming to ASTM D 3139 or ductile iron fittings as previously specified for use with ductile iron pipe.
2. Smaller than 2 Inches: Schedule 80 PVC with solvent weld or threaded joints and conforming to ASTM D 2467 and D 2464 respectively.

C. Joints:

1. 4 Inches and Larger: Elastomeric gasket joints conforming to ASTM D 3139 suitable for the pressure rating of the pipe. The joint may be a coupling manufactured as an integral part of the pipe barrel consisting of a thickened section with an expanded bell with a groove to retain a rubber sealing ring of uniform cross section, similar and equal to Johns-Manville Ring-Tite and Davis Meter Dav-Tite, or may be made with a separate twin gasketed coupling similar and equal to Certainteed Fluid-Tite.

2. Smaller than 4 Inches: Solvent welded in accordance with the recommendations of the pipe manufacturer, using the solvent welding compound furnished with the pipe, or threaded. Use threaded joints only with Schedule 80 pipe or better. At threaded joints between PVC and metal pipe, the metal shall contain the socket ends and PVC spigots. Do not under any circumstance, screw a metal spigot into a PVC socket.

2.03 GATE VALVES

- A. Less than 3 inches: Bronze, single wedge, non-rising stem, screwed bonnet, 125 pound S.P., 200 pound W.O.G. with stuffing box repackable under pressure and all parts renewable and conforming to Federal Specifications WW-V-54 for Class A, Type I. Provide ends as shown on the Drawings.
- B. 3 inches and Larger: Iron body, non-rising stem, bronze mounted gates valves, with mechanical joints and/or single gasket push-on type, conforming to AWWA C500 and having a 2-inch square operating nut and O-ring seals replaceable while in service without undue leakage.
- C. 16 inches and Larger: Valves conforming to AWWA C500 but when installed horizontally, have bevel gearing, a gear case that can be repacked from the outside, rollers, and scrapers constructed so that the weight of the gate is carried on the rollers throughout the entire length of travel.

2.04 BUTTERFLY VALVES

- A. General: Tight-closing valves with rubber seats securely fastened to the valve body or disc, with 90 degrees disc rotating from full open position to tight shut position, bubble-tight at rated pressures with flow in either direction, and satisfactory for applications involving frequent operation and for applications involving valve operation after long periods of inactivity and for buried installation. No metal-to-metal seating surfaces will be permitted. Provide valves conforming to AWWA C504 for Class 150B, as manufactured by Henry Platt Company, Allis-Chamber, Dresser or equal.
- B. Valve Body: Cast iron ASTM a 126 Class B, with mechanical joint ends, two trunnions for shaft bearings integral with valve body, and, when the disc has the rubber seat, a 18-8 Type 304 stainless steel body seat.
- C. Valve Discs: Either alloy of cast iron ASTM A 436 Type 1 (Ni-Resist), ductile iron ASTM A 536, or cast iron ASTM A 48, each with type 316 stainless steel seating edge, or the entire disc may be constructed of cast 316 stainless steel. The stainless steel seating edge is not applicable to rubber seat disc type valves.

- D. Valve Seats: Synthetic or natural rubber compound, mounted on either the disc or valve body.
- E. Valve Bearings: Sleeve-type bearings, corrosion resistant and self-lubricating.
- F. Buried Locators: Permanently lubricated, sealed for submersion in water for pressures of 20 feet, with a two inch square AWWA operating nut indicating the direction to open, and constructed such that the valve will open when the nut is turned to the left (counterclockwise) to open.

2.05 CHECK VALVES

- A. Smaller than 4 inches: Bronze, bronze disc, swing check valves conforming to Federal Specification WW-V-51D, Type 4 Class a-125 pound, with ends as shown on the drawings.
- B. 4 inches and Larger: Swing check valves having a cast iron or cast steel body, with bronze or stainless steel seat ring, non-corrosive shaft for attachment of weight on lever, a 300 psi hydrostatic test pressure rating and designed to absolutely prevent the return of water back through the valve when the inlet pressure decreases below the delivery pressure. Provide full opening, tight seating valve with renewable seat ring securely held in place by a threaded joint, and valve disc of cast iron or cast steel suspended from a non corrosive shaft passing through a stuffing box.

2.06 DETECTOR CHECK VALVE

- A. Double check detector, UL and FM approved, with meter bypass and integral backflow preventer, OS&Y gate valve equal to Watts Model DDC.

2.07 SOLENOID VALVES

- A. Solenoid valves on the plant water line shall be normally closed. All solenoid valves shall include a manual override operator (MO). Valves shall be of brass body construction, resilient seating, general purpose service Red-hat Type as manufactured by Automatic Switch Co. (ASCO), Florham Park, N.J., or equal.

2.08 AIR RELEASE VALVES

- A. Manual Type: Galvanized steel pipe conforming to ASTM A 53, Schedule 40, with gate valves conforming to Federal Specification WW-V-54D, Type I, Class A, wedge disc, non-rising stem, 125 psi steam pressure rating, assembled as shown on the

Drawings.

- B. Automatic Type: Air release valves designed and manufactured for water service, that will not stick or leak water under continued long operating conditions, that will open under high internal pressure, and incorporating a solids settling chamber or trap and a flushing system by which the trap and the entire valve can be back flushed and cleaned, as manufactured by APCO, Val Matic or equal.

2.09 VALVE BOXES:

- A. Cast iron valve boxes, of 3-piece construction, adjustable to fit the designated depth of earth cover over the valve, designed so as to prevent the transmission of surface loads directly to the valve or piping, having an interior diameter of not less than 5 inches, and with covers marked "WATER" so constructed as to prevent tipping or rattling. Provide valve boxes with covers equal to Clow Corporation No. F-2450, or Mueller Company No. H-10357. Provide cast iron extension sections, 6-inch in diameter over hydrant valves and 10-inch diameter over all other valves, and protective rings of Class B (3000 psi) concrete.

2.10 VALVE VAULTS:

- A. Precast concrete of the type shown on the Drawings and conforming to the applicable requirements of Division 3, with cover for the non-traffic bearing vault constructed of 3/16-inch steel floor plate with reinforcement, galvanized after fabrication by the hot dip method in conformance with ASTM A 123.

2.11 TAPPING SLEEVES AND VALVES

- A. Split cast iron tapping sleeves rated for 150 psi working pressure and non-rising stem gate valves with O-ring seals and conforming to applicable requirements for gate valves as specified above. Steel tapping sleeves will not be acceptable.

2.12 CORPORATION STOPS

- A. Mueller Co. Type H-15000 for 1 inch service and type H-10003 for 2-inch service or equal.
- B. Ford Meter Box Co. Type F-100, Mueller Co. Type H-15009 or equal, with inlet having AWWA tapered threads and outlet for polyethylene or copper tubing with stainless steel insert stiffener.

2.13 SERVICE TERMINAL FITTINGS

- A. Single 1 inch Terminal Fitting: 1 inch ring style valve, drilled for wire sealing, angle inverted key meter valve cat. No. KV-23W by Ford Meter Box Co. No. UV63-42W, Hays No. 25040 DF or equal.
- B. Twin 1 Inch Terminal Fitting: 1 inch branch valve assembly, with standard 7 1/2-inch spacing between outlet centers, drilled for wire sealing, Ford Meter Box Co. No. UV63-42W, Hays NO. 25040 DF or equal.

2.14 HOSE BIBB AND BACKFLOW PREVENTER

- A. Hose Bibb: 3/4-inch cast bronze sediment faucet with wheel handle, stem and seat seals of Buna-N or TFE rubber, equal to Mueller Co. No. H-8260 or Chicago Faucet Co. No. 993, or approved equal. Potable water bibb shall be No. 952, 3/4 inch or 1-inch with vacuum breaker as noted on the drawings
- B. Backflow Preventer: Watts Regulator Co. No. 8A 3/4-inch atmosphere type backflow preventer, or approved equal.

2.15 PLANT WATER SERVICE METER

- A. Provide a bronze 1-1/2-inch magnetic drive rotating disc meter by Rockwell International or approved equal.
- B. The meter shall be provided with high speed pickup register with local flow indicator and totalizer. The meter shall meet all requirements of AWWA C700, including the accuracy requirements.

2.16 METER BOXES

- A. Precast concrete of the style shown on the drawings and as manufactured by Brooks Products of Florida, Inc., Cast Crete Corporation or equal, with steel cover and lid fabricated from steel tread plate and hot dipped galvanized after fabrication in accordance with ASTM A 123.

2.17 ANCHORAGES

- A. For PVC Mains: Full circle bearing type. Clamps, Straps, and Washers in accordance with ASTM A 506, steel.

B. Rods and Bolts:

1. Steel for rods conforming to the requirements of ASTM A 242, steel.
2. Rods galvanized in conformance with ASTM A 123.
3. Rod couplings in accordance with ASTM A 197, malleable iron.
4. Bolts: ASTM A 307, steel.
5. Cast-Iron Washers: ASTM A 126, gray iron.
6. For tie rods and tie bolts, use Super Star Tierod (Fig. No. SS12) and Tiebolt (Fig. No. SST7) as manufactured by Star National Products or equal. .

2.18 CONCRETE

- A. As specified in Division 3.

2.19 ADDITIONAL WORK:

- A. Conform to specific details shown on the Drawings, and provide construction of first-class materials conforming to the applicable portions of these Specifications.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Pipe Cradle: Upon satisfactory installation of the pipe bedding material as specified in Section 02220 - Excavating, Backfilling and Compacting, dig by hand a continuous trough for the pipe barrel and recesses for the pipe bells or couplings to insure continuous, uniform support for the pipe and barrel and that no pressure will be exerted on the pipe joints from the trench bottom.
- B. Cleanliness: Thoroughly clean the interior of the pipes of all foreign matter before placing them in the trench and keep them clean during laying operations by means of plugs or other methods. During suspension of work for any reason at any time, place a suitable stopper in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.

3.02 INSTALLATION

A. Pipe:

1. Gradient: Install straight, and maintain depth of cover uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation. Where a grade or slope is shown on the Drawings, use batter boards with string line paralleling the design grade, or other previously approved means, to assure conformance to required grade.
2. Pipe Joint Deflection: Use pipe deflection only within the maximum limits allowed in AWWA C600 for ductile iron pipe and the maximum limits as established by the manufacturer of PVC pipe.
3. Rejects: Immediately remove defective pipe and replace with sound pipe at no cost to the Owner.
4. Anchors: Place concrete thrust blocks conforming to the details shown on the Drawings at all bends, tees, plugs and other fittings to provide lateral support, except when restrained joints are specified.
5. Joint Compounds: Use no sulfur base joint compound.

B. Ductile Iron Pipe Joints:

1. Type: Make the joints of all pipelines absolutely tight, using joints approved by the Owner prior to installation. Where shown on the Drawings or where, in the opinion of the Owner, settlement or vibration is likely to occur, use bolted joints.
2. Mechanical Joints: Install mechanical joints in full conformance with manufacturer's recommendations, using only especially skilled workmen. Use torque wrenches set specified in AWWA C111, or spanner type wrenches not longer than specified therein.
3. Push On Joints: Install push on joints in strict, complete compliance with the manufacturer's recommendations, using lubricant, if required, shall be an inert, nontoxic, water soluble compound incapable of harboring, supporting, or culturing bacterial life.
4. Restrained Joints: Provide restrained joints at changes in direction of all ductile iron pipe water mains. Tees and dead ends valved or capped are considered equivalent of 90 degrees bends. Test pressure is recommended at 200 psi.
5. Thrust Blocks: Install thrust blocks as approved by Owner.

- C. Polyvinyl Chloride Pipe Joints: Assemble the joints absolutely tight and in conformity with the requirements of the pipe manufacturer. For threaded joints, wrap the male threaded end with Teflon pipe tape. At threaded joints between PVC and metal pipes, always use a metal socket end and PVC spigot. Do not, under any circumstances, screw a metal spigot into a PVC socket. Restrain all underground pressure pipe.
- D. Installing Valves and Boxes:
1. Valves: Carefully inspect, open wide and then tightly close the valves and test the various nuts and bolts for tightness. Take special care to prevent any foreign matter from becoming lodged in the valve seat. Unless shown otherwise, set valves with their stems vertically above the center line of the pipe. Remove and replace any valve that does not operate correctly.
 2. Valves Boxes: Carefully center valve boxes over the operating nuts of the valves so as to permit a valve key to be fitted easily to the operating nut. In areas to be paved, set valve boxes to conform to the level of the finished surface and hold in position by a ring of concrete placed under the support flange as shown on the Drawings. Set the valve box so that surface loads are not transmitted to the pipe or valve. Reset any valve box which is out of alignment or whose top does not conform to the finished ground surface. Before final acceptance of the work, adjust all valve boxes to finish grade.
- E. Concrete Encasement:
1. Provide concrete encasement of Class C (2500 psi) concrete in accordance with details shown on the Drawings where indicated or ordered by the Owner.
 2. Commence and end pipe encasement at not more than 6-inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads. Use Class C (2500 psi) concrete.
- F. Backfilling:
1. After pipe has been laid, inspected, and found satisfactory, place sufficient backfill along the pipe barrel to hold the pipe securely in place during hydrostatic testing. Place no backfill over joints until the testing is satisfactorily completed, leaving them exposed to view for the detection of visible leaks.
 2. Upon satisfactory completion of the hydrostatic test, complete backfilling of the trench.
- G. Concrete Protective Slabs: Where waterways, canals, ditches or other cuts are crossed, install protective concrete slabs across and to 10 feet each side of the

bottom. Place approved utility crossing signs on the pipe alignment at each side of the canal, waterway, etc.

3.03 INSTALLATION OF ANCHORAGES

- A. Anchorages: Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrants branches.

3.04 APPLICATION OF PROTECTIVE COATINGS

- A Apply full coat of asphalt or other acceptable corrosion-retarding material to surface of installed ferrous anchorage devices.

3.05 FIELD QUALITY CONTROL

- A. Flushing: Flush the water mains with water to remove all sand and other foreign matter, and dispose of the flushing water without causing a nuisance or property damage.
- B. Hydrostatic Tests in accordance with Section 15415.
- C. Disinfection of Potable Water Lines in accordance with Section 15410.

3.06 CONNECTION TO EXISTING SYSTEM

- A. Make all the connections to existing system mains under the direction of the owners of the existing system. Valves separating the mains being installed from existing mains will be operated by or under the directions of said owner's representative. Special disinfecting procedures shall be used in connection to existing mains and where the method outlined in Section 15410 is not practical.
- B. In the event the proposed main is to be connected to a main in which has one or more active services between the point of connection and the first existing line valve, install a temporary plug or cap on the new main until the pressure tests are complete.
- C. In the event any existing users will be without water while a connection is being made, notify them when the water will be turned off and the estimated time service will be resumed.

END OF SECTION

SECTION 02710
CONCRETE SIDEWALK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section included furnishing all labor, material, equipment, transportation and performing all work necessary for the construction of the sidewalks to the lines and grades as shown on Drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 – Site Preparation and Earthwork
 - 2. Section 03100 - Concrete Formwork
 - 3. Section 03200 - Concrete Reinforcement
 - 4. Section 03250 - Concrete Accessories
 - 5. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

- A. Submit, in accordance with general conditions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, certificates by the producers or manufacturers that the furnished materials meet the specific requirements of the Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

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- A. Concrete: Class B (3000 psi) conforming to the requirements of Section 03300.
- B. Welded Wire Fabric: As specified in Section 03200.
- C. Preformed Joint Filler: Non-extruding and resilient bituminous type conforming to the requirements of ASTM D 1751.
- D. Membrane Curing Compound: Clear fugitive dye conforming to the requirements of AASHTO M 148. Type I-D, Class A.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Subgrade Condition:
- B. Maintain the finished subgrade in a smooth, compact condition and restore any areas which are disturbed prior to placing of the concrete. Uniformly apply water ahead of the pouring operations as directed by the Engineer to keep the subgrade moist at the time the concrete is placed. Remove large boulders and other obstructions to a minimum depth of 6 inches below the finished subgrade elevation, and backfill the space with sand, base course material or other suitable material thoroughly compacted by rolling or tamping.
- C. Trim the subgrade accurately to the required elevation with a ¼- inch tolerance. Trim high areas to proper elevation. Fill low areas with suitable material and compact to the specified density, or fill with concrete integrally with the placing of the pavement.
- D. Setting Forms: Set the forms accurately to line and grade and so that they rest firmly throughout their length, upon the compacted subgrade surface. Join forms neatly and tightly and brace them to resist the pressure of the concrete and the finished operations. Obtain the Engineer's approval for the alignment and grade of all forms before and immediately prior to the placing of concrete.
- E. Slipforming: The slipforming method will be allowed, provided that an acceptable finished product, true to line, grade, and cross section is consistently produced.
- F. Mixing Concrete: Mix in accordance with the requirements of Section 03300.

3.02 INSTALLATION

- A. Placing Concrete:

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1. Distribute the concrete on the subgrade to such depth that when it is consolidated and finished, the thickness required by the Civil Engineering Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible and is continuous between transverse joints, without the use of intermediate bulkheads.
2. Final Finish: As soon as the water sheen has disappeared and just before the concrete becomes non-plastic, finish all edges, including expansion joint edges, with an edging tool having a radius of ½-inch. Finally give the top a light broom finish perpendicular to the forms.

B. Joints:

1. Transverse Construction Joints: Construct at the end of all pours and at other locations where the pouring operation is stopped for as long as 30 minutes, but not within five feet of any other transverse joint or of either end of a section of walk. If sufficient concrete has not been placed to form a slab at least five feet long, remove the excess concrete, back to the last preceding joint. Form the joints by placing a wood or metal bulkhead accurately and securely in place, in a plane perpendicular to the profile and center line of the walk. Tool edges of construction joints with a ½ -inch radius.
2. Transverse Construction Joints: Form at five foot intervals as planes of weakness created by an edging tool. Cut the fresh concrete perpendicular to the surface of the walk, to a depth of 1-1/2 inches below the top surface and tool edges to ½ -inch radius.
3. Transverse Expansion Joints: Form by placing preformed joint filler, one-half inch thick around all structures and at intervals not exceeding 100 feet.

C. Curing:

1. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, cover the entire surface and the edges of the newly placed concrete and cure with membrane curing compound.
2. Apply curing compound uniformly to the surfaces to be cured, in a continuous film, at the rate of application and in the manner recommended by the manufacturer.
3. Do not apply the curing compound during periods of rainfall. Should the film become damaged from any cause within the required curing period, immediately

repair the damaged portions with additional compound. Upon removal of side forms immediately coat the sides of the slabs exposed, providing a curing treatment equal to that provided for the surface.

- D. Form Removal: After the concrete has sufficiently set a minimum of 12 hours, remove the forms and backfill the space on each side. Compact and grade the earth in a satisfactory manner without damage to the concrete work. Fill honeycombs with sand cement mortar. Plastering will not be allowed on the face of the walk. Remove rejected walk and replace without additional compensation.

END OF SECTION

SECTION 02720
STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMAMRY

- A. This Section included furnishing all labor, material, equipment, transportation and performing all work necessary for the construction of the storm drainage system consisting of culverts, storm sewers, inlets and other drainage structures as shown on Drawings and specified herein.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02221- Excavating, Backfilling and Compacting
 - 2. Section 03410 - Precast Concrete Structures
 - 3. Section 02210 - Site Preparation and Earthwork

1.03 SUBMITTALS

- A. Submit shop drawings, product data, certifications, etc., in accordance with General and Supplementary Conditions and Division 1 Specifications Sections.
- B. Submit shop drawings for the following items:
 - 1. Grates and castings
 - 2. Precast structures
- C. Submit product data and certification of quality by producers prior to installation.

1.04 JOB CONDITIONS

Holden Heights Community Center

02720-1

STORM DRAINAGE SYSTEMS

CTHA Project 1204.00

- A. Existing Drainage System: Maintain operational, prevent siltation and flooding.
- B. Cleanup: Maintain surface grade within 400 feet of pipe laying operation.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete Pipe: Reinforced concrete culvert pipe conforming to ASTM C 76, Class III, unless otherwise indicated and reinforced concrete horizontal elliptical pipe conforming to ASTM C 507, Class HE III, with rubber gasket joints conforming to Sections 941 and 942 of FDOT Specifications.
- B. Brick: Dense, hard burned, shale or clay brick conforming to ASTM C 32, Grade MM or C 62, Grade MW, except with brick absorption between five and twenty-five grams of water absorbed in one minute by dried brick, set flat face down, in 1/8-inch of water.
- C. Cement Mortar: One part and two parts clean sharp sand with lime added in an amount not exceeding twenty-five percent of volume of cement. Mix dry and then wet to proper consistency for use. Use no mortars that have stood for more than one hour.
- D. Concrete: Class B (3000 psi) concrete conforming to Section 03300 unless otherwise indicated on Drawings.
- E. Precast Concrete Units: Units constructed in accordance with Section 03410 using Class (4000 psi) concrete.
- F. Ballast Rock: Locally procured ballast rock obtained from fresh water sources, washed free of deleterious matter, having not more than 45 percent loss of section as specified by AASHTO M63 governing the Los Angeles Abrasion Test, Showing not more than a 10 percent loss in 10 cycles as specified by AASHTO M 63 governing the soundness test, and meeting gradation requirements as specified by AASHTO M 43 for size number 24 (2-1/2 to 3/4 inch) or number 4 (1-1/2 to 3/4 inch).
- G. Pea Rock: Grave or crushed limerock with 100 percent passing the 1-inch sieve and not more than 5 percent passing the 1/4 inch sieve.
- H. Plastic Filter Fabric: Filter fabric conforming to Section 985 of the FDOT Specifications, and equal to Bidim By Monsanto Company. Typar by E.I. duPont

de Nemours or Carthage Mills Filter X.

PART 3 - EXECUTION

3.01 PREPARATION

A. Pipe Trenches:

1. Excavate the pipe trenches to the widths necessary for the proper laying of the pipe and keeping the banks as nearly vertical and sheeted, if required, with the clearance between the pipe and trench wall or back of sheeting not exceeding 18". Excavate the bottom of the trenches to a depth of the outside bottom of the pipe barrel and replace any over excavation with suitable compacted material. For inlets and other appurtenances, make the excavation with suitable compacted material. For inlets and other appurtenances, make the excavation sufficient to provide a clearance between their outer vertical surfaces and the face of the excavation, or sheeting if used, of not less than 12 inches.
2. Remove for the full width of the excavation soft, spongy, or otherwise unstable material encountered below the established grade of the excavation which will not provide a firm foundation for subsequent work and replace with approved fill material.
3. Where sheeting and bracing are necessary to prevent caving of the trench sidewalls of excavation for other structures, and to safeguard the workmen, excavate the trench or excavation for other structures to such width that the proper allowance is made for the space occupied by the sheeting and bracing to provide clearance as specified above.

3.02 INSTALLATION

A. Concrete Pipe

1. Install concrete pipe carefully, true to the line and grade shown on the Drawings. Any deviation from true alignment or grade which would result in a displacement from normal position of the gasket of as much as 1/4-inch, or which would produce a gap exceeding 1/2 inch between sections of pipe for more than 1/3 of the circumference of the inside of the pipe, will not be acceptable and where such occurs, remove and reinstall the pipe, will not be acceptable and where such occurs, remove and reinstall the pipe without additional compensation. Use no mortar, joint compound, or other filler

which would tend to restrict the flexibility of the gasket joint. Install pipes having defects that have not caused their rejection so that these defects will be in the upper half of the sheet.

2. Before installation of the pipe gasket, clean the gasket and the surface of the pipe joint, including the gasket recess free from grit, dirt, or other foreign matter. Application of an approved vegetable soap lubricant immediately prior to closing of the joint will be permitted.
3. Install all pipes with bells or grooves uphill. As the pipes are laid throughout the work, thoroughly clean and protect them from dirt and water. Lay no length of pipe until the two preceding lengths have been thoroughly embedded in place so as to prevent any movement or disturbance of the finished joint, and do not walk on or work over the pipes after they are laid, except as may be necessary in tamping earth and refilling, until they are covered to a depth of 1-foot. Place fill around the pipe on both sides simultaneously to approximately the same elevation and uniformly compacted. Whenever the pipe laying is discontinued, as at night, protect the unfinished end from displacement due to caving of the banks or from other injury and insert a suitable stopper.

B. Drainage Structures:

1. Construct concrete inlets and other structures in conformity with the Drawings. Design and construct forms so that they may be removed without injury to the concrete. Thoroughly compact the concrete and leave forms in place for at least 24 hours after concrete is poured. Cure the concrete for at least 5 days after removal of forms. Thoroughly clean honey-comb places, saturate with water and point up with mortar.
2. Precast inlets or other structures may be used in lieu of cast-in-place structures. Set grates in mortar to the proper line and grade.

3.03 BACKFILLING FOR PIPE AND STRUCTURES

- A. After the pipe has been installed, place approved select material from excavation at a moisture content which will facilitate compaction alongside the pipe in layers not exceeding 6" loose measure in depth. Thoroughly compact the fill under the haunches of the pipe and compact each layer by rolling or tamping with mechanical rammers. Continue this method of filling and compacting until the fill is 12" above the pipe, then place the remainder of the backfill in lifts not exceeding 9". Operate heavy equipment in a manner so that no damage to the pipe will result. Compact backfill material 12 inches and more above the top of the pipe to not less than 95 percent of maximum density as determined by AASHTO T 180.

Tests for density of compaction may be required at the option of Owner. Correct deficiencies without additional cost to Owner.

- B. Place and compact backfill for drainage structures in the same manner as specified above for pipe, except allow the concrete to cure for not less than five days before placing the backfill.
- C. Backfilling in Wet Trenches: After the installation of the pipe and drainage structures, place backfill material carefully, uniformly and simultaneously on both sides of the pipe or structure by carefully lowering the material into the trenches down to the water surface and then releasing it to settle through the water. Do not, under any circumstances, dump, push or shove backfill material into the wet trench. Carefully ram backfill material around both sides of the pipe to properly bed and support the pipe. No specified density will be required in wet trenches until the fill has reached a level 1 foot above the water, at which elevation and above the backfill densities specified above will apply.

END OF SECTION

SECTION 02730
SANITARY SEWERAGE SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Section, apply to this Section.

1.02 SUMMARY

- A. This Section included furnishing all labor, materials, equipment, transportation and performing all work necessary to complete excavation, backfilling and grading as required for the construction of a complete system of sanitary sewer system consisting of pipes, manholes and appurtenant items as shown on Drawings and as specified herein.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02220 - Excavating, Backfilling, and Compacting:
 - 2. Section 03400 – Precast Concrete Structure
 - 3. Section 03600 - Grout

1.03 QUALITY ASSURANCE

- A. Design Requirements:
 - 1. Install all sewer mains with a minimum cover of 36 inches below finished grade, unless otherwise indicated.
 - 2. Construct sewer mains of the materials indicated on Drawings, unless otherwise directed by Owner.
 - 3. Pipe used in gravity sewer construction shall be polyvinyl chloride (PVC) or ductile iron pipe (DIP). Where reference is made to an ASTM, ANSI, or AASHTO designation, it shall be the latest revision.

- B. Pipe Inspection: Obtain from each pipe manufacturer a certificate of inspection to the effect that the pipe and fittings supplied for this contract have been inspected at the plant and that they meet the requirements of these specifications. Visually inspect all pipes and fittings at time of delivery and just before they are lowered into the trench to be laid. Reject and remove pipe, joints or fittings that are damaged or that do not conform to these Specifications.

1.04 SUBMITTALS

- A. Submit shop drawings, working drawings and samples in accordance with general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections.

PART 2 - PRODUCTS

2.01 GRAVITY SEWER PIPES

A. PVC Pipe:

1. PVC Gravity Sewer Pipe (4"-15"), ASTM D3034, SDR 35. Uniform minimum "pipe stiffness" at five (5) percent deflection shall be 46 psi. The joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. Applicable UNI-Bell Plastic Pipe Association standard is UNI-B-4.
2. PVC Gravity Sewer Pipe (18" - 27"), ASTM F679, SDR 35. Uniform Minimum "pipe stiffness" at five (5) percent deflection shall be 46 psi. The joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. Applicable UNI-Bell Plastic Pipe Association standard is UNI-B-7.
3. All PVC pipe shall bear the NSF-DW seal. The minimum standard length of pipe shall be thirteen (13) feet.

B. Ductile Iron Pipe

1. Ductile iron pipe shall conform to ANSI/AWWA A21.51/C151, class thickness designed per ANSI/AWWA A21.50/C150, with mechanical or push on joints. An interior protective lining of coal tar epoxy shall be provided with a minimum dry thickness of 30 mils. Ductile iron gravity sewers, where shown on the drawings, shall be wrapped with polyethylene film, AWWA C105. The minimum standard

length of pipe shall be eighteen (18) feet.

2.02 JOINT MATERIALS

A. PVC Pipe

1. PVC sewer pipe joints shall be flexible elastomeric seals per ASTM D 3212.

B. Ductile Iron Pipe

1. Ductile iron pipe and fitting joints shall be "push-on" or mechanical joints conforming to ANSI A21.11.

C. Joints For Dissimilar Pipe

1. Joints between pipes of different materials shall be made with a flexible mechanical compression coupling with No. 304 stainless steel bands.

2.03 PIPE FITTINGS

- A. Unless otherwise specified, wye branches shall be provided in the gravity sewer main for service lateral connections. Wyes shall be six (6) inches inside diameter, unless otherwise approved by Owner. All fittings shall be of the same material as the pipe.

- B. Plugs for stub outs shall be of the same material as the pipe, and gasketed with the same gasket material as the pipe joint, or be of material approved by Owner. The plug shall be secured to withstand test pressures specified in these specifications.

2.04 MANHOLES

- A. General: Manholes shall be leak-tight and constructed of pre-cast concrete units.

B. Pre-cast Concrete Sections

1. Pre-cast manholes shall conform to specifications for Pre-cast Reinforced Concrete Manhole Sections, ASTM Designation C478, except as otherwise specified below.

2. The minimum wall thickness shall be 5 inches. Pre-cast manholes shall be constructed with a pre-cast monolithic base structure as shown on Standard Details Drawings. The minimum base thickness shall be 8 inches.

3. Concrete for manholes shall be Type II, 4000 psi at 28 days. Barrel, top and base sections shall have tongue and groove joints. All jointing material shall be cold adhesive preformed plastic gaskets, conforming with FDOT Article 942-2..
4. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on each pre-cast section.
5. Pre-cast concrete top slabs shall be used where cover over the top of the pipe is less than 4 ft. Lift rings or non-penetrating lift holes shall be provided for handling pre-cast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the manhole sections.
6. Concrete surfaces shall have form oil, curing compounds, dust, dirt and other interfering materials removed by brush sand blasting and shall be fully cured prior to the application of any coatings.
7. Interior surfaces of manholes shall have a protective epoxy coal tar coating with a minimum dry mil thickness of 16 mils. Exterior surfaces shall have a protective epoxy coal tar coating with a minimum dry mil thickness of 9 mils. Coatings shall be applied in two (2) applications by the manhole manufacturer in strict accordance with the paint manufacturer's recommendations.

C. Castings

1. Gray iron castings for manhole frames, covers, adjustment rings and other items shall conform to the ASTM Designation A 48, Class 30. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects which would impair their strength, or otherwise make them unfit for the service intended. The seating surfaces between frames and covers shall be machined to fit true. No plugging or filling will be allowed. Lifting or "pick" holes shall be provided, but shall not penetrate the cover.
2. Casting patterns shall conform to those shown or indicated on the Standard Details. All manhole frames and covers shall be traffic bearing to meet AASHTO H-20 loadings. Frames shall be suitable for the future addition of a cast iron ring for upward adjustment of top elevation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Trench Preparation And Pipe Bedding

1. Contractor shall hand-grade bedding to proper grade ahead of pipe laying operation. Bedding shall provide a firm, unyielding support along the entire pipe length.
2. If without direction from Owner, the trench has been excavated below the required depth for pipe bedding material placement, Contractor shall fill the excess depth with pipe bedding material to the proper grade.
3. Contractor shall excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Contractor shall provide pipe bedding material in accordance with the Standard Details Drawings

B. Gravity Pipe And Water Main Separation

1. Gravity sewers that are laid in the vicinity of pipe lines designated to carry potable water shall meet the horizontal (10 feet) and vertical (18 inches) separations.

3.02 PLUGS AND CONNECTIONS

- A. Plugs for pipe branches, stubs or other open ends which are not to be immediately connected shall be made of an approved material and shall be secured in place with a joint comparable to the main line joint.

3.03 PIPE JOINTING

- A. PVC sewer pipe joints shall be flexible elastomeric seals per ASTM D 3212.4.
- B. Ductile Iron Pipe and fittings joints shall be "push-on" or mechanical joints conforming to ANSI A21.11.

3.04 MANHOLES

A. Bedding

1. Base sections shall be placed on bedding rock firmly tamped and made smooth and level to assure uniform contact and support of the pre-cast element.

B. Cast in place bases

1. Unless otherwise specified, cast-in-place bases shall be at least eight (8) inches in thickness and shall extend at least six (6) inches radially outside of the outside dimension of the manholes section. Reinforcement and connection to the riser

sections shall be designed by Contractor and submitted to Owner for approval.

C. Pre-Cast Manholes

1. A pre-cast base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment and making sure that all entering pipes can be inserted on proper grade.
2. Pre-cast manhole sections shall be handled by lift rings or non-penetrating lift holes. Such holes shall be filled with non-shrink grout after installation of the manhole.
3. The first pre-cast section shall be placed and carefully adjusted to true grade and alignment. All inlet pipes shall be properly installed so as to form an integral watertight unit. The sections shall be uniformly supported by the base structure, and shall not bear directly on any of the pipes.
4. Pre-cast sections shall be placed and aligned to provide vertical alignment with a 1/4-inch maximum tolerance per 5 feet of depth. The completed manhole shall be rigid, true to dimensions, and watertight.

D. Placing Castings

1. Casting shall be fully bedded in mortar with adjustment brick courses placed between the frame and manhole. Bricks shall be a minimum two (2) and maximum four (4) courses. Mortar shall conform to ASTM C-270, type M, and the bricks shall be clay and conform to ASTM C-216, grade SW, size 3 1/2" (w) x 8" (L) x 2 1/4" (h).
2. Top of manhole castings located in pavement, shouldered areas, and sidewalks shall be set flush with grade. Top of manhole castings located outside these areas shall be placed 2" above grade.

E. Channels

1. Manhole flow channels shall be as shown in the STANDARD DRAWINGS, with smooth and carefully shaped bottoms, built up sides and benching constructed using cement and brick with no voids. Channels shall conform to the dimension of the adjacent pipe and provide changes in size, grade and alignment evenly. Cement shall be Portland Cement Type II only.

F. Pipe Connections

1. Special care shall be taken to see that the openings through which pipes enter the structure are provided with watertight connections.

2. For ductile iron and PVC pipe, connections shall conform with ASTM C 923, "Standard Specifications for Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes."
3. For concrete pipe connection shall be made with non shrink nonmetallic grout.

3.05 INSPECTION AND TESTING

A. General

1. Each length of pipe shall bear the name or trademark of the manufacturer, the location of the manufacturing plant, and the class or strength classification of the pipe. The markings shall be plainly visible on the pipe barrel. Pipe which is not marked clearly is subject to rejection. All rejected pipe shall be promptly removed from the project site by the Contractor.

B. Miscellaneous Inspection And Testing Requirements

1. All pipe and accessories to be installed under this Contract shall be inspected and tested at the place of manufacture by the manufacturer as required by the Standard Specifications to which the material is manufactured.
2. Each length of pipe shall be subject to inspection and approval at the factory, point of delivery, and site of work. If requested by Owner, a sample of pipe to be tested shall be selected at random by Owner or the testing laboratory hired by Owner.
3. When the specimens tested conform to applicable standards, all pipe represented by such specimens shall be considered acceptable based on the test parameters measured. Copies of test reports shall be available before the pipe is installed in the project.
4. In the event that any of the test specimens fail to meet the applicable standards, all pipe represented by such tests shall be subjected to rejection.
5. The Contractor may furnish two additional test specimens from the same shipment or delivery, for each specimen that failed and the pipe will be considered acceptable if all of these additional specimens meet the requirements of the applicable standards. All such retesting shall be at the Contractor's expense.
6. Pipe which has been rejected by Owner shall be removed from the site of the work by the Contractor and replaced with pipe which meets these specifications.

30.6 CLEANING

- A. All newly constructed manholes shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection.

3.07 INSPECTION FOR ACCEPTANCE

- A. No visible leakage in the manhole or at pipe connections will be permitted. All manholes shall be inspected by Owner prior to acceptance. All manholes failing to meet the specification shall be reconstructed or replaced by the Contractor to comply with these specifications. Pressure grouting of manholes for repair shall not be accepted.

END OF SECTION

SECTION 02810
IRRIGATION SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. The work covered under this section includes supplying and installing all materials and equipment required for a complete operational automatic irrigation system.
- B. The information herein contained indicates the types of materials, quality of workmanship, and manner of protection, which shall be complied with in effecting the irrigation system.
- C. Completion of work shall mean the full and exact compliance and conformity with all the provisions of the Contract Documents.

1.2 SUBMITTALS

- A. Provide manufacturer's product data sheets for each item specified.
- B. Samples shall be specifically required for non-specified manufacturer's products submitted as a substitution.
- C. Product certificates shall be required by manufacturers for products not specifically named on plans or in specifications certifying that each product furnished meets this specification, specifications shown on drawings and any individual project requirements for the purpose intended.
- D. Provide complete materials list.

1.3 RELATED WORK

- A. The Contractor shall fully acquaint himself with related planting, paving, site, and utilities work described elsewhere in the Contract Documents to preclude any misunderstandings and to facilitate a trouble-free irrigation system.
- B. Electrical service to controller shall be provided by electrical subcontractor and shall be in compliance with NEC requirements. Coordinate with DIVISION 16 for voltage requirements.
- C. See SECTION 02900 - LANDSCAPING and SECTION 02930 - GRASSING
- D. See DIVISION TWO – EARTHWORK (and related referenced sections) for excavating, trenching and backfilling.

1.4 QUALITY ASSURANCE

- A. Landscape irrigation system installation shall only be performed by a firm that has a minimum of five (5) years full time experience with similar projects in the installation of underground landscape irrigation systems. The firm shall be state certified or a licensed sub-contractor or a locally registered subcontractor in Orlando, Florida. Crews shall be controlled and directed by a foreman who is thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation.
- B. Manufacturer's Qualifications: Employ only manufacturers with at least five (5) years experience making the specified materials as a current catalog and regular production item.

1.5 DESIGN MODIFICATIONS

- A. Slight layout modifications may be made only as necessary to meet field conditions and only as acceptable to the Architect. Piping shown on drawings is diagrammatically routed for clarity - route to avoid conflict with specimen plants and adjust as necessary to landscape construction.
- B. Design Criteria: The Architect shall have the right, at any stage of the operations, to reject any and all work and materials that, in his opinion, do not comply with the requirements of the Contract Documents. Such rejected work or material shall be immediately removed from the site and acceptable work or material substituted in its place.
- C. Contractor shall be responsible for verification at the site of all conditions and dimensions shown on the drawings prior to commencement of work.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

- A. Work shall comply with applicable codes, ordinances and regulations of all governing authorities including the current Florida Building Code.

1.7 AS-BUILT DRAWING/CLOSEOUT SUBMITTALS

- A. After completion of piping installation, the Contractor shall furnish to the Architect a reproducible "AS-BUILT" drawing showing all sprinkler heads, valves, and pipelines to reasonable scale, and provide a minimum of two dimensions taken from fixed obvious objects to point of connection, directional turns of all mainline piping, each automatic and manual control valve, and quick coupling valve. The plans shall be provided on or before the date of work review for provisional acceptance.

1. The Contractor shall also furnish a drawing showing a graphic representation of sprinkler zones and recommendations for controller time settings for each valve.
- B. Instruction sheets and parts lists covering all operating equipment shall be bound into folders and furnished to the Architect.
- C. Backflow preventer test report (passing) – See 2.11.A. this section.

1.8 UTILITIES

- A. Prior to excavation, verify in the field the location and depth of all new and existing utilities and other work that may be damaged by the Contractor's construction.

1.9 GUARANTEES

- A. The Contractor shall furnish warranties, in writing, certifying that the quality and workmanship of all materials and installation furnished is in accordance with the Contract Documents, Division One of the Project Manual and in accordance with the original manufacturer's warranties.
 1. The Contractor shall be responsible for the fulfillment of all manufacturers' warranties.
 2. The Contractor shall guarantee materials and workmanship for a period of one year from date of granting Substantial Completion by Owner or as stated in Division One of the Project Manual, whichever is greater.
- B. The Contractor is responsible for protection of the work until the date of Final Completion.
- C. The Contractor shall provide the Owner with a written guarantee.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials and equipment shall be new and shall operate at the manufacturer's published capacities.

2.2 PIPE

- A. Comply with the following unless otherwise indicated: All PVC mainline pipe shall be CL 200 ASTM D-2241 or Schedule 40 ASTM D-1785, all PVC lateral pipe shall be CL 200 ASTM D-2241 or Schedule 40 ASTM D-1785 PVC, Type 1, NSF approved.
- B. All crossings (sleeves) under paved areas shall be Schedule 40 PVC, ASTM D-1785.

- C. For PVC plastic pipe, ASTM D-2466 socket fittings with ASTM A-2564 solvent cement.

2.3 CONTROLLER

- A. The Contractor shall furnish electric controller(s) as indicated on the drawings and as specified herein.
 - 1. The controller(s) shall be installed in the area(s) shown on the drawings.
 - 2. All electrical connections are the responsibility of the Contractor.
 - 3. A typewritten plastic laminated legend shall be attached inside the controller(s) door stating the areas covered by each remote control valve.

2.4 SPRINKLER HEADS

- A. Sprinkler heads and drip tubing shall be of the type shown or scheduled on the drawings.

2.5 RISERS AND SWING JOINTS

- B. Risers and swing joints shall be as detailed on the drawings.

2.6 FLEX CONNECTIONS

- C. These connections shall be PVC flex pipe with glued fittings, or approved equal.

2.7 GATE VALVES

- A. Shall be all brass body, or approved equal.

2.8 REMOTE CONTROL VALVES

- A. Valves shall be as specified on the drawings. Use Teflon tape only on threaded connections.

2.9 VALVE BOXES

- A. Valve boxes (bodies and covers) shall be 11" x 17" or 12" x 17" rectangular box as shown in the details or approved equal installed flush with finish grade.

2.10 CONTROL WIRING

- A. All wiring to automatic circuit valves shall be UF-14 (14 gauge) UL approved, direct burial wire of a different color than the black and white wires used on the 115 volt AC power.
- B. Wiring from the controller to the valves shall be installed in same trench as the mainline where possible. Where wires are not placed in the trench with the mainline, install in schedule 40 PVC conduit, minimum of 18" below grade.
- C. All splices shall be made with King "One-step"(Tan) connectors, or approved equal.
- D. All wire shall be furnished in minimum 2,500' reels and spliced only at valve or tee locations. All splices shall be contained in a valve box.

2.11 BACKFLOW PREVENTER

- A. Backflow preventer shall be of the type shown on drawings. Installation shall comply with applicable regulatory agencies. The backflow preventer shall be approved by the City of Orlando and the applicable Water Management District and a passing test report shall be provided to the Owner.

2.12 SOLVENT CEMENT/SOLVENT & CLEANER

- A. Solvent Cement shall comply with ASTM A 2546.
- B. Solvent and cleaner: Uni-weld 1600. Solvent and cleaner for flex pipe to be specifically for PVC flex pipe.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Contractor must examine the areas and conditions under which landscape irrigation system is to be installed and notify the Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 COORDINATION

- A. Contractor shall install crossings (sleeves) under paved areas (such as sidewalks, roadways and parking lots) as indicated.
- B. Crossings shall be installed prior to construction of paving.

- C. The Contractor shall be responsible for coordinating his work with all other parties involved with the project, and shall coordinate the supply of electrical power to the Timing Device (controller) and tie-in into grounding system.
- D. The Contractor shall be responsible for full and complete coverage of all irrigated areas and shall make any necessary minor adjustments at no additional cost to the Owner.

3.3 EXCAVATING AND TRENCHING

- A. Perform all excavations as required for the installation of the work included under this section, including shoring of earth banks to prevent cave-ins. Where major root systems of large existing trees are encountered, including roots 4" diameter or larger, tunnel to avoid cutting the roots.
- B. Restore all surfaces, existing underground installations, damaged or cut as a result of excavations to their original conditions.
- C. Trenches for pipelines shall be made of sufficient depth to provide the minimum cover from finish grade as follows:
 - 1. 24" minimum cover over main lines.
 - 2. 24" minimum cover over control wires.
 - 3. 18" minimum cover over lateral lines to heads.
- D. Where possible, install pipe adjacent to curbs or paving to minimize interference with plants and their roots.
- E. Keep trenches free of obstruction and debris. Remove excess soil from the site and leave grade as it was prior to irrigation system installation.
- F. Piping shall be routed around shrubs, trees and other permanent obstacles.

3.4 PIPE LINE ASSEMBLY

- A. Install plastic pipe as recommended by the manufacturer and provide for expansion and contraction. Cut plastic pipe square. Remove burrs at cut ends prior to installation so that a smooth unobstructed flow will be obtained. Provide continuous support of the pipe using an unobstructed even trench bottom that is free of debris.
- B. Install remote control valves at locations no closer than 12" to weld edges, buildings, and walls. Plastic pipe fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush. Care should be taken not to use an excess amount of solvent, thereby causing a burr or obstruction to form on the inside of the pipe. Allow the joints to set at least 24 hours before applying pressure on PVC

pipe. Flush main and lateral piping on irrigation system to clean out all debris and sediment prior to the installation of heads and nozzles.

- C. Sprinkler heads shall be installed so that the top is slightly above finish grade. If finish grade has not been established, set the top of the sprinkler head 4" above grade and lower the sprinkler head when finish grade has been established and sod/mulch has been installed. Heads along curbs and walks shall be set flush to within 1/8" and 6" away from curb or walk. Heads and piping adjacent to buildings shall be a minimum of 12" off face of building. No application of water shall be made within 12" of the exterior building walls. Adjust heads having an adjustment stem, for the proper radius and throw for the area involved. Do not allow over-spray on buildings, walkways or on motor vehicles.
- D. All control wires shall be installed in a neat and orderly fashion underneath the main and lateral pipes, if possible. 10" loops shall be provided at each valve where control wires are connected.
- E. All piping and wiring passing under existing or future paving, construction, etc., shall be encased in sleeving as specified, extending at least 12" beyond edges of paving base or construction.
- F. Install warning tape directly above pressure piping, 12 inches below finish grade except under paving or slabs or where depth shall be 6 inches.

3.5 BACKFILLING AND COMPACTING

- A. After pressure testing is complete and systems are approved, or sections thereof, backfill excavations and trenches with clean soil, free of rubbish. Dress off all areas to finish grades. Repeat backfilling as required due to settlement.
- B. Balance and adjust the irrigation system components for efficient, proper operation. This includes controller synchronization as well as individual controller stations, valves and sprinkler head adjustments. Do not allow over-spray on buildings, walkways or other paving or on automobiles.

3.6 RAIN SENSOR

- A. Install rain sensor on exposed surface that is unobstructed from rainfall. Install rain sensor control wiring in rigid conduit.

3.7 LABELS

- A. Number each zone valve box on inside of valve box with a black waterproof marker for reference. Numbers shall match the zone numbers on the drawings.
- B. Number each zone valve control wire at the controller with a waterproof marker and tags. Numbers shall match the zone numbers on the drawings.

3.8 PRESSURE TESTING/SYSTEM DEMONSTRATION

- A. All piping, connectors and valves shall be hydrostatically pressure tested. The mainline test shall last for a minimum of six (6) hours at 100 PSI. All leak areas and equipment shall be replaced and the system shall be re-tested until no leaks are found. All testing shall be done before backfilling trenches.
- B. Provide a complete demonstration to the Owner's Authorized Representative of the operation of all components of the irrigation system as part of Close Out procedures.
- C. Provide complete typewritten instructions for operation including recommended watering times, duration and preventative maintenance.

3.9 MAINTENANCE

- A. Maintain the irrigation system until the date of Final Completion.
- B. Maintenance shall include work, materials and replacements necessary to insure a complete properly operating system.

3.10 OWNERS RESPONSIBILITY FOR MAINTENANCE

- A. It is be the Owner's responsibility to maintain the system in working order during the guarantee period, performing necessary minor maintenance, keeping grass from obstructing the sprinkler heads and preventing vandalism and damage during the landscape maintenance operation.

3.11 CLEAN-UP

- A. Upon completion and prior to inspection of the work, clear the site of debris, superfluous materials and equipment.

END OF SECTION 02810

SECTION 02831
CHAIN LINK FENCES AND GATES (VINYL CLAD)

PART 1 - GENERAL

1.01 REALTED DOCUMETNS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section,

1.02 SUMMARY

- A. This Section included furnishing all labor, material, equipment, transportation and performing all work necessary for the construction of a vinyl coated galvanized steel chain link fence, nominally 4-feet high, complete with gate as shown on the Drawings.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Fabric: 60 inches high, No. 9 gauge galvanized wire coated with a 7 mil coating of dark green vinyl, woven in a 2-inch mesh with top and bottom selvages barbed. Use steel wire uniformly galvanized in accordance with ASTM A 641, Class I coating.
- B. Posts and other Appurtenances: Pipe sections conforming to ASTM A 53, hot dipped galvanized with a minimum of 1.8 ounces per square foot of surface and then vinyl coated.
- C. Sizes of Posts, Gate Frames and Rails: Use posts, frames and rails conforming to the following sizes. Square posts, frames and rails conforming to the following sizes. Square posts and frames may be substituted for the listed members if test data can be supplied to show equal or greater bending strength. Dimensions below do not include vinyl coating thickness.

DIMENSIONS IN INCHES

<u>Designation</u>	<u>Nominal Diameter</u>	<u>Outside Diameter</u>	<u>Thickness</u>	<u>Pounds Per Foot Plain Ends</u>
1. End, corner & pull posts:	2 1/2	2.875	0.203	5.79
2. Gate posts (one leaf width over 13 feet):	6	6.625	0.280	18.97
3. Gate posts (one leaf width 6 feet to 13 feet):	3 1/2	4.000	0.226	9.11
4. Gate posts (one leaf width 6 feet or less)	2 1/2	2.875	0.203	5.79
5. Intermediate posts:	2	2.375	0.154	3.65
6. Gate frames:	1 1/2	1.900	0.145	2.72
7. Braces	1 1/4	1.660	0.140	2.27
8. Top rails:	1 1/4	1.660	0.140	2.27

A. Gates:

1. Swing Gates: Provide gates with frames constructed of round or square tubular members continuously welded at all corners or assembled with fittings and vinyl coated, with gate filler of same fabric as the fence and attached securely to the gate frame at intervals not exceeding 14 inches, with hinges of adequate strength for the gate and with large bearing surfaces for clamping in position, so that the hinges do not twist or turn under the action of the gate. Provide gates that are easily operable by one person, and provide latches, stops and keepers for all gates, with provision for padlocking.
2. Padlock: Schlage No. 45-101 case-brass, shackle-case hardened steel, 1-inch length with 9 inches of chain, 606 finish and keyed alike when more than one, unless otherwise specified or noted on the Drawing.

B. Top Rail: Vinyl coated with couplings of the outside sleeve type, at least 6-inches long, approximately every 20 feet.

C. Concrete: Class B (3,000 psi) conforming to Section 03300.

D. Hardware: Steel, malleable iron or ductile iron of standard design and conforming to the requirements of the Chain Link Fence Manufacturer's Institute, with all parts

galvanized except ties and clips may be of aluminum and vinyl coated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clearing: Provide the necessary clearing for installation of the fences and for access to the work.

3.02 ARRANGEMENT

- A. Posts: Install posts uniformly spaced, not to exceed 10-feet on centers with intermediate posts having waterproof tops and integrally cast openings through which the top rails shall pass.
- B. Braces: Provide at each gate, corner, pull and end post.
- C. Top Brace Rails: Securely fasten the top brace rail to the terminal posts and line posts by heavy pressed steel brace bands and malleable end connections.
- D. Top and Bottom Tension Wire: coiled spring No. 9 gauge galvanized steel wire coated with 7 mils of vinyl, stretched taut between terminal posts and securely fastened to each intermediate post 2 inches below top of fabric and 6 inches above the finish grade line respectively. Attach tension wires to the fence fabric with 9 gauge wire vinyl clad hog rings every 24 inches.
- E. Stretcher Bars: 3/16-inch x 3/4-inch minimum in cross section and having a minimum length 2 inches shorter than the fabric height. Use stretcher bars for attaching the fabric to all terminal posts by threading through the fabric and attaching to the posts with 11 gauge tension bands, or other positive mechanical means, spaced at 12-inch centers. Provide one stretcher bar for each gate and end post and two for each corner and pull post.
- F. Ties and Clips: Fasten fabric to all intermediate posts with 9 gauge tie wires coated with 7 mils of vinyl, spacing not to exceed 14-inches apart and to top rail with 9 gauge tie wires vinyl clad with spacing not to exceed 24 inches on centers.

3.03 INSTALLATION

- A. Post Setting: Set line posts in holes 12 inches in diameter, 38 inches deep with 36-nch post embedment, terminal posts in holes 15 inches diameter, 38 inches deep with 36-inch post embedment and after the post has been set and plumbed, fill the hole with concrete. Crown the exposed surface of the concrete to shed water.

- B. Terminal and Gate Posts: Set as specified above and brace to the nearest post with a galvanized horizontal brace used as a compression member and a galvanized 3/8-inch steel truss rod and truss tightener used as a tension member.
- C. Fabric and Tension Wires: Do not stretch fabric and tension wires until concrete footings have cured a minimum of three days. Place chain link fabric on the side designated by Owner and stretch taut approximately 2 inches above finish grade, then securely fasten to all posts and tension wires. Join rolls of wire fabric by weaving a single strand into the ends of the rolls to form a continuous mesh.

END OF SECTION

SECTION 02900
LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes provisions for furnishing all labor, materials and supervision required for the installation and establishment of all trees, shrubs, groundcovers, grassing and associated work of the species, size and quality indicated herein and on the drawings.
- B. Work shall include fine grading, taxes and permits.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Section 02810 - Irrigation System
- C. Section 02930– Sodding

1.3 QUALITY ASSURANCE

- A. General: Comply with applicable standards.
- B. Grades and Standards for Nursery Plants, Latest Edition, Division of Plant Industry, Florida Department of Agriculture and Consumer Services.
- C. American Standard for Nursery Stock, ANSI Z60.1, Latest Edition, American Nursery and Landscape Association.
- D. All Federal, State, and Local Governing Agency requirements and industry standards applicable to this section are hereby made part of this specification.
- E. Work shall not commence until all permits applicable to this section have been secured.
- F. The Owner's Representative or Landscape Architect shall have the right at any stage of the construction operation to reject any and all work and materials, which, in their opinion, do not meet the requirements of these specifications. Such rejected work and materials shall be immediately removed from the site and replaced in an acceptable manner.

- G. Substitutions permitted only upon submission of proof that any specified plant is not obtainable or suitable for the location as specified on the plan and upon written authorization.
- H. All work to be provided by personnel familiar with planting procedures and under the supervision of a qualified and experienced foreman who shall be at the site when planting operations are in progress.
- I. Provide certification by a Florida Division of Plant Industry representative or other approved independent certified horticulturist, botanist or agricultural laboratory that all materials comply with specified genus, species, variety, grade and standard.

1.4 SUBMITTALS

- A. Provide for approval a Planting Installation Schedule showing dates for starting each type of planting in each area of the site. Coordinate with other work on site and submit for approval. Schedule to be approved prior to construction kickoff meeting. Update schedule periodically to be consistent with overall project schedule.
- B. Prior to starting work, submit photographs of representative quality of all trees and shrubs to be installed. Submit the source and location of supplier of all materials. All plant materials shall be available at the source for inspection prior to delivery to the site. Submit three plants of each shrub or ground cover 7 gallons or less as specified for approval by the Owner's Representative and as a representative size, specification and plant type for all plants to be installed. Representative plants to be planted at the site for comparison. All plants not equal or better than the accepted sample shall be rejected. All trees shall be pre-tagged by the Owner's Representative and Landscape Architect prior to delivery to the site and planting.
- C. Provide a list of all non-plant materials to be installed on the job, listing quantity and specification.
- D. Submit samples, certificates and reports a minimum of two weeks prior to the installation of any of the materials. Work shall not begin until the Owner's Representative has approved all submittals. Submittals required, but not limited to the following:
 - 1. Existing soil analysis test report
 - 2. Prepared planting soil analysis test report and sample
 - 3. Plant samples and photographs
 - 4. Mulch
 - 5. Sod
- E. Submit manufacturer's cut sheets and analysis for all non-plant materials, including erosion control fabric, herbicides, drainage gravel, and ADS pipe.
- F. Submit soils test report and recommendations on soil samples taken from site after clearing of native vegetation and all fill is placed.

- G. Submit a proposed planting schedule indicating sequence of planting for each area of the site and state time anticipated for each installation operation.

1.5 WARRANTY

- A. Warranty all plant materials, except turf grass, for a period of one year from the date of substantial completion against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner and their agent, abuse or damage by others, or unusual phenomena which are beyond the Contractor's control. The warranty shall be submitted in writing to the Owner and shall state the name of the Owner, provide full guarantee terms, effective and termination dates, name of contractor providing guarantee, address, and telephone number. It shall be signed by the chief executive of the company and shall be notarized.
- B. Plants that show indication of probable non-survival or lack of health and vigor, or at anytime do not exhibit the characteristics to meet the specifications or Grades and Standards, shall be replaced immediately or within two weeks of notice from the Owner's Representative or Landscape Architect. All replacement plants shall be furnished and installed at no additional cost to the Owner. Replacement plants shall be guaranteed until the end of the guarantee period, but not less than 6 months. All replacements shall meet original specifications.

1.6 PROTECTION

- A. Provide and maintain all necessary safeguards for the protection of the public and protect all materials and work against damage from any cause. The Contractor shall be held responsible for any damage, disruption of service, cost of restoration, work of other trades at the site or injury to persons or property that may occur as a result of his negligence in the course of the work. The Owner's designated contractor shall restore any damage and the cost of this will be paid by the Contractor.

1.7 EXISTING CONDITIONS

- A. The plans show conditions as they are believed to exist and are not intended as a representation by or on behalf of the Owner that such conditions actually exist. The Contractor shall inspect the job site prior to any work, report all differences and unsatisfactory conditions to the Owner's Representative and Landscape Architect for instructions to proceed. Do not proceed until conditions have been corrected satisfactorily. All unfavorable conditions encountered during the execution of the work shall be brought to the immediate attention of the Owner's Representative.
- B. Locate all utilities, subsurface drainage and underground construction prior to commencing any work. Properly maintain and protect all utilities in place. Hand excavate within 5' of all utilities.

- C. Repair immediately any damage to the work of others caused in the course of work including, but not limited to, utilities, structures, pavement, proposed and existing grades, proposed and existing vegetation.
- D. Dispose of any objectionable materials encountered during the installation operations.
- E. Coordinate work with all other parties involved with the job.
- F. Maintain grade stakes set by others until parties concerned mutually agree upon removal.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

- A. Provide plant materials as designated on the Plant List on the drawings of a minimum of Florida Grades and Standards No. 1. Plants shall be supplied in containers no less than the size specified. All plants shall be typical of their species and variety; sound, healthy and vigorous, well branched and shaped within normal habit of growth, of proper color, and densely foliated when in leaf. Plants shall have healthy, well-developed root systems that completely bind all of the soil in their containers, but shall not be root bound and shall be free of disease and insect pests, eggs, or larvae.
- B. Trees: Symmetrically and uniformly branched on all sides, typical of habit of growth for the species. Multiple trunk trees shall have several main trunks well balanced around an imaginary central axis, emanating from a compact group of trunks at soil level, to produce a vase shaped branching structure. Standard trees shall have a single straight trunk and well-developed main leader. Trees that have been topped will not be accepted. Provide height, caliper and clear trunk shown on plans and schedules. All specified sizes are minimum. Caliper to be taken six (6) inches above ground level up to and including four (4) inch caliper trees and twelve (12) inches above ground level for larger trees.
- C. Shrubs and Groundcovers: Of the height and spread as shown and listed and with not less than minimum number of canes, pips or runners specified and required by ANSI Z60.1 for type and height of plant required.
- D. Palms and Cycads: Of the height and spread as shown and listed and consistent with Florida Grades and Standards No. 1.

2.2 PLANTING SOIL MIXTURE

- A. Soil mixture: Determine final soil mix after soil tests. Soil analysis testing shall include measurements of infiltration or percolation rates, percentages of large and small capillary pores, total pore space, percentage of water holding capacity on a weight basis, textural classification and breakdown of sand fractions, pH, total soluble salts, percentage organic, cation exchange capacity and all major and minor nutrients present. Topsoil for soil mix shall be friable, loamy surface soil from well drained

sources, reasonably free of subsurface soil, clay lumps, roots, stones and weeds and any other extraneous materials that would not be suitable for backfill of planting holes. Soil reaction shall range from pH 5.8 to pH 6.5 inclusive. Maximum soluble salts are 300 PPM. Soil mixture to be one-thirds acceptable natural topsoil, one-third Florida pulverized peat and one-third clean D.O.T. sand, thoroughly blended by mechanical means. Soil mixture is to be adjusted when approved by the Owner's representative if test results indicate changes are necessary.

- B. At Contractor's expense test representative samples from various locations around the site representing a range of future uses for pH, percentage organic content, permeability, minor elements and available nutrients.
- C. Improve the planting soil based on individual site conditions and proposed plant type and as recommended by the soil test results by the addition of approved amendments.
- D. All topsoil and planting soil shall be treated with a pre-emergent herbicide prior to installation of plant materials.
- E. Planting soil mixture shall be used in all planting, at the quantities necessary, as shown on the details and required for installation of the plant materials.

2.3 FERTILIZER

- A. General: All fertilizer applications shall be based upon a review of the soils tests results and laboratory recommendations and as directed by the Owner's Representative. Complete fertilizer of neutral character, with at least 50% of the nitrogen derived from a non-water soluble organic source and all potash to be derived from triple super sulfate forms for all plantings. Fertilizer shall contain minor elements and nutrients suitable for specified plants. All fertilizer to be slow release.
- B. At planting, fertilize trees and shrubs with a slow release 1:1:1 ratio fertilizer equal to Polyon or Nuticote 13-13-13, type 180. In addition, all palms shall be treated with Lutz's or Jobe's manganese or magnesium fertilizer spikes. Fertilizer subsequently used shall be slow release 4-2-4 ratio fertilizer. Surface applied fertilizers shall be applied in the presence of an Owner's representative.
- C. Fertilizer for ground cover beds shall be evenly applied to all newly planted areas at a rate of 1/2 pound of actual potash per 1000 square feet.
- D. Fertilizer lawns to provide not less than one pound of actual nitrogen per 1,000 square feet of area.

Provide nitrogen in form that will be available to lawn during initial period of growth; at least 50% of nitrogen to be organic form. Use 16-4-8 fertilizers derived from ammonium sulfate and containing micronutrients for specified lawns, unless soil tests recommendations stipulate otherwise.

2.4 MULCH

- A. Provide 3" compressed depth of "Mimi" pine bark mulch for plantings and tree rings.

2.5 GUYING AND STAKING MATERIAL

- A. At grade staking, sizes shown on details.
- B. Guying tape: as shown on details.

2.6 GRAVEL SUBDRAIN

- A. Where indicated on the drawing or as requested by the Owner's Representative, install subdrains beneath trees and planting areas as directed using 6" perforated flexible PVC pipe with sock to aid in soil drainage and percolation. Drainage gravel shall consist of washed, clean gravel $\frac{3}{4}$ inch to 2 inches in size, and will be of such mineral composition that it will not adversely affect the plant.

2.7 SOIL SEPARATION MAT

- A. To be Bidim (gray felt), as manufactured by Monsanto Co., 800 North Lindbergh Road, St. Louis, MO63166 or approved equal. Edges to overlap a minimum of 4 inches. Prevent tearing or crushing during installation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that grading operations have been completed and that final grades have been set and grading is complete and water for planting and maintenance is available prior to the installation of trees, shrubs, and groundcovers. Verify that the irrigation system is operational and fully tested and that the specified number of bubblers for each location is in place.
- B. Protect trees during delivery to prevent damage to root ball, trunk and branches and desiccation of leaves. Cover entire trees with tarps during transport. Trees to be free from chain marks, girdling or other damage, any of these will render the tree unacceptable. All plants shall be handled by the root ball or container, not stem or trunk. Do not store plants on site. All plants to be delivered within 24 hours of planting.
- C. Pesticide and herbicide materials shall be delivered to the site in original unopened containers with legible labels.
- D. The Contractor shall assume full responsibility for protection and safekeeping of products stored on the job site.

- E. Fine grade all shrub and groundcover areas immediately prior to planting to remove all noticeable irregularities or unevenness of surface grade. Water shall not be trapped behind curbs and established drainage patterns shall not be altered. Do not alter final grades that have been established or cause damage to previously established turf or planted areas, or trees retained on site. All tree protection barriers around retained trees shall not be disturbed.
- F. Verify the location of underground utilities, irrigation heads and valves, and provide markers or other suitable protection, where necessary, to prevent damage.
- G. Stake or flag tree locations and plant bed locations for approval by Landscape Architect prior to installation and to determine potential conflicts with unforeseen obstacles, inconsistencies between plans and field conditions, and any other circumstances that might preclude the planting of trees and shrub beds as indicated on the plans. If such conflicts are encountered, notify the Landscape Architect prior to proceeding. Make adjustments to locations as directed to achieve project objectives. The relative position of each tree and plant is subject to approval by the Owner's representative, and shall be relocated as directed at no additional cost to the Owner.
- H. Lay out plant beds with smooth bed lines as indicated on the plans.
- I. Uniformly space plants at the spacing indicated on the plans. In-fill any noticeable gaps in plant beds resulting during layout.
- J. Uniformly space and plant in line hedge plants, without noticeable gaps or irregularities in layout.
- K. Provide an acceptable soil mixture in an around the root zone of all plants, including the top 8" of groundcover beds, the top 12" of shrub beds and 12" beneath the root balls of trees when indicated on the drawings. Blend soil mixture to depth of 12 inches in groundcover beds.
- L. Treat plant bed areas with the post-emergent herbicide Round-up, and the pre-emergent herbicide Ronstar, according to the manufacturers' recommended instructions and application rates as necessary to eliminate present and future weeds in plant beds. Correct weed outbreaks in plant beds prior to acceptance.
- M. Verify all grades prior to placing sod. Do not interrupt drainage patterns. Scarify or loosen the area over which the sod is to be placed to a depth of approximately 4 inches and rake smooth to eliminate surface irregularities. Remove rocks, stones and other debris. Fine grade and moisten all areas to be sodded immediately prior to sod placement. Grade 1 ½ inch to 2" below adjacent walks, curbs and pavement to allow for the thickness of sod, resulting in a flush condition of soil with paved surface after placement of sod. Strip to bare soil, scarify and loosen soil and fine grade areas to be sodded that have existing herbaceous vegetation, including existing sod when indicated on the drawings.

3.2 INSTALLATION

- A. Provide plant holes cylindrical in shape with vertical sides. Holes for containerized plants shall be twice the diameter and the depth of the container. Holes for B&B plants shall be ball diameter plus 2' and ball depth of the tree. Pits for shrubs shall be at least twelve inches greater in diameter than their root ball and at least six inches deeper than the bottom of the root ball. Loosen hard soils to encourage root growth beyond the planting hole.
- B. Test, twice in succession, a representative number of plant holes in each area for vertical drainage prior to planting. Test drainage in presence of the construction manager. Fill each hole full of water and measure the water level after one hour and each successive hour. Note length of time required for each hole to drain. Notify the Landscape Architect prior to planting in areas of inadequate drainage.
- C. Backfill and compact prepared planting soil mixture sufficiently in the bottom of the planting hole to support the root ball at the correct height relative to surrounding grade.
- D. Place plants in the planting holes and orient to present best appearance from the most prominent viewpoints.
- E. Backfill and tamp planting soil around the root ball to one-half the depth of the root ball. Water and rod-in to remove air. Then backfill and tamp additional planting soil to bring the soil even with the surrounding grade.
- F. Form an earthen saucer 6" high around individual trees and shrubs for retaining water. Inside diameter of the saucer shall be equal to the diameter of the planting hole. Maintain saucers until the date of substantial completion. Remove saucers from trees in grass areas when sod is installed.
- G. Water-in thoroughly immediately after planting with a hose to eliminate air pockets and completely wet the root ball and planting soil. Backfill any voids with additional prepared planting soil.
- H. Top dress all plant beds and tree holes with a 3" layer of mulch within 24 hours after planting.
- I. All plants shall be straight and plumb and root balls shall be at proper grade after planting. Replant or straighten plants that have settled or are leaning until end of guarantee period.
- J. Supplemental hand watering is required on an as needed basis. Apply water to trees at a rate of 5-7 gallons per inch of caliper, a minimum of three days a week, to maintain a moist condition until final completion. Each time plants are watered, water completely using a slow-soak technique, saturating the root ball to its full depth. Water shrubs, ground covers and sod to obtain optimal conditions for plant establishment and growth.
- K. After planting of trees, shrubs and ground covers sod shall be placed to present an even and consistent cover with tight butt joints and without openings and overlaps. Sod

shall be cut to fit irregular spaces and pieces shall be one-half the size of a pad or more. On slopes alternate joints between pieces and place pieces perpendicular to the slope.

3.3 STAKING AND GUYING

- A. Maintain the stability and plumb condition of all trees and shrubs. Provide guying as detailed and specified and maintain at all times.

3.4 FERTILIZER

- A. Apply fertilizer to the soil in the quantities recommended in soils tests, distributed evenly around the root ball.

3.5 PRUNING

- A. Prune in accordance with standard horticultural practice. Limit pruning to the removal of dead or injured branches, unless otherwise directed by the Landscape Architect.
- B. Remove dead wood immediately, routinely and spontaneously without prompting from the Owner or Landscape Architect.
- C. Remove from the site and replace immediately trees that fail to meet size and quality specifications after the removal of dead wood.

3.6 MAINTENANCE

- A. Begin maintenance immediately after planting. Maintain all plant material until the date of final completion. Maintain to assure vigorous, healthy growing conditions and shall include, but not be limited to, watering, weeding, mowing, pruning, fertilization, disease and pest control, replacement of non-conforming plants and sod, straightening, and all other procedures consistent with good horticultural practice. During maintenance perform all seasonal maintenance.
- B. Mow sod regularly until date of final completion. Do not remove more than one-half the leaf blade at a single mowing. Resod as necessary for full even coverage. Fill all depressions and eroded channels to adjust grade to assure proper drainage.

3.7 FIELD QUALITY CONTROL

- A. The Owner's Representative or Landscape Architect shall inspect the work at any time during the course of the construction activities to ensure adherence to the plans and specifications.

- B. Upon completion of all work in this section, an inspection for acceptance of the work will be held. Notify the Owner's Representative and Landscape Architect at least seven days prior to the anticipated inspection date.
- C. At the time all work is found to be acceptable, a letter of acceptance or certificate of substantial completion will be issued stating the date the guarantee period shall begin. Minor deficiencies shall be rectified within 3 days of the inspection date. If there are significant deficiencies found during the inspection, such work shall be corrected prior to the issuance of the letter of acceptance

3.8 CLEANING

- A. Keep the premises free from accumulations of waste materials or rubbish at all times. Dispose of all waste materials properly off-site no less than weekly.
- B. Upon completion, remove all excess subsoil, cordage, wrapping and other extraneous materials from the site. Remove all tools, equipment and other materials, except those necessary for maintenance work. Remove litter and debris occurring from maintenance work.

3.9 ACCEPTANCE

- A. When the work is complete an inspection for acceptance shall be made upon written request of the Contractor. All plant materials shall be healthy, well-rooted, evenly colored for plant type, viable and free of weeds and disease.
- B. A substantial completion inspection shall be conducted with all deficiencies noted and given to the Contractor to be corrected. Final completion acceptance will be issued only when all items have been completed and a re-inspection by the Owner finds the work to be complete and satisfactory.
- C. At the conclusion of the warranty period an inspection will be made to determine the condition of the materials and the work. Remove all materials not in a healthy-growing condition and replace at no additional cost, with material of like kind and size in accordance with the specification for the original plant. Warranty replaced material for the specified period. In addition, remove all tree stakes and guys and dispose of off site.

END OF SECTION 02900

SECTION 02930
SODDING

PART 1- GENERAL

1.1 SUMMARY

- A. Provide all labor, materials, equipment and incidentals required to prepare lawn bed, install sod and repair existing sod in accordance with the drawings, scheduled mowing, and all work that is part of the 30-day grow-in period, and as specified.
- B. Secure and pay applicable taxes and permits.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Section 02810 – Irrigation System
- C. Section 02900 - Landscaping

1.3 SUBMITTALS

- A. Certificate and Guarantee
 - 1. Growers' Certification and Guarantee
 - a. All sod shall be Florida Standard Grade sod as defined by the Florida Turf Producer Association that is true to botanical variety and 98% free of weeds and foreign grasses.
 - b. Florida Standard Grade may have no visible broadleaf weeds when viewed from a standing position and the turf shall be visibly consistent with no obvious patches of foreign grasses. In no case may the amount of foreign grasses or weeds exceed 2% of the total. The sod shall be neatly mowed and be mature enough that when grasped at one end, it can be picked up and handled without damage.
 - c. Certify grass species and variety with date and location of field from which sod was cut. One certificate per load is required.
 - d. Compliance with State and Federal quarantine restriction, if applicable.
 - 2. Manufacturer's certification of fertilizer and herbicide composition.
 - 3. Contractor shall submit all certification, reports and documentation to the Owner's Representative a minimum of one week prior to installation.

- B. Provide Florida Department of Agriculture, Bureau of Plant Industry inspection certificates at time of delivery of sod.
- C. Submit soils tests for all sod areas. Analysis shall include recommendation for fertilizer specific to the soil chemistry of the existing soil.

1.4 QUALITY ASSURANCE

- A. Sod shall be grown by certified Florida State Plant Board Sod Farm or as approved by the Owner's Representative. The Owner's Representative shall inspect sod prior to cutting and delivery to the site.
- B. The Owner's Representative shall have the right at any stage of the construction to reject any and all work and materials, which in his opinion do not meet the requirements of these specifications. Such rejected work and materials shall be immediately removed from the site and replaced in an acceptable manner.

PART 2 - PRODUCTS

2.1 SOD

- A. Grass species: Paspalum notatum, Argentine Bahia grass, sand grown.
- B. Provide sod taken up in rectangles, preferably 16 inch by 24 inch, or rolls, a minimum of 2 inches in thickness excluding growth and thatch, well matted with grass roots, and live, fresh, sand grown specifically for landscape use and uninjured at the time of planting. Before being cut and lifted the sod shall have been mowed three times with the final mowing not more than a week before cutting.
- C. American Sod Producers Association (ASPA) Grade: Nursery Grown or Approved. Field grown sod is not acceptable. Florida Turf Producer Association: Florida Standard Grade.
- D. Sod shall be certified to meet Florida State Plant Board specifications, absolutely true to varietal type and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind.
- E. Time delivery so sod will arrive at site within twenty-four hours after being stripped. Do not deliver more sod than can be installed within 24 hours. Owner's Representative reserves the right to reject sod in extended storage at the site.
- F. Protect sod against drying and breaking. Maintain proper moisture conditions, prior to placing, to assure sod viability and to prevent soil falling off during handling.

2.2 SOIL CONDITIONERS

- A. Fertilizer shall be complete and derived from organic sources and comply with the State and Federal fertilizer laws.

For the purpose of bidding, assume 8% nitrogen, 8% phosphorus and 8% potash by weight. At least 50% of the total nitrogen shall contain no less than 3% water-insoluble nitrogen.

At the Contractor's expense, samples of existing on-site soils will be submitted to a certified testing laboratory for analysis and recommendation for the proper fertilizer to attain optimum growth of the sod. The test finding, along with the recommendations for amending the specified fertilizer mix shall be reviewed and approved by the Owner prior to delivery and application at the job site.

At the Contractor's expense, fertilizer amendments shall be added in the amount and manner prescribed by the soil analysis. Fertilizer mixture shall be delivered to the site in original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a certificate of compliance covering analysis shall be furnished to the Owner's Representative. Store fertilizer in a waterproof place and in a manner that it will be kept dry and its effectiveness will not be impaired.

- B. Superphosphate shall be composed of finely ground phosphate rock intended for agricultural purposes containing not less than 20% available phosphoric acid.
- C. Lime: agricultural limestone containing a minimum 80% calcium carbonate, 99% passing through No. 8 sieve and a minimum 75% passing through No. 60 sieve.
- D. Sulfur: granular, biodegradable, containing a minimum of 90% sulfur, agricultural grade.

2.3 WATER FOR GRASSING

- A. Obtain from any approved pond, lake, stream, or municipal water system.
- B. Free of excess and harmful chemicals, acids, alkalis, or any substance, which might be harmful to plant growth or of obnoxious odor. Do not use salt water.

PART 3 - EXECUTION

3.1 LAWN BED PREPARATION

- A. Remove all grasses, weeds and debris and verify with the Owner's Representative that grading operations have been completed and that final grades have been set. When removing weeds remove entire plant, including roots.
- B. Scarify or loosen the area over which the sod is to be placed to a depth of approximately 4-6 inches and then rake smooth to eliminate surface irregularities. Remove rocks, stones, and other debris.
- C. Spread superphosphate and fertilizer evenly over the area to receive sod. For bidding purposes apply superphosphate at rate of 5 pounds per 1000 square feet and complete

fertilizer at rate of 16 pounds per 1000 square feet. Incorporate into soil to a depth of 6 inches.

- D. Fine grade and moisten all areas to be sodded immediately prior to placement of sod. Do not interrupt establish drainage flow patterns.
- E. Grade 1-½" to 2" below adjacent walks, curbs and pavement to allow for the thickness of sod resulting in a flush condition of soil to paved surface after placement of sod.
- F. The surface shall conform with finish grade, less the thickness of the sod, free of water-retaining depressions, with the soil friable and of uniformly firm texture.

3.2 INSTALLATION

- A. Place sod on prepared surface with edges in close contact. Firmly and smoothly embed by light tamping with appropriate tools. Roll when conditions warrant.
- B. Stagger setting of the pieces in drainage swales and on slopes to avoid a continuous seam along the line of flow.
- C. Prevent the sod from sliding on steep slopes of 1:3 or steeper by means of wooden pegs driven through the sod into firm earth at suitable intervals.
- D. Remove and replace any pieces of sod that show dryness or poor color.
- E. Cut sod with a sharp tool to conform to walks, planting bed, header boards and other features. Do not allow gaps and laps and noticeable irregularities or unevenness of surface grade. Sod used to fill irregular spaces shall be of a size at least one-half piece of sod.
- F. Finish grade of all sod areas shall not be higher than adjacent paving, curbs, yard boxes, drains or other on-grade elements.

3.3 WATERING

- A. Provide sufficient moisture for optimum results to areas on which the sod is to be placed.
- B. Keep in a moist condition to the full depth of the rooting zone for at least 2 weeks after placing sod.
- C. Apply water as needed for a minimum of 30 days and until established as determined by the Owner's Representative. Supplement irrigation system as needed.

3.4 MAINTENANCE

- A. Maintain the sodded areas in a satisfactory condition to produce a dense, well-established lawn. Maintenance shall include repairing of any damaged areas and replacing areas in which the establishment of the grass stand does not appear to be developing satisfactorily.
- B. Mow newly sodded areas as soon as sod is rooted sufficiently to permit mowing. Mow periodically as directed. Maintain height typical for species. Do not remove more than one-half height at a single mowing.
- C. Replanting or repair necessary due to the Contractor's negligence, carelessness, or failure to provide routine maintenance shall be at the Contractor's expense. Others shall pay for replanting necessary due to factors determined to be beyond the control of the Contractor.

3.5 ACCEPTANCE

- A. For the purpose of establishing an Acceptance Standard, sod shall be healthy, well-rooted, evenly colored, viable, vigorous; free of weeds, disease and insects.
- B. Substantial Completion and Final Acceptance shall be as stated in the General Conditions. Acceptance shall be no less than 30 days after substantial completion.

END OF SECTION 02930

Division 3 Concrete

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplemental Conditions and Division 1 Specifications Section, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation to provide formwork for cast-in-place concrete.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 03200 -: Concrete Reinforcement
 - 2. Section 03300: - Cast-in-Place Concrete
 - 3. Section 03600: - Grout

1.03 SUBMITTALS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division Specifications Sections apply to this Section.

1.04 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:
 - 1. Standard Building Code.
 - 2. ACI 347 Recommended Practice for Concrete Formwork.
 - 3. Responsibility: The Contractor shall be responsible for the design of the formwork and for safety in its construction, use and removal.
 - 4. Tolerances: Formwork shall be constructed to insure that finished concrete surfaces will be in accordance with the tolerances listed in ACI 347. Camber shall be provided as necessary to compensate for anticipated deflection in

formwork and concrete due to weight and pressure of fresh concrete and other construction loads.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Forms:

1. Forms shall be of wood, steel or other approved materials, and as specified in this Section. The sheeting for all exposed surfaces shall be 5-ply plywood, unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. Forming for exposed exterior concrete from 1-foot below finished exterior grade to top of structure shall be carefully fabricated so as to provide a smooth finish without defects.
2. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of Owner. If it is his opinion that the interior surfaces of the forms are too irregular to produce the specified finish, they shall be lined with smooth dense, moisture resistant hardboard or other material of which he approves.

B. Plywood: Unless otherwise indicated, forms shall be PLYFORM, Class 1, BB-Exterior type, mill oiled and edge sealed. Thickness shall be as required to support concrete at the rate place, but not less than 3/4-inch.

C. Form Accessories: Form accessories shall be of a commercially manufactured type.

1. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete.
2. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 1 1/2-inches from the formed face of the concrete. Use embedded rods with integral waterstops and cones.
3. Wire ties and wood spreader will not be permitted.

D. Chamfer Strips: Chamfer strips shall be polyvinyl strips or other approved material designed to be nailed in the forms to provide a 3/4-inch chamfer at exposed edges of concrete members.

E. Form Release Agent: form release agent shall be a paraffin base oil or mineral oil coating that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain the concrete surfaces, and will leave the concrete with a paintable surface.

PART 3 - EXECUTION

3.01 INSTALLATION/ERECTION

A. Forms

1. Construction:

- a. Forms shall be built true to line and grade, and shall be mortartight and sufficiently rigid to prevent displacement or sagging between supports. Particular attention shall be given to adequacy of supports and shoring, which is the Contractor's responsibility. The surfaces of forms used for permanently exposed surfaces shall be smooth and free from irregularities, dents, sags or holes. Forms for surfaces to receive stucco finish shall be suitable for its application.
 - b. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges at expansion joints or at any other corners that are to remain. Beams below grade shall have forms at both sides.
 - c. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal is at least 1-1/2 inch from any concrete surface. Form ties shall be removed immediately after removal of forms, and holes shall be thoroughly plugged with grout within 24 hours after form removal and kept damp for 4 days to prevent shrinking.
 - d. Wire ties will not be permitted.
2. Form facing Materials: The facing material shall produce a hard form texture on the concrete. Facing materials with raised grain, torn surfaces, worn edges, patches, dents or other defects shall not be used. The maximum deflection of facing materials as reflected in concrete surfaces shall not exceed 1/240 of the span between structural members.
 3. Preparation of Form Surfaces: After each use and prior to placing reinforcing, forms shall be cleaned of mortar, grout and other foreign material and the form release agent shall be applied. Form releasing agent shall not be allowed to stand in puddles in the forms or allowed to come in contact with hardened concrete against which fresh concrete is to be placed.
 4. Coating: Prior to the placing of steel reinforcement or concrete, forms for exposed surfaces shall be coated with a non-staining paraffin base oil or mineral oil. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete.

- B. Adjustment: Positive means of adjustment of shores and struts shall be provided and all settlement shall be taken up during concrete placing.
- C. Temporary Openings: Temporary openings shall be provided in wall forms to limit the free fall of concrete to a maximum of 4 feet unless an elephant trunk is used. such openings shall be located to facilitate placing and consolidation and shall be spaced no more than 8 feet apart. Temporary openings shall also be provided in the bottom of wall and column forms and elsewhere as necessary to facilitate cleaning and observation immediately prior to placing.
- D. Construction Joints: At construction joints, the contact surfaces of the form sheathing shall overlap the hardened concrete by not less than 1 inch. Forms shall be held against the hardened concrete to prevent offsets or loss of mortar.
- E. Chamfers: All exposed concrete edges shall be chamfered 3/4-inch by 3/4-inch, unless otherwise indicated on the Drawings.
- F. Runways: Smooth and rigid runways shall be provided (if needed) for moving equipment and concrete. Runways shall be supported directly on formwork or on grade and in no case on reinforcing steel or bar supports.
- G. Footings, Grade Seams and Slab Edges: Exterior faces of footings, grade beams, walls and slab edges shall be formed with plywood.
- H. Embedded Item: Set anchor bolts and other embedded items accurately and hold securely in position in the forms until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check all nailing, blocks, plugs and strips necessary for the attachment of trim, finish and similar work prior to concreting.
- I. Pipes and Wall Spools Cast in Concrete:
 - 1. Install wall spools, wall flanges and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools to the reinforcing steel.
 - 2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will be possible during construction.
- J. Form Removal: Formwork shall not be removed from any concrete until it has obtained a minimum of 3,000 psi compressive strength to support itself and any live loads it may be subjected to, and then only with the approval of Owner.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing and transport of reinforcing steel and welded wire mesh for cast-in-place or precast concrete structures.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02650 – Water Distribution System
 - 2. Section 02710 – Sidewalks
 - 3. Section 02720 – Storm Drainage System
 - 4. Section 02730 – Sanitary Sewerage System

1.03 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall meet all requirements of the latest editions of the following standards:
 - 1. Southern Standard Building Code.
 - 2. ACI 318 Building Code Requirements for Reinforced Concrete.
 - 3. ACI 315 Details and Detailing of Concrete Reinforcement.
 - 4. CRSI Manual of Standard Practice, MSP-2.

1.04 SUBMITTALS

- A. Submit complete shop drawings including bar lists and placing drawings to Owner for review in accordance with general provisions of Contract, including General and

Supplementary Conditions and Division 1 Specification. Drawings shall show the type, spacing and location of metal bar supports, the grade of the reinforcing and the name of the manufacturer. The type of coupler splice devices shall be designated.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel:

1. Reinforcing steel shall conform to the requirements of ASTM Designation A 615, Deformed Grade 60, except where otherwise indicated.
 - a. The name of the manufacturer of the reinforcing steel shall be called out in the shop drawings together with a sketch showing the pattern of the deformation, including the mill mark.
 - b. Bar reinforcement shall be accurately fabricated in accordance with the latest CRSI Manual of Standard Practice. The Contractor shall have prepared and shall submit to Owner six (6) copies of necessary shop drawings and bar lists. The Contractor shall be responsible for errors made in shop drawings even though approved by Owner.

B. Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM Designation A 185 and shall be formed with smooth cold-drawn wire.

C. Supports:

1. Metal Bar Supports:

- a. Bar supports for reinforcing steel shall conform to the requirements of CRSI Manual of Standard Practice, Chapter 3 and shall be of a height to furnish the concrete cover called for on Drawings. High chairs shall be furnished for bent or top bars in solid slabs. Bar supports to be in contact with exterior surfaces of concrete shall be Class C with plastic caps at least 1-inch in length on the leg tips, or Class E with stainless steel legs. Bar supports shall be spaced not more than 100 times the diameter of the bars to be supported, with not more than 1/4 spacing from the end of the supported bars to the first chair.
- b. Bar supports for slabs on grade shall be plain concrete blocks, 3-inches high by 4-inches square with the tie wires embedded in support. Concrete strength shall be at 3,000 psi at time of use.

2. Cold-drawn wire for spirals shall be plain and shall conform to the requirements

of ASTM Designation A 82 with a minimum yield strength of 70,000 psi.

2.02 FABRICATION

- A. Fabrication shall not begin until the approval of the shop drawings by Owner has been received. Fabrication shall meet all requirements of the specified standards. Unless otherwise indicated the following shall apply:
1. Hooks shall be standard hooks.
 2. Bottom bars shall extend a minimum of 6 inches into supporting members.
 3. Cover is to the outermost stirrup, tie or bar.
 4. Splices are permitted only where indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Reinforcing Steel: When placed in the forms, reinforcement shall be clean and free of all rust, scale, dust, dirt, paint, oil or other foreign material and shall be accurately and securely positioned in the forms as shown on the Drawings before the placing of concrete. Reinforcing steel shall be wired or otherwise fastened together at intersections and shall be supported by concrete or metal supports, spacers or hangers. Bar supports, where adjacent to the ground, shall be set on precast concrete pads compressed into the subgrade. The Contractor shall obtain Owner's approval before fastening reinforcing steel at intersections by welding methods.
1. Splicing of reinforcement shall be held to a minimum and shall be placed at points of minimum stress. Bars shall be lapped at splices a minimum of 24 bar diameters unless otherwise shown on the Drawings or directed by Owner, and shall be rigidly wired or clamped.
 2. Wire fabric shall be straitened before placing and shall overlap one full space of mesh at ends and edges and shall be securely fastened. Fabric shall be supported so as to occupy its proper location in the concrete as shown on the Drawings. Fabric shall not cross any expansion joints.
- B. Embedded Items: In addition to steel reinforcement, pipes, inserts and other metal objects as shown, specified or ordered shall be built into, set in or attached to the concrete. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before concrete is placed, care shall be taken to determine that all embedded parts are firmly and securely fastened in place as

indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. No wood shall be embedded in concrete. The concrete shall be packed tightly around pipes and other metal work to prevent leakage and to secure perfect adhesion. Drains shall be adequately protect from intrusion of concrete.

- C. Supporting Reinforcing: Bar supports shall be provided as required by CRSI MSP-2 and ACI-315. Top and bottom bars in slabs formed on earth shall be supported on precast concrete block supports except where such bars are properly supported from formwork. Precast concrete block supports are not required in slabs formed on tremie concrete but may be used at the Contractor's option.
- D. Placing Reinforcing: Placing of reinforcing and welded wire fabric shall be as indicated on the Drawings and as recommended by CRSI MSP-2 and ACI 315. Reinforcing shall be securely tied and supported to prevent displacement during concrete placement.
- E. Welded Wire Fabric: Splices in welded wire fabric shall be such that the overlap between the outermost cross wires of each fabric sheet is not less than the spacing of the cross wires, plus 2 inches. Fabric shall not be extended through expansion joints or construction joints in slabs on grade, except as otherwise noted.
- F. Dowels: Dowels shall be wired in position prior to placing concrete.
- G. Field Bending: Heat shall not be used to bend bars. Bars shall not be bent after being embedded in concrete.
- H. Welding: Welding of reinforcing will not be permitted.
- I. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Slabs-on-grade.
 - 3. Suspended slabs.
 - 4. Equipment Pads.
 - 5. Columns and Beams.
- B. Related Sections include the following:
 - 1. Division 32 Section "Concrete Paving" for concrete pavement and walks.
 - 2. Division 32 Section "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sample of vapor retarder and self-adhesive tape.

- C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- E. Qualification Data: For Installer and manufacturer.
- F. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type I. Supplement with the following at the contractor's option:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source.
1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.

2.6 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
- B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Manufacturers:
 - a. Bometals, Inc.
 - b. Greenstreak.
 - c. Meadows, W. R., Inc.
 - d. Murphy, Paul Plastics Co.
 - e. Progress Unlimited, Inc.
 - f. Tamms Industries, Inc.
 - g. Vinylex Corp.
 2. Profile: Flat, dumbbell without center bulb .
 3. Dimensions: 6 inches by 3/8 inch thick; nontapered.

2.7 VAPOR RETARDERS

- A. Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products:
 - a. Fortifiber Corporation; Moistop Ultra 15.
 - b. Raven Industries Inc.; Vapor Block 15.
 - c. Reef Industries, Inc.; Griffolyn Type-65G.
 - d. Stego Industries; Stego Wrap 15.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products:
 - a. ChemMasters; Spray-Film.
 - b. Dayton Superior Corporation; Sure Film.
 - c. Euclid Chemical Company (The); Eucobar.
 - d. L&M Construction Chemicals, Inc.; E-Con.
 - e. Meadows, W. R., Inc.; Sealtight Evapre.
 - f. Sika Corporation, Inc.; SikaFilm.
 - g. Symons Corporation, a Dayton Superior Company; Finishing Aid.
- B. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products:
 - a. ChemMasters; Safe-Cure Clear.
 - b. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
 - c. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - d. Euclid Chemical Company (The); Kurez DR VOX.
 - e. L&M Construction Chemicals, Inc.; L&M Cure R.
 - f. Meadows, W. R., Inc.; 1100 Clear.
 - g. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
- C. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
1. Products:
 - a. Euclid Chemical Company (The); Super Diamond Clear VOX.
 - b. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - c. Meadows, W. R., Inc.; Vocomp-30.

- d. Symons Corporation, a Dayton Superior Company; Cure & Seal 31 Percent E.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 CONCRETE FLOOR SEALER - EXTERIOR

- A. One of the following for exterior second floor walkways and stairs:
 1. "Kure-N-Seal 30": Sonneborn Building Products
 2. Equal product by L & M Construction Chemicals, Inc.
 3. Equal product by Dayton Superior Corp.
- B. Finish Color: Clear.
- C. All concrete floors scheduled to receive polyurethane floor sealers shall be mechanically profiled sanded or sandblasted prior to application of primer, in strict accordance with the manufacturer's written recommendations.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly ash or other pozzolans used as admixtures may be used provided they conform to ASTM C618 Class C or F. Pozzolan replacement of cement shall not exceed 20% (one part pozzolan max. to four parts cement) by weight
 2. Submit manufacturer's certification that product conforms to the requirements specified and is compatible with all other admixtures.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing admixture in pumped concrete and concrete with a water-cementitious materials ratio below 0.50.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Design mixes to provide normal weight concrete with the following properties as indicated on the drawings and schedules:
1. 4000 psi, 28 day compressive strength; water cement ratio, 0.48 maximum (non air entrained).
 2. 3000 psi, 28 day compressive strength; water cement ratio, 0.48 maximum (non air entrained).
- B. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
 2. Reinforced foundation systems: 4 inches, +/- 1 inch.
 3. Concrete containing high range water reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site verified 2 to 3 inch slump concrete.
 4. Other concrete: 4 inches, +/- 1 inch.
- C.
1. All exterior concrete flatwork shall be 3000 psi @ 28 days with 1/2"-3/4" long monofilament polypropylene added at the rate of 1½ lbs per cubic yard (no WWF required). Do not add any fly ash to exterior concrete flatwork.

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
 - F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
 - G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
 - H. Chamfer exterior corners and edges of permanently exposed concrete.
 - I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
 - J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
 - K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
 - L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for walls and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

- A. Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.7 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Before test sampling and placing concrete, water may be added at the plan only, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces to be covered with a coating or covering material applied directly to concrete.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces to receive trowel finish .
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

- b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
2. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has

- dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Headed bolts and studs.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
 - 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 4. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

5. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two laboratory cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24hours of finishing.

END OF SECTION

SECTION 03400
PRECAST CONCRETE STRUCTURES

PART 1 -GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing and installing complete precast concrete structures as shown on Drawings for storm drainage system and/or sanitary sewerage system and appurtenances.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02220 - Excavating, Backfilling, and Compacting
 - 2. Section 02720 - Storm Drainage System
 - 3. Section 02730 – Sanitary Sewerage System

1.03 SUBMITTALS

- A. Shop Drawings: Submit in accordance with general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections shop drawings and manufacturer's data sheet for proposed precast concrete structures. Units which are not manufactured in strict compliance with the approved Shop Drawings and these Specifications will be rejected.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION

- A. Precast units shall conform to the requirements of ASTM Designation C478, Precast Reinforced Concrete Manhole Sections, with reinforcement of Grade 60 bars and the

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following modifications thereto:

1. The minimum wall thickness shall be as indicated on the Drawings.
2. Placing and setting of the reinforcing steel shall be inspected at the casting yard prior to pouring of concrete.
3. Cement shall be Type II.
4. Joints shall be compression type, neoprene gasket joint of a design approved by Owner. A preformed plastic joint filler shall be used in filling the remainder of the joint.
5. Lifting holes through the structures are not permitted.
6. The reinforced concrete bottom slab shall be as shown on Drawings, The bottom slab for manholes shall be cast monolithically with the lower wall section and the longitudinal cylindrical reinforcement shall extend into the slab wall reinforcement shall be as shown on Drawings or as otherwise approved by Owner.

B. Grout: See Section 3600 - Grout

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The precast structures shall be set level with the walls plumb on the graded crushed rock bedding as specified in Section 02220 – Excavating, Backfilling and Compacting..
- B. Coatings shall be as specified on the Drawings, if required.
- C. Backfill around structures shall consist of clean sand, install in 8-inch layers and thoroughly compacted.

END OF SECTION

SECTION 03471
TILT-UP CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies load-bearing, tilt-up concrete, including the following:
 - 1. Monolithic panels.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for slab-on-grade closure strip and general concrete construction.
 - 2. Division 07 Section "Sheet Metal Flashing and Trim" for flashing receivers and reglets.
 - 3. Division 07 Section "Joint Sealants" for elastomeric joint sealants and sealant backings between tilt-up panels.
 - 4. Division 31 Section "Earth Moving" for engineered fill and drainage fill under slab-on-grade closure strip.

1.3 DEFINITIONS

- A. Face-down Surface: Concealed surface of as-cast, tilt-up panel formed against the casting slab.
- B. Face-up Surface: Exposed upper surface of as-cast, tilt-up panel.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings: Detail fabrication and installation of tilt-up concrete units. Indicate panel locations, plans, elevations, dimensions, shapes, cross sections, and details of

steel embedments. Match panel identification designations on Shop Drawings with those on Contract Drawings.

1. Include steel reinforcement, detailing fabrication, bending, and placing. Include material, grade, bar schedules, stirrup spacing, bent-bar diagrams, arrangement, and supports of concrete reinforcement.
2. Include additional steel reinforcement to resist hoisting and erection stresses.
3. Include locations and details of hoisting points and lifting devices for handling and erection.
4. Include engineering analysis data of additional steel reinforcement and hoisting and erection details, signed and sealed by the qualified professional engineer responsible for their preparation.
5. Indicate welded connections by AWS standard symbols. Detail cast-in inserts, connections, and joints, including accessories.

D. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs a supervisor on Project who is an ACI-certified Tilt-up Supervisor.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade I, according to ACI CP-01 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
- F. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," Sections 1 through 5, unless modified by requirements in the Contract Documents.
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

- H. Mockups: Cast and erect tilt-up concrete panel mockups to demonstrate typical reveals, surface finishes, texture, color, and standard of workmanship.
1. Build mockup panels in the location and of the size indicated or, if not indicated, as directed by Architect.
 2. In presence of Architect, damage part of an exposed surface for each finish, color, and texture required, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with tilt-up concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Tilt-up concrete subcontractor.
 2. Review special inspection procedures; testing and inspecting agency procedures for field quality control; tilt-up concrete finishes and finishing; cold- and hot-weather concreting procedures; curing procedures; casting-slab construction, flatness and levelness, finish, and joint requirements; steel reinforcement installation; hoisting and erection plans; measurement of fabrication and erection tolerances; tilt-up concrete repair procedures; and tilt-up concrete protection.

PART 2 - PRODUCTS

2.1 FORMS AND ACCESSORIES

- A. Forms: Metal, dressed lumber, or other approved materials that are nonreactive with concrete and that will provide continuous, true, and smooth concrete surfaces.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch.
- C. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.
- D. Reveal Strips: Metal, PVC, rubber, straight dressed wood, or plywood; with sides kerfed.

- E. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleedwater and prevent migration of set-retarding chemicals from wood or plywood.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Bar Supports: Manufactured according to CRSI's "Manual of Standard Practice" of plastic or CRSI Class 1 plastic-protected steel wire or Class 2 stainless-steel wire.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout the Project:
 - 1. Portland Cement: ASTM C 150, Type I or III, gray.
- B. Coarse Aggregate: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
- C. Fine Aggregate: ASTM C 33, manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M.

2.4 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

2.5 BONDBREAKERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in this Article.

- B. Solvent-Borne, Chemically Reactive Bondbreaker: Penetrating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
1. Burke by Edoco; Clean Lift 90 V.O.C.
 2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Conspec CST VOC.
 3. Dayton/Richmond Concrete Accessories; Maxi Tilt.
 4. Dayton Superior Corporation; Sure Lift (J-6).
- C. Solvent-Borne, Membrane-Forming Bondbreaker: Dissipating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
1. Burke by Edoco; Super Bondbreaker V.O.C.
 2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Tilt-Eez VOC.
- D. Waterborne, Chemically Reactive Bondbreaker: Penetrating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
1. Burke by Edoco; Super Tilt Bondbreaker W.B.
 2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Conspec CST/WB.
 3. Dayton/Richmond Concrete Accessories; Maxi Tilt E.
 4. Dayton Superior Corporation; Sure-Lift WB (J-5).
 5. Nox-Crete Products Group, Kinsman Corporation; Silcoseal 2000F.
- E. Waterborne, Membrane-Forming Bondbreaker: Dissipating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
1. Burke by Edoco; Super Bondbreaker W.B.
 2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Tilt-Eez WB.
 3. Dayton/Richmond Concrete Accessories; Rich Tilt E.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- B. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

- B. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.
- C. Unheaded Carbon-Steel Rods and Nuts: ASTM A 36/A 36M, threaded rods with ASTM A 563, nuts.
- D. Welded Headed Studs: AWS D1.1, Type B headed studs, and cold-finished, carbon-steel bars.
- E. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- F. Chord Bar Sleeves: Tubular sheathing, plastic or moisture-resistance-treated cardboard.
- G. Welding Electrodes: Comply with AWS standards.

2.8 LIFTING INSERTS AND ACCESSORIES

- A. Furnish inserts, dowels, bolts, nuts, washers, and other items to be cast in panels for tilting and lifting.
 - 1. Manufacture inserts with feet of plastic, galvanized steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.
- B. Furnish brace anchors and other accessories to be cast in panels and in casting slab for attaching bracing.
 - 1. Manufacture wall brace anchors and accessories with feet of galvanized steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.
 - 2. Manufacture floor brace anchors that will not penetrate vapor retarder under slab-on-grade.

2.9 BEARING PADS

- A. High-Density Plastic Strips: Multimonomer, nonleaching plastic.

2.10 GROUT

- A. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents; complying with ASTM C 1107, of consistency suitable for application.

2.11 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

- B. Patching Mortar: Dry-pack mix consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing No. 16 sieve, using only enough water for handling and placing.

2.12 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures based on laboratory trial mixtures.
- B. Proportion concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: 5 inches plus or minus 1 inch.
- C. Limit water-soluble chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMS

- A. Construct and brace formwork so tilt-up concrete panels are of size, shape, alignment, elevation, and position indicated.
 - 1. Construct forms on slab-on-grade or on temporary casting slab, at Contractor's option.
 - 2. Provide for openings, offsets, recesses, reveals, rustications, reglets, and blockouts.

3. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concreting. Coat form liner with form-release agent.
- B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Use kerfed inserts, such as those forming reglets, rustications, and recesses, for easy removal.
- C. Set edge forms for panels to achieve required panel thickness.
- D. Chamfer exposed corners and edges, unless otherwise indicated, using chamfer strips fabricated to produce uniform, smooth lines and tight edge joints.
- E. Coat contact surfaces of wood forms and chamfers with sealer before placing reinforcement.

3.2 BONDBREAKERS

- A. Uniformly and continuously apply two coats of bondbreaker to casting-slab surfaces by power spray or roller according to manufacturer's written instructions, before placing steel reinforcement. Recoat areas subjected to moisture before drying. Maintain continuity of coating until concrete placement.
- B. After placing steel reinforcement, touch up or recoat worn or damaged areas with bondbreaker. Do not splash or coat steel reinforcement and inserts.

3.3 REINFORCEMENT AND INSERTS

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating and placing reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 1. Do not tack-weld crossing reinforcing bars.
 2. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- C. Accurately place and securely support embedded items, anchorages, inserts, cramps, retainers, bar chords and sleeves, and other items to be built into panels. Coordinate with other trades for installing cast-in items.

3.4 PANEL CASTING, GENERAL

- A. Comply with ACI 301 for handling, placing, and consolidating concrete.
- B. Maintain position of steel reinforcement, inserts, and anchors during concrete placement, consolidation, and finishing.

- C. Screed panel surfaces to correct level with a straightedge and strike off.
 - 1. Begin initial floating before excess moisture or bleedwater appears on the surface. Use bull floats or darbies to form a uniform and open-textured surface plane free of humps or hollows. Do not disturb panel surfaces before beginning finishing operations.
- D. Form chamfers at top edges of panel perimeters, openings, and similar locations not formed by chamfer strips, unless otherwise indicated.
- E. Surface Defects: Limit visible surface defects to those permitted by TCA's "Tilt-up Concrete Association's Guideline Specifications" for Grade A, Architectural panel surfaces.

3.5 CASTING TOLERANCES

- A. Cast tilt-up concrete panels without exceeding the following tolerances:
 - 1. Height and Width of Panels:
 - a. For Panels up to 20 Feet Tall: 1/4 inch wide.
 - b. For Panels 20 to 30 Feet Tall: 3/8 inch wide.
 - c. Each Additional 10 Feet in Excess of 30 Feet Tall: 1/8 inch wide.
 - 2. Thickness: 3/16 inch.
 - 3. Skew of Panel or Opening: Difference in length of diagonals of 1/8 inch per 72 inches with a maximum difference of 1/2 inch.
 - 4. Openings Cast into Panel:
 - a. Size of Opening: 1/4 inch.
 - b. Location of Centerline of Opening: 1/4 inch.
 - 5. Location and Placement of Embedded Items:
 - a. Inserts, Bolts, and Pipe Sleeves: 3/8 inch.
 - b. Lifting and Bracing Inserts: As required by manufacturer.
 - c. Lateral Placement of Weld Plate Embedments: 1 inch.
 - d. Tipping and Flushness of Weld Plate Embedments: 1/4 inch.
 - 6. Deviation of Steel Reinforcement Cover: Maintain minimum cover required by ACI 301.

3.6 FACE-UP FINISHES

- A. Trowel Finish: After applying float finish, apply first trowel finish and consolidate plastic concrete by hand trowel or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and is uniform in texture and appearance.

3.7 FACE-DOWN FINISHES

- A. Smooth, As-Cast Finish: Cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

3.8 CONCRETE PROTECTING AND CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures according to ACI 301.
 - 1. Apply evaporation retarder in hot, dry, or windy weather to protect concrete from rapid moisture loss before and during finishing operations. Apply according to manufacturer's written instructions after screeding and bull floating concrete, but before float finishing.
- B. Begin curing immediately after finishing concrete. Cure by one or a combination of the following methods according to ACI 308.1:
 - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 ERECTION

- A. Use erection equipment with care to prevent damage to floor slabs and panels.
- B. Lift, support, and erect panels only at designated lifting or supporting points indicated on Shop Drawings.
- C. Do not erect panels until 75 percent of 28-day compressive strength of concrete has been verified.
- D. Install tilt-up concrete panels level, plumb, square, and true. Place panels on leveled grout-setting pads or shims in correct position. Maintain joint width of 1/2 inch between panels.
- E. Temporarily brace and support panels securely in position against loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to panels are secured.
- F. Anchor panels in place and, if indicated, to one another.
 - 1. Weld steel connectors to steel supports and embedments indicated, complying with AWS D1.1.
- G. Solidly grout-fill gaps between foundation system and bottom of panels.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Headed bolts and studs.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
 - 6. Verification of concrete strength before erection of tilt-up panels.
- C. Testing Services: Tests shall be performed according to ACI 301.

3.11 ERECTION TOLERANCES

- A. Install tilt-up concrete panels without exceeding the following erection tolerances:
 - 1. Joint Width Variation (Exterior Face): Without decreasing or increasing more than 50 percent from specified joint width, maintain joint width as follows:
 - a. For Panels up to 20 Feet Tall: 1/4 inch.
 - b. Each Additional 10 Feet in Excess of 20 Feet Tall: 1/8 inch.
 - 2. Joint Taper: Maximum 3/8 inch over length, but not greater than the following:
 - a. For Panels up to 20 Feet Tall: 1/4 inch.
 - b. Each Additional 10 Feet in Excess of 20 Feet Tall: 1/8 inch.
 - 3. Panel Alignment:
 - a. Alignment of Horizontal and Vertical Joints: 1/4 inch.
 - b. Offset in Exterior Face of Adjacent Panels: 1/4 inch.

3.12 FILLING AND REPAIRS

- A. Patch holes and voids left by erecting and bracing inserts on tilt-up panels and slabs-on-grade. Cut or chip edges of voids perpendicular to concrete surface. Fill blockouts where indicated.
 - 1. Clean, dampen with water, and brush-coat holes, voids, and blockouts with bonding agent. Fill and compact with patching mortar of a stiff consistency before bonding agent has dried.
 - 2. Finish surfaces of fills and repairs to Architect's approval, with materials of same colors and textures as finishes on surrounding surfaces.

- B. Repair damaged galvanized steel surfaces of connectors by cleaning and applying a coat of zinc repair paint.
- C. Repair damage to tilt-up panels and slabs-on-grade resulting from tilt-up work, as directed by Architect.
- D. Remove and replace tilt-up panels that do not comply with requirements in this Section.
- E. Demolish and remove temporary concrete casting slabs.

END OF SECTION

SECTION 03600
GROUT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specifications, apply to this section.

1.02 SUMMARY

- A. The work included under this section consists of furnishing all materials, forms, transportation and equipment, and performing all necessary labor to do all the pointing and patching of reinforced concrete paving and concrete sitework as shown on Drawings, or incidental to the proper execution of the work, or as herein specified.

- B. Related Sections: The following sections contain requirements that related to this section.

- 1. Section 02650 – Water Distribution System
- 2. Section 02710 – Sidewalks
- 3. Section 02720 – Storm Drainage System
- 4. Section 02730 – Sanitary Sewerage System

1.03 SUBMITTALS

- A. Submit to the Owner in accordance with general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections.

- 1. Grout design mix for Class A and Class B concrete

PART 2 - PRODUCTS

2.01 GENERAL

- A. Composition: Grout for pointing and patching shall consist of cement and fine aggregate
Holden Heights Community Center 3600-2 GROUT

mixed in the proportions used in the concrete and a minimum amount of water to produce a plastic workable grout mixture in accordance with all requirements under this section suitable to the specific conditions of placement.

- B. Non-shrink Grout: Non-shrink grout shall be nonmetallic, pre-mixed type and shall be Sauereisen F-100 Level Fill, Master Builders Masterflow 713, Burke Non-Ferrous, Non-Shrink Grout or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Grout Mixing:

1. Grout shall be mixed by hand.
2. Measurement: All materials, cement and fine aggregate, shall be measured by weight, except that water may be measured by volume.

3.02 INSTALLATION

- A. The grout shall be as thick as possible on vertical surfaces and at least 1/2-inch thick on horizontal surfaces.
- B. All voids produced by spacers or any honeycombing shall be pointed up with grout and troweled flush with the concrete surface immediately after removal of forms and water cured to prevent shrinkage.
- C. The use of grout pointing or patching shall be confined to the repair of small defects in relatively green concrete.

END OF SECTION

Division 4

Masonry

SECTION 04810
UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Masonry joint reinforcement.
 - 5. Miscellaneous masonry accessories.

1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- C. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.

2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Grout mixes. Include description of type and proportions of ingredients.
 4. Reinforcing bars.
 5. Joint reinforcement.
 6. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in.
- C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
 1. Provide special shapes for corners, jambs, bonding, and other special conditions.
 2. Provide square-edged units for outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90, Type II (Non-Moisture Controlled).
 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi .
 2. Weight Classification: Normal weight.

3. Size (Width): Manufacturer's standard units with face dimensions of 15-5/8 by 7-5/8 inches (actual), 7-5/8"x12-5/8" (actual), 7-5/8 inches by 7-5/8 inches (actual), 11-5/8 inches by 7-5/8 inches by 15-5/8 inches (actual).
4. Faces to Receive Stucco: Where units are indicated to receive a direct application of stucco, provide textured-face units made with gap-graded aggregates.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Masonry Cement: ASTM C270
- D. Mortar Cement: ASTM C 1329.
- E. Aggregate for Mortar: ASTM C 144.
- F. Aggregate for Grout: ASTM C 404.
- G. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.
 1. Exterior Walls: Hot-dip galvanized, carbon steel.
 2. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
 3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
 4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar.
 - 1. For reinforced masonry, use Type S.
- C. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying

unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- C. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. For conspicuous vertical lines, such as external corners and ends of walls, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 2. For conspicuous horizontal lines, such as tops of walls, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
- B. Cut joints flush for masonry walls to receive stucco.

3.5 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 1/2 inch. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls.

- B. Provide continuity at wall intersections by using prefabricated T-shaped units.
- C. Provide continuity at corners by using prefabricated L-shaped units.

3.6 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.7 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

3.8 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
 - 1. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 2. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 3. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.9 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

Division 5 Metals

SECTION 05120
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Sections include the following:
 - 1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 05 Section "Steel Decking" for field installation of shear connectors.
 - 3. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
 5. calculation for the components for exterior ceiling and wall framing
- C. Welding certificates.

D. Calculations:

The shop drawings for all steel connections as indicated in the construction documents shall be prepared under the direct supervision of a Professional Engineer, registered in the State that the project is located, employed by the fabricator. The shop drawings shall show complete details of the assembled joint with all bolts and welds required. Where the connections are detailed in the construction documents by the engineer of record or Where pre-designed connections are taken directly from tables in the AISC Manual, calculations need not be submitted provided the job design conditions precisely match those assumed in the tables, All steel shop drawings and the design calculations for the connections that are not designed by the engineer of record shall be signed and sealed by the fabricator's registered professional engineer. Shop drawings submitted that are not in compliance with the above requirements will not be approved.

E. Surveys:

The General Contractor shall employ a registered professional engineer or land surveyor for accurate erection of structural steel.

1. Initial Survey:

The surveyor or engineer shall check elevations of concrete and masonry bearing surfaces and anchor bolt locations prior to erection and submit any discrepancies to the Engineer prior to the start of erection. Corrections or compensating adjustments to the structural steel shall be made and approved prior to the start of erection.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- B. Comply with applicable provisions of the following specifications and documents:
 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- C. Unheaded Anchor Rods: ASTM F 1554, Grade 36 .
 1. Configuration: Straight.
 2. Nuts: ASTM A 563 heavy hex carbon steel.
 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 4. Washers: ASTM F 436 hardened carbon steel.
 5. Finish: Plain.

2.3 Hot Dip Galvanizing:

1. Scope:

Hot dip galvanizes after fabrication all structural steel items and their connections permanently exposed to the outside, whether specified on the drawings or not. Such items include, but are not limited to:

- a. Shelf angles.
- b. All embedded plates and connection steel plates or angles below grade such as tilt-up wall connections at foundation.
- c. Cooling tower support steel.

Examine the architectural and structural drawings for other items required to be hot dipped galvanized.

Galvanize all nuts, bolts, and washers used in the connection of such steel. Field welded connections shall have welds protected with "Z.R.C. Cold Galvanizing Compound" as manufactured by Z.R.C. Products Company.

2.4 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
 - 5. All exterior steel shall be hot-dip galvanized after fabrication, field touch-up damaged areas with two coats of galvanizing repair paint.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions. Hand welding of shear connectors will not be acceptable.
- F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.

- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to receive sprayed fire-resistive materials.
- B. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.9 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
- B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base plates. Clean bottom surface of base plates.
 1. Set base plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of base plate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and base plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow

to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design " for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded and shop welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Headed stud bases shall be qualified through an Application Qualification Test (AQT) in accordance with AWS D1.1, Section 7.6 and Annex G. In lieu of an AQT, the manufacturer's Qualification Test (QTD) data may be used. Equipment settings from AQT, or QTD, as applicable, shall serve as the basis for the field production setups.
 - 2. Pre-production testing and operator qualification shall be performed in accordance with Section 7.7 of AWS D1.1, except that a minimum of three studs shall be tested for each start, and shift, as defined by AWS D1.1 Section 7.7.1. Pre-production testing for each operator is required if more than one.
 - 3. All production (fabrication) studs shall be visually inspected in accordance with Section 7.8 of AWS D1.1.
 - 4. All production (fabrication) studs shall be subjected to hammer ping test. Studs with a hollow ping shall be subjected to bend test.
 - 5. Additionally, two studs shall undergo a bend test (torque test for a threaded stud) for every 110 studs installed within each set-up. These tests shall be performed as described in Section 7.8 of AWS D1.1 to insure that significant deviation from the initial set-up did not take place.

The frequency of these additional tests may be increased as directed by the engineer of record depending on failure rates.

6. Two additional tests per AWS D1.1 Sections 7.8 shall be performed at the start of any welding of studs through deck onto painted surfaces in order to qualify the procedure and the welder for this condition. These additional tests are not required if the paint has been removed from the welding surface. However, in no instance shall the weld occur through the coating which would be in any manner injurious to the strength and quality of the weld.
 7. Production studs not passing the visual test and bent at 15 degrees shall be left bent. All other studs bent at 30 degrees shall also be left bent.
 8. The results of the above tests 1, 2, 3, 4, 5, and 6 shall be submitted to the Architect/ Engineer of Record before concrete pour for wall, tilt-up wall, column, beam and composite slab.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories and abutting structural steel.
1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- B. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION

SECTION 05210
STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. K-series steel joists.
 - 2. Long span steel joist
 - 3. Joist girders.
 - 4. Joist accessories.

1.3 DEFINITIONS

- A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. Shop Drawings: Show layout, designation, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.
- C. Submit design calculations for all joists showing complete geometry and member sizes, including web and chord member splices to verify compliance with these specifications, contract drawings, and SJI specifications. Calculations shall be signed and sealed by a registered professional engineer in the state where the project is located.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."
- B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.

2.2 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.3 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- C. Camber joist according to SJI's "Specifications."
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 JOIST GIRDERS

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as follows:
 - 1. End Arrangement: Underslung with bottom-chord extensions.
 - 2. Top-Chord Arrangement: Parallel.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- C. Camber joist girders according to SJI's "Specifications."
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.
- C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.6 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by power-tool cleaning, SSPC-SP 3.
- B. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.
- C. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists abutting structural steel, and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05310
STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

- 1. Roof deck.
- 2. Acoustical roof deck.
- 3. Composite floor deck.

- B. Related Sections include the following:

- 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
- 2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
- 3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- B. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Bowman Metal Deck Div., Cyclops Corp.
 - 2. Epic Metal Corp.
 - 3. Consolidated Systems, Inc.
 - 4. Vulcraft Div., Nucor Corp.
 - 5. Wheeling Corrugating Co.
 - 6. Marlyn Steel Deck Co.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G90 zinc coating.
 - 2. Deck Profile: Per Structural Drawings.
 - 3. Profile Depth: Per Structural Drawings.
 - 4. Span Condition: Triple span or more.
 - 5. Side Laps: nested seam.

2.3 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G90zinc coating.
 - 2. Profile Depth: Per Structural Drawings.

3. Span Condition: Triple span or more.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- H. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Galvanizing Repair Paint: ASTM A 780.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Do not shore decking.
- C. Locate deck bundles to prevent overloading of supporting members.

- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
 - 2. Weld Spacing: Per Structural Drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 12 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
 - 2. Weld Spacing: Per Structural Drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 18 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.
- D. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05400
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior non-bearing wall framing.
 - 2. Exterior ceiling, fascias and soffit framing.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: as indicated in structural drawings.
- B. Component Design: Calculate structural properties of studs and joists in accordance with the American Iron and Steel Institute (AISI) "North American Specification for the Design of Cold-Formed Steel Structural Members of the American Iron and Steel Institute."
- C. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
- D. Technical tabulations of section properties and load capacities shall indicate dimensions, steel characteristics, and allowable stresses upon which computations are based.

1.3 SUBMITTALS

- A. Product Data: For each type of product and accessory indicated.
- B. Shop Drawings: Include placing drawings for framing members showing size and gage designations, number, type, location, and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories, and details required for proper installation.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Provide vertical stiffeners or support members to structure above to support exterior ceiling or soffit to prevent wind uplift and wind induced flutter.
- C. Welding certificates.
- D. Qualification data from testing agency.
- E. Research/evaluation reports.
- F. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
 1. Steel sheet.
 2. Expansion anchors.
 3. Power-actuated anchors.
 4. Mechanical fasteners.
 5. Vertical deflection clips.
 6. Horizontal drift deflection clips
 7. Miscellaneous structural clips and accessories.
- G. Shop drawings shall be stamped, sealed and signed by a registered structural engineer in the State of Florida. Indicate all loading requirements as specified herein and as required by State and local codes and regulations.

1.4 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."
 1. Field welding of studs shall not be permitted in exterior walls.
- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- E. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

- F. Pre-Installation Conference: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.
- G. The following documents of the issue in effect on date of material procurement, referred to thereafter by basic designation only, form a part of this Specification to the extent indicated by reference thereto.
 - 1. North American Specification for the Design of Cold-Formed Steel Structural Members, American Iron and Steel Institute.
 - 2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 4. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Fabricate metal framing components of corrosion resistant steel sheet conforming to ASTM A-1003/A 1003M, Structural Grade, Type H, and having yield strengths of 40,000 PSI for studs and 33,000 PSI for runners.
 - 2. Provide galvanized finish to metal framing components complying with ASTM A653/A653M for minimum G 60 coating.

2.2 EXTERIOR NON-BEARING WALL FRAMING, FASCIA, CEILING AND SOFFIT FRAMING

A. System Components: Manufacturers' standard structural steel studs and joists of type, size, shape, and gage as indicated. With each type of metal framing required, provide manufacturer's standard, steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system. Provide manufacturer's recommended "slip" connection where the deflections of overhead decking or structural members may cause an axial load to be imposed on the steel studs. Exterior ceilings and soffits shall be designed and constructed to support code required wind uplifts. Provide vertical stiffeners or support members to structure above to support ceiling or soffit to prevent wind uplift and wind induced flutter.

2.3 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- C. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless bolts, with encased end threaded, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class Retain paragraph below if expansion anchors are acceptable. Verify safety factor with Project's structural engineer. Revise as required or insert specific load requirements and names of acceptable products.
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.4 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035 or ASTM A 780. or Cold Galvanizing Compound: "ZRC Cold Galvanizing Compound", by ZRC Chemical Products.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/16 inch in 10 feet.

3.3 EXTERIOR NON-BEARING WALL, FASCIA, CEILING AND SOFFIT INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm)
- C. Set studs plumb, except as needed for diagonal bracing or required for non plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 1. Install single deflection tracks and anchor to building structure.
 2. Install double deflection tracks and anchor outer track to building structure.
 3. Connect vertical deflection clips to studs and anchor to primary building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking as indicated on Shop Drawing.
 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.4 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.

- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Steel framing and supports for countertops.
 - 2. Steel framing and supports for mechanical and electrical equipment.
 - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 4. Miscellaneous metal trim.
 - 5. Pipe bollards.
- B. Related Sections include the following:
 - 1. Section 05120: "Structural Steel" for structural-steel framing system components.
 - 2. Section 06100: "Rough Carpentry" for metal framing anchors and other rough hardware.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Paint products.
 - 2. Grout.
- B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.05 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.06 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.01 METALS

- A. Metal Surfaces: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- D. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- E. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- F. Slotted Channel Framing: Cold-formed metal channels with flange edges returned toward web and with 9/16-inch- wide slotted holes in webs at 2 inches o.c. Provide widths, depths and thicknesses as indicated or required.
- G. Malleable-Iron Castings: ASTM A 47, Grade 32510.

- H. Cast-in-Place Anchors in Concrete: Unless indicated or required otherwise, provide anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- I. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- J. Aluminum Extrusions: ASTM B 221, alloy 6063-T6.

2.02 PAINT

- A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FASTENERS

- A. Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Expansion Anchors: Except as detailed or required otherwise, provide anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
- C. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.04 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.05 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements in Section 03300: "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.06 FABRICATION

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

- J. Remove sharp or rough areas on exposed traffic surfaces.
- K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches wide by 1/4 inch thick by 8 inches long at 24 inches o.c., unless otherwise indicated.
- D. Galvanize miscellaneous framing and supports where indicated.

2.08 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 40 steel pipe.
 - 1. Cap bollards with 1/4-inch- minimum steel plate.
- B. Fabricate sleeves, when required, for bollard anchorage from steel pipe with 1/4-inch thick steel plate welded to bottom of sleeve.
- C. Fabricate internal sleeves for removable bollards, when required, from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 1/2-inch steel machine bolt.

2.09 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- E. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

3.03 INSTALLING PIPE BOLLARDS

- A. Install pipe bollards to comply with one of the following methods unless directed otherwise.
- B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete: After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- C. Anchor bollards in concrete in formed or core-drilled holes: Provide holes not less than 8 inches deep and 3/4 inch greater than OD of bollard. After bollards have been inserted into holes, fill annular space surrounding bollard solidly with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings: Support and brace bollards in position in footing excavations until concrete has been placed and cured.
- E. Unless required otherwise, fill bollards solidly with concrete, mounding top surface.

3.04 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

Division 6

Wood and Plastics

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Wood blocking.
 - 2. Plywood backing panels.

1.03 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association.
 - 2. NLGA - National Lumber Grades Authority.
 - 3. RIS - Redwood Inspection Service.
 - 4. SPIB - Southern Pine Inspection Bureau.
 - 5. WCLIB - West Coast Lumber Inspection Bureau.
 - 6. WWPA - Western Wood Products Association.

1.04 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Preservative-treated wood.
 2. Fire-retardant-treated wood.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:
 - a. Ammoniacal, or amine, copper quat (ACQ).
 - b. Ammoniacal copper citrate (CC).
 - c. Copper azole, Type A (CBA-A).
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches above grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated lumber and plywood are indicated, use materials impregnated with fire-retardant chemicals by a pressure process or other means acceptable to authorities having jurisdiction to produce products with the following fire-test-response characteristics:
 - 1. Flame-spread index of not greater than 25 when tested according to ASTM E 84.
 - 2. Flame-spread index of not greater than 25 when tested according to ASTM E 84 with test continued for a period of 30 minutes with no evidence of significant progressive combustion. Flame front shall not progress more than 10-1/2 feet (3.2 m) beyond centerline of burner at any time during test.
- B. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.

- C. Interior, Low-Hygroscopic-Type, Fire-Retardant Treatment: Formulation that results in treated material with an apparent moisture content of not more than 28 percent when tested according to ASTM D 3201 at 92 percent relative humidity.
- D. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber and plywood from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- E. Kiln-dry material after treatment to levels required for untreated material. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

2.04 DIMENSION LUMBER

- A. Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

2.05 MISCELLANEOUS LUMBER

- A. Provide lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
 - 1. Mixed southern pine; SPIB.
 - 2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 - 3. Eastern softwoods; NELMA.
 - 4. Northern species; NLGA.
 - 5. Western woods; WCLIB or WWPA.
- C. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.06 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4 inch thick.

2.07 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material (interior locations): Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material (exterior locations): Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Apply field treatment complying with AWWPA M4 to cut surfaces of preservative-treated lumber and plywood.

- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. CABO NER-272 for power-driven fasteners.
 2. Published requirements of metal framing anchor manufacturer.
 3. Table 2306.1, "Fastening Schedule," in the Standard Building Code.
- E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.
- F. Blocking and Nailer Installation:
1. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
 2. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.
- G. Plywood Backing Panels: Nail or screw to supports.

END OF SECTION

SECTION 06402
INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Plastic-laminate cabinets.
 - 3. Plastic-laminate and solid surface countertops.
 - 4. Shop finishing interior woodwork.

1.03 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated, including] [cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples for Verification: For the following:
 - 1. Exposed cabinet hardware and accessories, two of each type and finish.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Fabricator Qualifications: A firm experienced in production of architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork.
 - D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for specified grades of interior architectural woodwork, construction, finishes, and other requirements.
 - 1. Provide AWI Quality Certification Program certificate indicating that woodwork complies with requirements of grades specified.
 - E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.
- 1.07 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
 - B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.08 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.01 PRODUCT MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering high pressure decorative laminates which may be incorporated into the Work include, but are not limited to, the following:
 - 1. Formica Corp. (Basis of Design)
 - 2. International Paper; Decorative Products Div.
 - 3. Laminart.
 - 4. Pioneer Plastics Corp.
 - 5. Westinghouse Electric Corp.; Specialty Products Div.
 - 6. Wilsonart International; Div. of Premark International, Inc.

2.02 MATERIALS

- A. Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 3. Hardwood Plywood: HPVA HP-1.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
- D. Adhesive for Bonding Plastic Laminate: As recommended by manufacturer and fabricator.

2.03 CABINET HARDWARE AND ACCESSORIES

- A. Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

- C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Provide Type 2 (institutional) stainless steel complying with Satin Stainless Steel: BHMA 630.
- D. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- E. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings and nylon roller, BHMA A156.9, B05091, and rated for the following loads:
 - 1. Box Drawer Slides: 75 lbf.

2.04 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.05 FABRICATION, GENERAL

- A. Interior Woodwork: Provide interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
 - 2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

- E. Factory cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of water resistant coating.
 - 2. Provide a continuous preservative pressure treated wood base for all cabinetwork. Refer to Division 6 Section: Rough Carpentry for acceptable preservative materials and processes.
 - 3. Provide plywood substrates for floor based cabinetwork in Kitchen areas and in cabinets within 24 inches of sinks, water heaters and dishwashers.
- 2.06 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH
- A. Quality Standard: Comply with AWI Section 300.
 - B. Grade: Custom.
 - C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
 - D. Assemble casings in plant except where limitations of access to place of installation require field assembly.
 - E. Wood Species and Cut: Red oak, plain sliced.
- 2.07 PLASTIC-LAMINATE CABINETS
- A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.
 - B. Grade: **Custom.**
 - C. AWI Type of Cabinet Construction: Flush overlay.
 - D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. Provide materials for Architect's selections from laminate manufacturer's full range of colors and finishes.
 - b. Horizontal Surfaces Other than Tops: GP-50, **0.050-inch (1.270-mm)** nominal thickness.
 - c. Postformed Surfaces: PF-42, **0.042-inch (1.067-mm)** nominal thickness.
 - d. Vertical Surfaces: GP-28, **0.028-inch (0.711-mm)** nominal thickness.
 - e. Edges: GP-50, **0.050-inch (1.270-mm)** nominal thickness.

- E. Semiexposed Surfaces: Provide surface materials indicated below:
1. Surfaces Other than Drawer Bodies: High-pressure decorative laminate, Grade GP-28, except as otherwise indicated.
 2. Cabinet lining: FL-20 (.020 in. nominal thickness).
 3. Panel Backing: BK 20 (.020 in. nominal thickness).
 4. Drawer Sides and Backs: Shop finished solid hardwood lumber, or thermoset decorative overlay.
 5. Drawer Bottoms: Shop finished solid hardwood lumber, or thermoset decorative overlay.
- F. Cabinet Wood Base: Provide preservative pressure treated continuous wood base for all base cabinets.

2.08 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.
- B. Grade: Custom.
- C. High-pressure decorative laminate complying with the following:
1. Grade: GP-50, 0.050-inch nominal thickness.
 2. Grade: PF-42, 0.042-inch nominal thickness.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Provide materials for Architect's selections from manufacturer's full range of colors and finishes.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces.

2.09 SOLID SURFACE COUNTERTOPS

- A. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
1. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Corian; DuPont Polymers (Basis of Design)
 - b. Avonite; Avonite, Inc.
 - c. Surell; Formica Corporation.
 - d. Fountainhead; International Paper, Decorative Products Div.
 - e. Swanstone; Swan Corporation (The).

- f. Gibraltar; Wilsonart International, Div. of Premark International, Inc.

2.10 SHOP PREPARATION

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.
- D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
 - 1. Grade: Custom.
 - 2. AWI Finish System TR-4: Conversion varnish, or
 - 3. AWI Finish System TR-5: Catalyzed vinyl lacquer.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.02 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

- C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than **60 inches** long, except where shorter single-length pieces are necessary.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 - 2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Except when hanging cleats are approved, fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c.
- G. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

3.03 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06640
PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.
- C. Samples for Initial Selection: For each type of plastic paneling and trim accessories involving color selection, in manufacturer's standard sizes.
- D. Product Certificates: For each type of plastic paneling certifying materials comply with specified performance characteristics, criteria, and physical requirements.
 - 1. Deliver certificates, signed by manufacturer at time of product manufacture, with plastic paneling delivered to site.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Testing Agency: Acceptable to authorities having jurisdiction.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination". Review

methods and procedures related to plastic paneling including, but not limited to, the following:

1. Substrate conditions.
2. Manufacturer's installation instructions.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual measurements/openings by field measurements before fabrication and indicate measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 - PRODUCTS

2.1 PLASTIC SHEET PANELING

- A. General: Glass-fiber reinforced plastic panels complying with ASTM D 3841.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Kemlite Company Inc.; PIF and FXI or comparable product by one of the following:
 - a. Glasteel.
 - b. Lasco.
 - c. Sequentia.
 2. Flame-Spread Index: As required based on specific locations.
 - a. Class A Locations: Flame-Spread Index: 25 or less.
 - b. Class C Locations: Flame-Spread Index: 200 or less.
 3. Smoke-Developed Index: 450 or less.
 4. Nominal Thickness: Not less than 0.09 inch (2.3 mm).
 5. Surface Finish: Molded pebble texture.
 6. Surface Protection: Provide manufacturer's proprietary surface protection for glass-fiber reinforced plastic panels.
 7. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside

corners, caps, and outside angles as needed to conceal edges; longest length possible to eliminate end joints.

1. Color: Match panels.
- B. Trim Accessories: Manufacturer's standard two-piece, snap-on vinyl extrusions designed to cover edges of panels. Provide division bars as needed to conceal edges; longest length possible to eliminate end joints.
1. Color: Match panels.
- C. Adhesive: As recommended by plastic paneling manufacturer.
- D. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."
- E. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
1. Color: Match panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
 1. Mark plumb lines on substrate at trim accessory or panel joint locations for accurate installation.

2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels **over cmu, concrete, and non-porous substrates** with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
 1. Drill oversized fastener holes in panels and center fasteners in holes.
 2. Apply sealant to fastener holes before installing fasteners.
- D. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.
- E. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- F. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

Division 7
Thermal and Moisture
Protection

SECTION 07115
BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes hot-applied and cold-applied, emulsified- asphalt dampproofing applied to the following surfaces:
 - 1. Exterior, below-grade surfaces of concrete and masonry foundation walls.
 - 2. Exterior face of inner wythe of exterior masonry cavity walls.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.
- B. Material Certificates: For each product, signed by manufacturers.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.05 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hot-Applied Asphalt Dampproofing:

- a. Meadows, W. R., Inc.
- b. Owens Corning; Trumbull Division.
- c. Or approved equal

2. Cold-Applied, Cut-Back (Solvent-Based) Asphalt Dampproofing:

- a. Gardner Asphalt Corporation.
- b. Henry Company.
- c. Karnak Corporation.
- d. Koppers Industries, Inc.
- e. Malarkey Roofing Company.
- f. Meadows, W. R., Inc.
- g. Sonneborn, Div. of ChemRex, Inc.
- h. Tamms Industries.

3. Cold-Applied, Emulsified-Asphalt Dampproofing:

- a. Euclid Chemical Company (The).
- b. Gardner Asphalt Corporation.
- c. Henry Company.
- d. Karnak Corporation.
- e. Koppers Industries, Inc.
- f. Malarkey Roofing Company.
- g. Meadows, W. R., Inc.
- h. Sonneborn, Div. of ChemRex, Inc.
- i. Tamms Industries.

4. Protection Course, Asphalt-Board Type:

- a. Grace, W. R. & Co.; Construction Products Div.
- b. Meadows, W. R., Inc.
- c. Sonneborn, Div. of ChemRex, Inc.

2.02 BITUMINOUS DAMPPROOFING

- A. Odor Elimination: For interior and concealed-in-wall uses other than exterior face of inner wythe of cavity walls, provide dampproofing material warranted by manufacturer to be substantially odor free after drying for 24 hours under normal conditions.
- B. Hot-Applied Asphalt Dampproofing: ASTM D 449, Type I.
- C. Cold-Applied, Emulsified-Asphalt Dampproofing:
 - 1. Trowel Coats: ASTM D 1227, Type II, Class 1.
 - 2. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
 - 3. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.03 MISCELLANEOUS MATERIALS

- A. Cut-Back Asphalt Primer: ASTM D 41.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Protection Course, Asphalt-Board Type: Premolded, 1/8-inch- (3-mm-) thick, multi-ply, semirigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on 1 side with polyethylene film.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
 - 1. Begin dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
 - 1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.
 - 2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
- B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior whether indicated or not.
 - 1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of **6 inches (150 mm)** over outside face of footing.
 - 2. Extend **12 inches (300 mm)** onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an **8-inch- (200-mm-)** wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat required for embedding fabric is in addition to other coats required.
- C. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls.
 - 1. Lap dampproofing at least **1/4 inch (6 mm)** onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
 - 2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least **1/4 inch (6 mm)** onto shelf angles supporting veneer.
- D. Provide hot-applied, cold-applied, emulsified- asphalt dampproofing, as specified in subsequent articles for substrates indicated, within the following limitations:
 - 1. Use hot-applied asphalt dampproofing only on exterior, below-grade surfaces or earth-covered areas of building and at elevator pit walls.
 - 2. Use cold-applied, emulsified-asphalt dampproofing on exterior face of inner wythe of cavity walls.

3.04 HOT-APPLIED ASPHALT DAMPPROOFING

- A. Do not apply hot asphalt when substrate condition causes foaming.
- B. Prime masonry and other porous substrates.

- C. Apply a uniform coat of hot asphalt by mopping or spraying at not less than **20 lb or 2.5 gal./100 sq. ft. (98 kg or 1 L/sq. m)**.
- D. Apply a second coat to below-grade foundation walls as specified above. Apply double thickness of second coat where first application has failed to produce a smooth, shiny, impervious coat.

3.05 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than **1 gal./100 sq. ft. (0.4 L/sq. m)**.

3.06 INSTALLATION OF PROTECTION COURSE

- A. Install protection course over completed-and-cured dampproofing at below grade dampproofing only. Comply with dampproofing material manufacturer's written recommendations for attaching protection course. Support protection course with spot application of trowel-grade mastic where not otherwise indicated.

3.07 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION

SECTION 07132

SHEET WATERPROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes, but is not limited to, self-adhering waterproofing at:
 - 1. Exterior side of below grade wall surfaces at building perimeter walls.
 - 2. Other locations indicated or required.
- B. Provide waterproofing materials selected from the following types:
 - 1. Rubberized-asphalt sheet waterproofing.
 - 2. Rubberized-asphalt sheet waterproofing, fabric reinforced.

1.03 PERFORMANCE REQUIREMENTS

- A. Provide waterproofing that prevents the passage of water.

1.04 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- C. Samples: For the following products:
 - 1. 12-by-12-inch square of waterproofing and flashing sheet.
- D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- E. Product Test Reports: From a qualified independent testing agency indicating and interpreting test results of waterproofing for compliance with requirements, based on comprehensive testing of current waterproofing formulations.

- F. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is authorized, approved, or licensed by waterproofing manufacturer to install manufacturer's products.
- B. Source Limitations: Obtain waterproofing materials through one source from a single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination" Article - Project Meetings. Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Store rolls according to manufacturer's written instructions.
- E. Protect stored materials from direct sunlight.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.08 WARRANTY

- A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during specified warranty period.
 - 1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.
 - 2. Warranty Period: Five years after date of Substantial Completion.
- B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years.
 - 1. Warranty includes removing and reinstalling protection board.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Rubberized-Asphalt Sheet Waterproofing:
 - a. American Hydrotech, Inc.; VM 75.
 - b. Carlisle Corporation, Carlisle Coatings & Waterproofing Div.; CCW 701.
 - c. W. R. Grace & Co.; Bituthene.
 - d. T. C. Miradri; Miradri.
 - 2. Optional Alternative Products: Rubberized-Asphalt Sheet Waterproofing, Fabric Reinforced:
 - a. Protecto Wrap Co.; Jiffy Seal 140/60.
 - b. Royston Laboratories, Div. of Chase Corporation; Royal-Gard.

2.02 RUBBERIZED-ASPHALT SHEET WATERPROOFING

- A. Rubberized-Asphalt Sheet: 60-mil- thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil- thick, polyethylene film with release liner on adhesive side.
 - 1. Physical Properties: As follows, measured per standard test methods referenced:
 - a. Tensile Strength: 250 psi minimum; ASTM D 412, Die C, modified.
 - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
 - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
 - e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
 - f. Hydrostatic-Head Resistance: 150 feet minimum; ASTM D 5385.
 - g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
 - h. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

- B. Rubberized-Asphalt Sheet, Fabric Reinforced: 60-mil- thick, self-adhering sheet consisting of rubberized-asphalt membrane embedded in spun-bonded polyester or fiberglass nonwoven fabric reinforcement laminated to a 0.50-mil- thick, polyester film with release liner on adhesive side, with the following physical properties measured per standard test methods referenced:
 - 1. Pliability: No cracks when bent 180 degrees over a 1-inch mandrel at minus 25 deg F; ASTM D 146.
 - 2. Hydrostatic-Head Resistance: 150 feet minimum.
 - 3. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.

2.03 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid primer recommended for substrate by manufacturer of sheet waterproofing material.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.
- D. Sheet Strips: Self-adhering, rubberized-asphalt composite sheet strips of same material and thickness as sheet waterproofing.
- E. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.
- F. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.
- G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.
- H. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.
- I. Protection Course: Semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - 1. Thickness: 1/8 inch, nominal, for vertical applications; 1/4 inch, nominal, elsewhere.
 - 2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for type of protection course.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that earth material has been adequately and properly removed, at required existing areas, to required / necessary depths.
 - 2. When applied over new concrete, verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, and treat required new and existing substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- F. Bridge and cover isolation joints, expansion and other joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.03 SHEET WATERPROOFING APPLICATION

- A. Install self-adhering sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.
- D. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.
- E. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.
- F. When required by existing conditions, install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheets extending 6 inches beyond repaired areas in all directions.
- H. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings at no additional cost to Owner.

3.04 PROTECTION COURSE INSTALLATION

- A. Install protection course with butted joints over waterproofing membrane before starting subsequent construction operations, or placing backfill.

END OF SECTION

SECTION 07210

THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Concealed and exposed building insulation.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.01 INSULATING MATERIALS

- A. Provide insulating materials that comply with requirements and with referenced standards.
1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Unfaced, Mineral-Fiber Blanket Insulation: Thermal insulation combining fibers of glass, slag wool, or rock wool with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).
- C. Exterior Wall Thermal Insulation: Provide the following where indicated.
1. Unfaced, Glass-Fiber Board Insulation: ASTM C 612, Type IA or Types IA and IB; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
 2. Extruded-Polystyrene Board Insulation: Rigid extruded closed cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using HCFCs as blowing agents, complying with ASTM C 578, Type IV (1.60 lb/cu. ft.), or Type X, (1.30 lb/cu. ft.).
 - a. Water absorption: Max. 0.1 % by volume (ASTM C 272).
 - b. Surface Burning Characteristics: Flame spread: 5; Smoke developed: 165.
 - c. Recycled Content: Not less than 50 percent blend of postconsumer and recovered polystyrene resins.
 3. Foamed-in-Place Insulation: Two component system, that when properly ratioed and propelled by compressed air, produces an expanding foam insulation which fills irregular cavities, sets cold in less than 60 seconds, and achieves final cure in less than 72 hours. ASTM D 1622. Density of 0.7 to 0.9 pcf dry.
 - a. R-Value: Calculations for R-Values shall use 6.70 and 10.0 for nominal 8" and 12" normal weight block respectively, without regard for any manufacturer or industry association publications to the contrary.
 - b. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 - 1) CP Chemical Co.
 - 2) Tailored Chemical Products.
 - 3) Thermo Foam Insulation.
- D. Glass-Mat-Faced, Glass-Fiber Board Insulation: ASTM C 612, Type IA or Types IA and IB; faced on one side with black glass-fiber mat; maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:
1. Nominal density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F (29.1 K x m/W at 24 deg C).

2.02 AUXILIARY INSULATING MATERIALS AND FASTENERS

- A. Adhesive for Bonding Board Type Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates and as recommended by insulation manufacturer.
- B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
1. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper-coated, low carbon steel, fully annealed, 0.105 inch (2.67 mm) in diameter, length to suit depth of insulation indicated.
- C. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
1. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
 2. Spindle: Copper-coated, low carbon steel, fully annealed, 0.105 inch (2.67 mm) in diameter, length to suit depth of insulation indicated.
- D. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.
- E. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of dimension indicated between face of insulation and substrate to which anchor is attached.
- F. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
- H. Vapor and Air Barrier System: Product designed to function as a monolithic air and vapor barrier membrane, formulated for spray application.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Grace, Perm-A-Barrier Liquid.
 - b. Carlisle, Barriseal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of substances harmful to insulations, including removing projections capable of puncturing or interfering with insulation attachment.

3.03 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.04 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
- C. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
- D. Install board insulation on substrates by adhesively attached, spindle-type insulation anchors as follows:
1. Fasten insulation anchors to substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- E. Install extruded-polystyrene board insulation as follows:
1. Fit courses of insulation between furring and other confining obstructions, with edges butted tightly both ways. Retain in place with small pads of adhesive or other means as recommended by manufacturer until gypsum board is placed.
- F. Install foamed-in-place insulation in masonry cells as indicated, complying with manufacturer's written instructions. Installation shall be free of voids, cavities, air pockets, etc.
- G. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
1. Retain insulation in place by metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
 2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.
- H. Stuff mineral-fiber insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
- I. Spray Vapor and Air Barrier System lapping onto adjacent wall and roof deck surfaces, to provide a complete seal at joints and penetrations.

3.05 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07220
ROOF INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Roof insulation.

1.3 PERFORMANCE REQUIREMENTS

- A. Roofing System Design: Provide an insulation installation for roofing systems identical to those portions of roof assemblies that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressures calculated according to [the Wind Information located on Drawings](#), using the appropriate factors and coefficients.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, sections, details, and attachments to other Work.
 - 1. Tapered insulation, including slopes.
 - 2. Crickets, saddles, and tapered edge strips, including slopes.
 - 3. Insulation fastening patterns.
 - 4. Cover board fastening patterns.
 - 5. Sheathing fastening patterns.
 - 6. Submit evidence of complying with design requirements. Include Engineering Calculations signed and sealed by the qualified professional engineer who was responsible for their preparation.
- C. Samples for Verification: For the following products:
 - 1. **12-by-12-inch (300-by-300-mm)** square of roof insulation.
 - 2. Six fasteners of each type, length, and finish.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing.
- B. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- C. Handle, place and store materials in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

PART 2 - PRODUCTS

2.1 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate.
 - 1. Product: Subject to compliance with requirements, provide "Dens-Deck" by Georgia-Pacific Corporation.
 - a. Regular: Minimum 1/4 inch (6 mm) thick.
 - b. Fire Rated: Type X, 5/8 inch (16 mm) thick.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening substrate panel to roof deck.

2.2 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6-lb/cu. ft. (26-kg/cu. m) or X, 1.3-lb/cu. ft. (21-kg/cu. m) minimum density, square edged.
 - 1. Minimum total thickness of extruded polystyrene insulation on roof: 4 inches; individual board thickness may not exceed 2 inches.
 - 2. Additional thickness as required for fill.
- C. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 3, felt or glass-fiber mat facer on both major surfaces.
 - 1. Minimum total thickness of polyisocyanurate insulation on roof: 4 inches; individual board thickness may not exceed 2 inches.
 - 2. Additional thickness as required for fill.
 - 3. Board length or width may not exceed 48 inches.
- D. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated, that comply with requirements indicated.
 - 1. Extruded-Polystyrene Board Insulation.
 - 2. Polyisocyanurate Board Insulation.
- E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.3 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch (6 mm) thick minimum.
 - 1. Product: Provide one of the following based on the type of roof system to be installed over it.
 - a. Provide "Dens-Deck" by Georgia-Pacific Corporation for mechanically attached thermoplastic membrane roofing.

- b. Provide "Dens-Deck Prime" by Georgia-Pacific Corporation for fully adhered thermoplastic membrane roofing.
 - c. Provide "Dens-Deck DuraGuard" by Georgia-Pacific Corporation for hot mopped modified bituminous membrane roofing.
- D. Sheathing, Roof Side, Parapets and Area Divider Walls: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (12 mm) thick minimum.
- 1. Product: Provide one of the following based on the type of roof system to be installed over it.
 - a. Provide "Dens-Deck" by Georgia-Pacific Corporation for mechanically attached thermoplastic membrane roofing.
 - b. Provide "Dens-Deck Prime" by Georgia-Pacific Corporation for fully adhered thermoplastic membrane roofing.
 - c. Provide "Dens-Deck DuraGuard" by Georgia-Pacific Corporation for hot mopped modified bituminous membrane roofing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck comply with requirements in Division 05 Section "Steel Decking."
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of debris, moisture, and other substances detrimental to insulation installation according to manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Deck," according to acoustical roof deck manufacturer's written instructions.

3.3 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.

3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Install layers with joints of each succeeding layer staggered from joints of previous layer a minimum of **6 inches (150 mm)** in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding **1/4 inch (6 mm)** with insulation.
 - 1. Cut and fit insulation tight to nailers, projections, and penetrations.
- G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of **6 inches (150 mm)** in each direction. Loosely butt cover boards together and fasten to roof deck.
 - 1. Fasten to resist uplift pressure at corners, perimeter, and field of roof.
- I. Install sheathing where roof membrane flashing will be installed. Loosely butt sheathing boards together and fasten to structure below.
 - 1. Fasten to resist uplift pressure at parapets and area divider walls.

3.5 PROTECTION

- A. Protect insulation from damage and water during remainder of construction period.

END OF SECTION

SECTION 07413
COMPOSITE METAL PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes composite metal panel system

1.03 PERFORMANCE REQUIREMENTS

- A. General: Provide composite metal panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.
- B. Air Infiltration: Provide composite metal panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 4.0 lbf/sq. ft.
- C. Water Penetration: Provide composite metal panel assemblies with no water penetration as defined in the test method when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. and not more than 12.0 lb/sq. ft.
- D. Structural Performance: Provide composite metal panel assemblies capable of withstanding design wind loads indicated under in-service conditions with deflection no greater than the following, based on testing manufacturer's standard units according to ASTM E 330 by a qualified independent testing and inspecting agency.
 - 1. Maximum Deflection: 1/180 of the span.
- E. Wind Loading: Design wall panel system to meet wind-loading requirements for the IBC. Refer to Structural Drawings for wind velocity

1.04 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.
2. Shop Drawings: Submit shop drawings showing project layout and elevations; fastening and anchoring methods; detail and location of joints, sealant, and gaskets, including joints necessary to accommodate thermal movement; trim; flashing; and accessories.
 - a. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - b. Shop drawings shall show the preferred joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration, on the inside face of the panel system as determined by ASTM E 331. Systems not utilizing a construction sealant at the panel joints (i.e. Dry System) shall provide a means of concealed drainage with baffles and weeps for water which may accumulate in members of the system.
 - c. Shop Drawings shall bear the seal and signature of Structural Engineer registered in the State of Florida.
 - d. Calculations for wind load design shall be stamped, sealed and signed by a Professional Engineer in the State of Florida verifying compliance with ASCE 7.
3. Samples for Verification: Provide sample panels 12 inches long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.
4. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
5. Product Test Reports: Indicate compliance of composite metal panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed metal wall panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699.
- D. Fire-Test-Response Characteristics: Where fire-resistance-rated wall panel assemblies are indicated, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: As indicated by design designations in UL's "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

E. Mockups: Before installing wall panels, construct mockups indicated to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using exposed and concealed materials indicated for the completed Work.

1. Construct a complete panel system mock-up. Provide a 4-foot long section of each profile.
2. Obtain Architect's approval of mockups before proceeding with construction of wall panels.
3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.
- B. Exercise care in unloading, storing, and erecting wall panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish opening dimensions and proceed with fabricating wall panels without field measurements or allow for trimming panel units. Coordinate wall construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.08 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence

of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

- C. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Product and Manufacturer: Alpolic, Mitsubishi Chemical America, Inc. – or approved equal

2.02 MATERIALS

- A. Aluminum faced composite wall panels with mounting system. Panel mounting system including concealed fasteners, shims, furring, gaskets and sealants, related flashing adapters, and masking as required for a complete watertight system.

1. Panel Thickness: 4mm (0.157").

- B. Panel Composition: Two sheets of aluminum sandwiching a core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. Products laminated sheet by sheet or in a batch process using glues or adhesives between materials are not acceptable.

1. Aluminum Face Sheet Thickness: 0.50mm (0.0197")

- a. Alloy: AA3003 Painted material.

2. Panel Weight: 4mm (0.157"): 1.12 lbs./ft²

- C. Tolerances:

1. Panel Bow: Maximum 0.8% of panel dimension in width and length.
2. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
3. Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.
4. Maximum deviation from panel flatness shall be 1/8" in 5'0" on panel in any direction for assembled units. (Non-accumulative)

2.03 SYSTEM CHARACTERISTICS

- A. System Characteristics. Plans, elevations, details, characteristics, and other requirements indicated are based upon standards by one manufacturer. It is intended that other manufacturers may be acceptable provided their details and characteristics comply with size and profile requirements, and material/performance standards as follows:

1. System shall provide a wet seal reveal joint or an aluminum extrusion as detailed on drawings. Sealant type shall be as specified in Section 07901 with foamed type backer rod.

2. System shall not have any visible fasteners, telegraphing or fastening on the panel faces or any other compromise of a neat and flat appearance.
3. System shall comply with the applicable provisions of the "Metal Curtain Wall, Window, Storefront, and Entrance Guide Specifications Manual" by AAMA and ANSI/AAMA 302.9 requirements for aluminum windows.
4. Fabricate panel system to dimension, size, and profile indicated on the drawings based on a design temperature in accordance with local design ambient conditions.
5. Fabricate panel system so that no restraints can be placed on the panel which might result in compressive skin stresses. The installation detailing shall be such that the panels remain flat regardless of temperature changes and at all times remain air and water tight.
6. The finish side of the panel shall have a removable plastic film applied prior to fabrication which shall remain on the panel during fabrication, shipping, and erection to protect the surface from damage.

2.04 METALS AND FINISHES

- A. Aluminum Sheet: Aluminum sheet complying with ASTM B 209 for alclad alloy 3003, with temper as required to suit forming operations, with the following requirements:
1. Surface: Smooth, flat, mill finish.
 2. Exposed Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - a. Fluoropolymer 2-Coat Coating System: Manufacturer's 2-coat, thermocured system composed of specially formulated 0.2 mil thick inhibitive primer and 0.8 mil thick fluoropolymer top coat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 1402, Test Method No. 7. Provide a minimum total dry film thickness of 2.4 mils, with a 30 percent reflective gloss when tested according to ASTM D 523.
 - 1) Color: Dark bronze to match color of storefront aluminum window frame system.

2.05 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
1. Use aluminum or stainless-steel fasteners for exterior applications and aluminum fasteners for interior applications.
 2. Provide washers and weather seals as necessary at exterior penetrations.
- B. Accessories: Provide the following.
1. Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.
 2. Panel stiffeners, if required, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
 3. Sealants and gaskets within the panel system shall be as per manufacturer's

standards to meet performance requirements.

4. Fabricate flashing materials from 0.030" minimum thickness aluminum sheet painted to match the adjacent curtain wall / panel system where exposed. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bed of non-hardening sealant.
5. Fasteners (concealed/exposed, non-corrosive/concealed and exposed, non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal. Delete fastener not required.

C. Vapor Barrier:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vycor Ultra; Grace: W.R. Grace & Co.

2.06 FABRICATION

A. General: Fabricate and finish panels and accessories at the factory by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Fabricate panel joints with captive gaskets or separator strips that provide a tight weather seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
2. Reveals: 1/2 inch by 1/2 inch
3. NO FIELD FABRICATION WILL BE ALLOWED

2.07 SECONDARY FRAMING

A. Panel Supports and Anchorage: Provide girts, furring channels, angles, plates, bracing, and other secondary framing members.

1. Girts: C- or Z-shaped sections fabricated from minimum 0.0598-inch-thick, shop-painted, roll-formed steel.
2. Flange and Sag Bracing: 1-5/8-by-1-5/8-inch angles, fabricated from minimum 0.0598-inch-thick, shop-painted, roll-formed steel.
3. Base or Sill Angles: Fabricate from minimum 0.079-inch-thick, cold-formed, galvanized steel sections.
4. Secondary structural members, except columns and beams, shall be manufacturer's standard sections fabricated from minimum 0.079-inch-thick, cold-formed galvanized steel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panel walls.

1. Panel Supports and Anchorage: Examine wall framing to verify that girts, angles, and other secondary structural panel support members and anchorage have

- been installed to meet requirements of panel manufacturer.
2. Do not proceed with wall panel installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate metal wall panels with rain drainage work; flashing; trim; and construction of soffits, roofing, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.
- C. Secondary Structural Supports: Install girts, angles, and other secondary structural panel support members and anchorage according to the Light Gage Structural Institute's "Guide Specifications".

3.03 PANEL INSTALLATION

- A. General: Erect panels plumb, level, and true. Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted.
- B. Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation. Panels shall be erected in accordance with an approved set of shop drawings. Anchor panels securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.
- C. Conform to panel fabricator's instructions for installation of concealed fasteners.
- D. Do not install component parts which are observed to be defective, including; warped, bowed, dented, abraded, and broken members.
- E. Do not cut, trim, weld, or braze component parts during erection in a manner which would damage the finish, decrease strength, or result in a visual imperfection or a failure in performance.
- F. Return component parts which require alteration to shop for refabrication, if possible, or for replacement for new parts.
- G. Separate dissimilar metals and use gasketed fasteners where needed to eliminate the possibility of corrosive or electrolytic action between metals.

3.04 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces

Bid Documents

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as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION

SECTION 07540
THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Thermoplastic membrane roofing system.

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Corner: The area defined as the portion of the roof beginning at the intersection of two roof edges and proceeding in both directions, having sides equal to the greater of 0.4 times the building's height or 0.1 times the building's width, but not less than 4 feet.
- C. Perimeter: The area defined as the outer boundary of the roof with a width equal to the smaller of 0.4 times the building's height or 0.1 times the building's width, but not less than 4 feet.
- D. Roof Field: The remainder of the roof not included in the corner and perimeter areas.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting

agency to resist uplift pressures calculated according to [the Wind Information located on the Drawings](#), using the appropriate factors and coefficients.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Membrane sheet layout.
 - 2. Membrane flashings and terminations.
 - 3. Walkpad layout.
- C. Samples for Verification: For the following products:
 - 1. **12-by-12-inch (300-by-300-mm)** square of sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. **12-by-12-inch (300-by-300-mm)** square of walkway pads or rolls.
 - 3. **12-inch (300-mm)** length of metal termination bars.
 - 4. **12-inch (300-mm)** length of battens.
 - 5. Six roof cover fasteners of each type, length, and finish.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system with required warranty.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements. [Include Engineering Calculations signed and sealed by the qualified professional engineer who was responsible for their preparation.](#)
- F. Maintenance Data: For roofing system to include in maintenance manuals.
- G. Warranties:
 - 1. [Notice of Intent to Warrant.](#)
 - 2. [Special warranties specified in this Section.](#)
- H. Inspection Reports: Copies of roofing system manufacturer's inspection reports.
 - 1. [In-progress inspections.](#)
 - 2. [Substantial Completion inspection.](#)
 - 3. [Final Completion inspection.](#)
 - 4. [11th month follow-up inspection.](#)

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
1. Allow no work to be done to roof assembly by anyone other than roofing manufacturer's approved installer.
 2. Maintain full-time supervisor / foreman, not a foreman / workman, on job site during times that roofing work is in progress. Provide a supervisor with proven experience in roofing similar to nature and scope of specified roofing.
- B. Source Limitations: Obtain components for membrane roofing system from roofing membrane manufacturer.
1. Original Manufacture: Provide membrane roofing of original manufacture.
 2. Track Record: Provide membrane roofing of same formulation, with not less than a ten year track record of successful performance under the proposed conditions of installation.
 3. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.
- D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01 Section "Project Management and Coordination". Notify participants a minimum of five (5) working days before conference. Roofing Systems Manufacturer's Technical Representative shall be required to attend the Preinstallation Roofing Conference meeting. Review methods and procedures related to roofing system including, but not limited to, the following:
1. Meet with Owner, Architect, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.
10. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

E. **Manufacturer's Inspections:** Manufacturer inspections shall be accomplished by technical representatives with technical department of roof membrane manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
 1. Deliver material requiring fire resistance classification to the job with label attached and packaged as required by labeling service.
 2. Deliver sufficient material for continuous work.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. **Weather Limitations:** Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate roofing work with installers of other work to ensure that components which are to be secured to or stripped into the roofing system are available and that flashings and counterflashings are installed as the work progresses.
 - 1. Phased construction is not acceptable.
 - 2. Delayed installation of sheet metal flashing and trim is not acceptable.

1.10 ROOF MAINTENANCE MANUAL

- A. Submit a Roof Maintenance and Inspection Manual with warranties and project closeout submittals.
- B. Roof Maintenance and Inspection Manual shall be bound in a 3 ring D-style binder with name of project, Owner, Architect, and Contractor on front cover.
- C. Roof Maintenance and Inspection Manual shall include:
 - 1. Cover letter recommending to the Owner that two roof maintenance inspections should be conducted per year.
 - 2. Table of Contents.
 - 3. Visual inspection checklist indicating specific flashings and details to be inspected. Include items such as base flashing, seams, reglets and counterflashings, roof edge flashings, roof penetration flashings, roof curb flashings, boot flashings, roof drain areas, parapet wall flashings, copings, roof membrane seams, etc. Applicable items shall be listed per project.
 - a. Include a set of instructions detailing preventative maintenance and noting a list of harmful substances which may damage the roofing membrane.
 - b. Include procedures for exercising warranty and guarantee provisions, leak calls, temporary repairs and future modifications to roof system.
 - 4. Copies of as-built roofing details.
 - 5. Roof plan indicating penetrations, detail locations, roof drains, and seams.
 - 6. Copy of SPRI / NRCA "Manual of Roof Inspection, Maintenance and Emergency Repair for Existing Single-Ply Roofing Systems".

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
 - 1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, walkway products and other components of membrane roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.
 3. Special Warranty Rider: Coverage for winds up to and including 100 mph.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, fasteners, and walkway products, for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Products: Subject to compliance with requirements, provide one of the products and respective methods of installation specified.

2.2 ROOFING MEMBRANE

- A. PVC Sheet: ASTM D 4434, Type II or Type III, fiber reinforced, as follows:
1. Products:
 - a. Sarnafil Inc.; "Sarnafil S327" or approved equal: Mechanically attached to metal deck below both Dens-Deck/rigid insulation or LWIC.
 - b. Sarnafil Inc.; "Sarnafil G410" or approved equal: Fully adhered to mechanically attached Dens-Deck prime.
 - c. Sarnafil Inc.; "Sarnafil G410 Feltback" or approved equal: Fully adhered to LWIC.
 2. Thickness: 60 mils (1.5 mm), nominal, membrane.
 3. Exposed Face Color: White.
- B. PVC Sheet: ASTM D 4434, Type III, fabric reinforced.
1. Products:
 - a. Duro-Last Roofing, Inc.; "Duro-Last" or approved equal: Mechanically attached to metal deck below both Dens-Deck/rigid insulation or LWIC.
 - b. Duro-Last Roofing, Inc.; "Duro-Last" or approved equal: Fully adhered to mechanically attached Dens-Deck prime.
 2. Thickness: 60 mils (1.5 mm), nominal, membrane.
 3. Exposed Face Color: White.

C. KEE Sheet: ASTM D 6754, fabric reinforced.

1. Products:

a. Seaman Corporation; "8155 FiberTite-XT" or approved equal: 60 mils (1.5 mm), nominal membrane thickness.

- 1) Mechanically attached to metal deck below both Dens-Deck/rigid insulation and LWIC assemblies.
- 2) Fully adhered to mechanically attached Dens-Deck prime.

b. Seaman Corporation; "8155 FiberTite-XT Fleeceback" or approved equal: 60 mils (1.5 mm), nominal membrane thickness.

- 1) Fully adhered to mechanically attached Dens-Deck prime.
- 2) Fully adhered to both LWIC and structural concrete.

2. Exposed Face Color: White.

D. Membrane shall meet EPA Energy Star standards.

2.3 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.

C. Laminated Metal: Manufacturer's standard minimum 25 gauge galvanized steel laminated with a minimum 20 mil compatible polymeric coating, of same color as sheet membrane.

D. Bonding Adhesive:

1. Roofing Membrane: Manufacturer's standard solvent or water-based bonding adhesive for membrane.
2. Sheet Flashing: Manufacturer's standard solvent-based bonding adhesive for base flashings.

E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

F. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, or aluminum alloy bar, approximately 1 inch (25 mm) wide, prepunched.

- G. **Polymeric Battens:** Manufacturer's standard high performance thermoplastic polymer strip, approximately 1 inch (25 mm) wide, prepunched.
- H. **Fasteners:** Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- I. **Miscellaneous Accessories:** Provide preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.
- J. **Sealants:** As specified in Division 07 Section "Joint Sealants".
- K. **Pitch Pans:** Pitch pans are not acceptable.

2.4 WALKWAYS

- A. **Flexible Walkways:** Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that insulation and cover board are securely anchored to roof deck.
 - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 - 5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 - 7. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
 - 1. Install sheet according to ASTM D 5036.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive:
 - 1. Apply solvent-based bonding adhesive to substrate and underside of roofing membrane as required by manufacturer. Do not apply bonding adhesive to splice area of roofing membrane.
 - 2. Apply water-based bonding adhesive to substrate as required by manufacturer. Do not apply bonding adhesive to splice area of roofing membrane.
- D. Mechanically **and** adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
 - 1. Secure membrane edges under battens or termination bars. Locate battens or termination bars continuously around the edge of the roof on the flat of the deck adjacent to the roof edge or parapet, around penetrations such as curbs in the field of the roof, and elsewhere as detailed. Fasten battens and termination bars at maximum **8 inches** o.c.
 - 2. Secure top edge of preformed boots and pipe flashings with drawbands.
- E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- F. Peel Stops: Install battens or termination bars continuously around the perimeter of the roof, at the following approximate distances from the roof's edge based on the

particular roof's height. Install additional peel stops per manufacturer's engineering to comply with requirements specified in "Performance Requirements" Article.

1. Roofs less than 20' high: 3' from edge.
2. Roofs between 20' and 30' high: 3' and 7' from edge.
3. Roofs between 30' and 40' high: 3', 7', and 11' from edge.
4. Roofs above 40' high: Additional peel stops per manufacturer's engineering.

G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane **as required by manufacturer**.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

I. Install roofing membrane and auxiliary materials to tie in to existing roofing where indicated.

3.4 MECHANICALLY FASTENED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

1. Install sheet according to ASTM D 5082.
2. **Fasteners to be driven into top metal deck rib only.**
3. **Install half sheets at roof perimeters and corners. Install full sheets at roof field.**

B. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Attachment:

1. In-Splice Attachment: Secure one edge of roofing membrane using fastening plates or battens centered within membrane splice and mechanically fasten roofing membrane to roof deck. Field-splice seam.
2. Through-Membrane Attachment: Secure roofing membrane using fastening plates or battens and mechanically fasten roofing membrane to roof deck. Cover battens and fasteners with a continuous cover strip.

D. Mechanically **and** adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

1. Secure membrane edges under battens or termination bars. Locate battens or termination bars continuously around the edge of the roof on the flat of the deck adjacent to the roof edge or parapet, around penetrations such as curbs in the field of the roof, and elsewhere as detailed. Fasten battens and termination bars at maximum 8 inches o.c.
 2. Secure top edge of preformed boots and pipe flashings with drawbands.
- E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- F. Peel Stops: Install battens or termination bars continuously around the perimeter of the roof, at distances from the roof's edge per manufacturer's engineering to comply with requirements specified in "Performance Requirements" Article.
1. Peel stops installed at distances from the roof edge corresponding to half-sheet dimension may take the place of the half-sheet installation requirement.
- G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane as required by manufacturer.
 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
- H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- I. Install roofing membrane and auxiliary materials to tie in to existing roofing where indicated.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and fully adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing as required by manufacturer. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing. Use prefabricated flashings as furnished by manufacturer wherever possible.
- D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
 - 1. Install rows of intermediate fasteners vertically as required by manufacturer.
 - 2. Apply a bead of sealant large enough to entirely fill the void at shaped term bars, reglets, and drawbands. Tool the sealant to shed water and insure full adherence to surfaces. Use primer when recommended by membrane manufacturer.
- F. Incomplete flashings at the end of the work day, and the use of temporary flashings without prior approval of the Architect will not be accepted. Water penetration of the new roofing system due to incomplete flashings will require removal and replacement of the affected area at the Contractor's expense.

3.6 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer Roof Inspections: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation **on each building** and submit **separate** reports to Architect and Owner **for each**. Notify Architect **and** Owner 48 hours in advance of date and time of inspection.
 - 1. In-progress inspections.
 - a. Make first in-progress inspection within 7 days of start of installation on each building.
 - 2. Substantial Completion inspection.
 - 3. Final Completion inspection.
- B. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Follow-up Roof Inspections: Arrange for roofing system manufacturer's technical personnel to provide follow-up inspections of roofing installation on each building and submit reports to Owner. Notify Owner 48 hours in advance of date and time of inspection.
 - 1. 11th month inspection.
 - 2. 23rd month inspection.

3.8 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.9 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: <Insert name of Owner.>
 - 2. Address: <Insert address.>
 - 3. Building Number(s)/Square footage(s): <Insert information.>
 - 4. Address: <Insert address.>
 - 5. Area of Work: <Insert information.>
 - 6. Acceptance Date: <Insert date.>
 - 7. Warranty Period: <Insert time.>
 - 8. Expiration Date: <Insert date.>
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
 - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 100 mph;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;

- e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 - a. Roofing Installer shall guaranty to respond to all notifications within forty-eight (48) hours and to make all such repairs as deemed necessary to correct said leaks or defects to the satisfaction of the Owner, such satisfaction shall not be unreasonably withheld.
 - b. Roofing Installer acknowledges Owner's right to make emergency repairs without violating this warranty, if the Roofing Installer does not respond within forty-eight (48) hours of notification by the Owner of a defect or leak.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature: <Insert signature.>
2. Name: <Insert name.>
3. Title: <Insert title.>

END OF SECTION

SECTION 07720
METAL FLASHINGS, ROOF
SPECIALTIES AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:

- 1. Roof curbs.
- 2. Roof hatches.
- 3. Copings.
- 4. Counterflashing.
- 5. Manufactured through-wall flashing.
- 6. Manufactured reglets.
- 7. Formed equipment supports and flashing.
- 8. Formed overhead-piping safety pans.

- B. Related Sections include the following:

- 1. Sections 04200: "Unit Masonry" for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
- 2. Section 05500: "Metal Fabrications" for ladders and miscellaneous metal framing and supports.
- 3. Section 06100: "Rough Carpentry" for wood cants, and wood nailers.
- 4. Division 7 Sections for roofing accessories included as part of roofing Work.
- 5. Section 09900: "Painting" for shop primers and field painting.
- 6. Division 15 Sections for roof-mounted equipment.
- 7. Section 07920: "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.03 PERFORMANCE REQUIREMENTS

- A. Install sheet metal flashing, trim, roof specialties and accessories to withstand wind loads as required by applicable codes, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

- B. Thermal Movements: Provide sheet metal flashing, trim, roof specialties and accessories that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; material surfaces.
- C. Water Infiltration: Provide sheet metal flashing, trim, roof specialties and accessories that do not allow water infiltration to building interior.
- D. Coping manufacturer shall certify that high performance copings meet performance design criteria according to the following test standards.
1. ANSI / SPRI ES-1-98 Test RE-3 for Coping Wind Design for Edge Systems Used with Low Slope Roofing Systems (current edition). The coping system shall be tested simultaneously on horizontal and vertical surfaces and shall exceed horizontal and vertical design wind pressure as calculated in accord with the ANSI / SPRI ES-1-98 Test RE 3.
 2. FMRC Loss Prevention Data Sheet 1-49 "Perimeter Flashing." The coping products shall be listed in current Factory Mutual Research Corporation Approval Guide as approved for required uplift requirements in the zone in which the Project is located.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
1. Show layouts of sheet metal flashing and trim. Distinguish between shop- and field-assembled work.
 2. Include plans, elevations, sections, details, and attachments to other Work.
 3. Show fabrication and installation details. Show details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 4. Indicate layout, joining, profiles, accessories, anchorage, flashing connections, and relationship to supporting structure and to adjoining roof and wall construction.
 5. Show details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips and cleats.
 6. Indicate material, thickness, dimensions, weights, loadings, required clearances, method of field assembly, all components and finishes for each item and location in Project.

- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.
- D. Samples for Verification, General: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.
- E. Samples for Verification of Manufactured Roof Specialties: Of the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work. Furnish straight Samples in lengths specified below or where corner pieces are required for Project; furnish corner Samples with each leg in lengths specified below:
 - 1. Copings: 8 inches long.
 - 2. Reglets and Counterflashing: 8 inches long.

1.05 QUALITY ASSURANCE

- A. Roof Accessories Standards: For roof accessories, comply with the following:
 - 1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
 - 2. NRCA's "Roofing and Waterproofing Manual" details for installing units.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- C. Source Limitations: Obtain each type of manufactured roof specialty from one source and by a single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.06 PROJECT CONDITIONS

- A. Coordinate work of this Section with adjoining work for proper sequencing of each installation to ensure best-possible weather resistance and protection of materials and finishes against damage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Formed-Aluminum Copings and Edging:
 - a. Architectural Products Co.
 - b. ATAS International, Inc.
 - c. Cheney Flashing Company.
 - d. Hickman: W.P. Hickman Co.
 - e. MM Systems Corp.
 2. Aluminum Reglets:
 - a. Fry Reglet Corporation.
 - b. Hickman: W.P. Hickman Co.
 - c. Keystone Flashing Company.
 - d. MM Systems Corp.
 3. Roof Curbs and Equipment Supports:
 - a. AES Industries, Inc.
 - b. Custom Curb, Inc.
 - c. LMCurbs.
 - d. Metallic Products Corporation.
 - e. Pate Co.(The).
 - f. Roof Products & Systems Corp.
 - g. ThyCurb, Inc.
 - h. Uni-Curb, Inc.
 4. Roof Hatches:
 - a. Bilco Company. Design Basis.
 - b. Custom Curb, Inc.
 - c. J. L. Industries, Inc.
 - d. Milcor, Inc.
 - e. O'Keeffe's Inc.

2.02 METALS

- A. Aluminum Extrusions: **ASTM B 221**, 6063-T5 alloy and temper, or as recommended by manufacturer for use intended and as required for proper application of finish indicated.
- B. Aluminum Sheet: **ASTM B 209**, alloy and temper recommended by aluminum producer and finisher for use intended and finish indicated, and with not less than the strength and durability of alloy and temper designated below:

1. Alloy 3003-H14, with a minimum thickness of **0.040 inch**, unless otherwise indicated, for aluminum sheet with mill finish.
2. Alloy 5005-H14, with a minimum thickness of **0.050 inch**, for aluminum sheet with other than mill finish.

2.03 COPINGS

- A. Provide copings in shapes and sizes indicated, with shop-fabricated corners. Include anchor plates formed from at least **0.028-inch**-thick, galvanized steel sheet; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.
- B. Provide exposed coping components fabricated from the following metal:
 1. Formed-aluminum sheet in thickness indicated, but not less than the following:
 - a. Thickness: **0.050 inch**.

2.04 REGLETS

- A. Provide reglets of type, material, and profile indicated, compatible with flashing. Form to securely interlock with counterflashing.
- B. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
- C. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
- D. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials; special fasteners for attaching reglet to concrete forms; and guides to ensure alignment of reglet section ends.
- E. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
- F. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing's lower edge.
- G. Material: Fabricate reglets from the following metal in thickness indicated:
 1. Aluminum Sheet: **0.024 inch** thick.

2.05 COUNTERFLASHING

- A. Provide counterflashing fabricated from the same metal as reglets and compatible with reglet system installed.
- B. Provide counterflashing fabricated from the following metal in thickness indicated:
 1. Aluminum Sheet: **0.032 inch** thick.

2.06 ACCESSORIES

- A. Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.
- B. Exposed Fasteners: Stainless steel, nonmagnetic, of manufacturer's standard type and size for product and application indicated. Match finish of exposed heads with material being fastened.
- C. Concealed Fasteners: Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.
- D. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.
- E. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- F. Foam-Rubber Seal: Manufacturer's standard foam.

2.07 ROOF CURBS

- A. Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
- B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch- thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.
 - 1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
 - 2. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 - 3. Provide manufacturer's standard rigid or semirigid insulation where indicated.
 - 4. Provide formed cants and base profile coordinated with roof insulation thickness.
 - 5. Fabricate units to minimum height of 8 inches, unless otherwise indicated.
 - 6. Sloping Roofs: Where slope of roof deck exceeds 1/4 inch per foot, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.08 EQUIPMENT SUPPORTS

- A. Provide equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

- B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum **0.0747-inch**- thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.
1. Provide preservative-treated wood nailers at tops of curbs and formed flange at perimeter bottom for mounting to roof.
 2. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 3. Fabricate units to minimum height of **8 inches**, unless otherwise indicated.
 4. Sloping Roofs: Where slope of roof deck exceeds **1/4 inch per foot**, fabricate support units with height tapered to match slope to level tops of units.

2.09 ROOF HATCHES

- A. Fabricate units to withstand **40-lbf/sq. ft.** external and **20-lbf/sq. ft.** internal loading pressure. Frame with minimum **9-inch**- high, integral-curb, double-wall construction with **1-1/2-inch** insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with **1-inch**- thick insulation core. Provide gasketing and equip with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.
- B. Type: Single-leaf personnel access. Design Basis - Bilco; Type S, ladder access.
1. For Ladder Access: **36 by 36 inches**.
Ladder safety post: Aluminum, Type LU-4.
- C. Material: Aluminum or galvanized steel, or in combination, at Contractor's option.
1. Finish for steel: Baked enamel.
 2. Finish for aluminum: Clear anodic.
- D. Sloping Roofs: Where slope or roof deck exceeds **1/4 inch per foot**, fabricate hatch curbs with height tapered to match slope to level tops of units.

2.10 OVERHEAD-PIPING SAFETY PANS

- A. Fabricate from the following material:
1. Galvanized Steel: **0.0396 inch**.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

- A. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- B. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating or resin manufacturer's written instructions.
 - 2. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 1402, Test Method 7.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range of colors and glosses.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine walls, roof edges, and parapets for suitable conditions for roof edge system installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Promptly remove protective film, if any, from exposed surfaces of finished metals. Strip with care to avoid damage to finish.
- B. Prepare concrete, concrete masonry block, cement plaster, and similar surfaces to receive roof edge system specified. Install blocking, cleats, water dams, and other anchoring and attachment accessories and devices required.

3.03 INSTALLATION

- A. Comply with manufacturer's written installation instructions. Coordinate with installation of roof deck and other substrates to receive work of this Section and with vapor retarders, roofing insulation, roofing membrane, flashing, and wall construction, as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor products securely to structural substrates to withstand lateral and thermal stresses and inward and outward loading pressures.
- B. Isolation: Where metal surfaces of units contact dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces or provide other permanent separation as recommended by aluminum producer.
- C. Expansion Provisions: Install running lengths to allow controlled expansion for movement of metal components in relation not only to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in a manner sufficient to prevent water leakage, deformation, or damage.

3.04 MISCELLANEOUS COMPONENTS INSTALLATION

- A. Overhead-Piping Safety Pans: Suspend pans from pipe and install drain line to plumbing waste or drain line.

3.05 CLEANING AND PROTECTING

- A. Clean exposed metal surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.
- B. Protection: Provide protective measures as required to ensure work of this Section will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 07842
FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes firestopping and smoke sealing for the following:
 - 1. Through-penetrations of fire-resistance-rated construction including both empty openings and openings containing cables, pipes, ducts, conduits, structural members, and other penetrating items.
 - 2. Membrane-penetrations of fire-resistance-rated construction including both empty openings and openings containing cables, pipes, ducts, conduits, structural members, and other penetrating items.
 - 3. Joints in fire-resistance-rated construction, including floor-to-floor, wall-to-wall, floor-to-wall and head-of-wall joint systems.
 - 4. Openings of, and annular spaces of, through- and membrane-penetrations in smoke barriers and other compartmentalized areas.
 - 5. Construction, control and expansion joints of, and perimeters of, smoke barriers and other compartmentalized areas.

1.03 REFERENCES

- A. ASTM E-814 "Test Method for Fire Tests of Through-Penetration Fire Stops".
- B. UL 2079 "Standard for Tests for Fire Resistance of Building Joint Systems".
- C. FM 4991 "Standard for Approval of Firestop Contractors"

1.04 DEFINITIONS

- A. Firestopping: The combination of materials utilized to restore the integrity of an assembly identified with an hourly rating.
- B. Smoke sealing: The combination of materials utilized to restore the integrity of an assembly identified as a smoke barrier.

- C. Through-Penetration: The incident in which a penetrating item passes entirely through any assembly identified either with an hourly rating or as a smoke barrier; i.e. breaching both sides of the assembly.
- D. Membrane-Penetration: The incident in which a penetrating item passes into or exits from any assembly identified either with an hourly rating or as a smoke barrier; i.e. entering into or exiting from only one side of the assembly.
- E. Joint: The abutment of or gap between two or more assemblies. Either one or both of the assemblies may be identified either with an hourly rating or as a smoke barrier. The assemblies may be either parallel or perpendicular to each other. These include floor-to-floor, wall-to-wall, floor-to-wall, head-of-wall, or any other linear breach of the assembly(ies).

1.05 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide systems that are produced and installed to resist the spread of fire and the passage of smoke and other gases according to requirements indicated, and to restore integrity of assembly.
 - 1. For systems subject to movement, provide products that will remain flexible to allow for such movement without affecting the integrity of the system when exposed to movement.
 - 2. For systems exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 3. For systems for items subject to binding, eg fire or smoke dampers, provide non-intumescent type products.
- B. F-Rated Penetration Firestop Systems: Provide penetration firestop systems with F ratings determined per ASTM E 814, not less than that of the construction penetrated.
- C. T-Rated Penetration Firestop Systems: Provide penetration firestop systems with T ratings, in addition to F ratings, determined per ASTM E 814, where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas.
- D. Joint Firestop Systems: Provide joint firestop systems with fire-resistance ratings determined per UL 2079, not less than that of the construction in which the joint occurs.
 - 1. Where movement is required or can be anticipated, joint firestopping system must be listed as a dynamic joint, with movement capabilities equal to those of the in-service conditions.
- E. Materials offered for horizontal applications shall be capable of self-supporting any penetrating item and shall maintain their integrity when tested in horizontal applications.

1.06 SUBMITTALS

- A. Schedule identifying conditions to be firestopped and smokesealed. Include type of construction, orientation, type and size of penetrant, type and size of joint, and methods to accomplish firestopping and smoke sealing.
 - 1. One axis of schedule shall identify each assembly to be firestopped or smokesealed and its' rating (i.e., 1 hour cmu wall). Second axis of schedule shall identify each penetrant or joint to be firestopped or smokesealed (i.e., 4" cast iron pipe – insulated). Intersection point between both axes of schedule shall identify design designations from qualified testing and inspecting agency proposed to accomplish firestopping and smoke sealing (i.e., C-AJ-5102).
- B. Product data and copies of listings or test reports. Cross reference each to schedule.
 - 1. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular condition, submit illustration approved by manufacturer's fire protection engineer with modifications marked and signed engineering opinion letter stating basis for modifications.
- C. Qualification data for firm and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, and dates (month/year); names and phone numbers of Architects and Owners; products installed at each listed project; and other information specified.
 - 1. Include letter from manufacturers of products specified, wherein manufacturer recognizes as trained or approved, or certifies, firm and persons for installation of that manufacturer's products.
 - 2. Copy of Factory Mutual's Approved Firestop Contractor certificate, if applicable.
- D. Identification label.
- E. Certification affidavit.

1.07 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics:
 - 1. Firestopping tests performed by a qualified nationally recognized independent testing and inspecting agency performing testing and follow-up inspection services for firestopping that is recognized by the Council of American Building Officials and is acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping identical to that tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the firestopping surrounding the penetrating items in the test assembly.
 - 3. Joint firestopping identical to that tested per UL 2079 under conditions where all components of each joint system, including splices, are exposed to a positive

furnace pressure differential. For tests of floor-to-floor, floor-to-wall and head-of-wall joint systems, the average furnace pressure shall be measured at 12 inches below the exposed horizontal surface of the test assembly. For tests of wall-to-wall joint systems, the average furnace pressure shall be measured at the elevation of the midheight of the exposed vertical surface of the test assembly. After the initial 10 minutes of fire exposure, the furnace pressure for the respective joint systems shall not be less than 0.01 inch of water for an aggregate time period exceeding 10 percent of the fire exposure for fire tests of 1 hour or less duration, 7.5 percent of the fire exposure for fire tests longer than 1 hour but not longer than 2 hours and 5 percent of the fire exposure for fire tests exceeding 2 hours.

- B. References to specific design designations of firestop systems is intended to establish requirements for performance based on conditions that are expected to exist during installation. Any changes in conditions and designated systems require the Architect's prior approval. Submit documentation showing that the performance of proposed alternate systems equals or exceeds that of the systems they would replace and are acceptable to authorities having jurisdiction.
- C. Installer Qualifications: A single experienced Installer who is trained, certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements and who has specialized in installing firestopping systems similar in material, design, and extent to those indicated for this Project. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
 - 1. All firestopping and smoke sealing products, regardless of the Section in which their use is specified or drawing on which their use is indicated, are to be installed by a single installer.
- D. Technical Advice: Provide technical advice from material manufacturer's lab and technical department on materials and assemblies as required. For through- or membrane-penetrations and assemblies proposed but not yet tested provide an Engineering Opinion, in writing on manufacturer's letterhead signed by a qualified person and bearing his title, with copies to the Architect. Engineering Opinions shall be based on approval tests from recognized independent testing agency.
- E. Pre-Installation Conference: Prior to preparation for and installation of materials to be used as firestops and smoke seals convene a pre-installation conference at project site with the Contractor, installer, affected subcontractor(s), material supplier(s), and Architect. Review Contract Document requirements, submittals, status of coordinating work, availability of materials and installation facilities, proposed installation schedule, safety and handling requirements, requirements for inspections and testing or certifications, proposed installation procedures and protection requirements for construction period extending beyond installation. Record discussion; furnish copy of recorded discussions to each participant.
- F. Field-Constructed Mockup: Prior to installing firestopping and smoke sealing, erect mockups for each different system to verify selections made and to demonstrate

qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final installations.

1. Locate mockups on site in locations indicated or, if not indicated, as directed by Architect.
2. Identify mockups as specified under the "Field Quality Control" article.
3. Notify Architect 1 week in advance of the dates and times when mockups will be erected.
4. Obtain Architect's acceptance of mockups before start of final unit of Work.
5. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging completed unit of Work.
 - a. When directed, demolish and remove mockups from Project site.
 - b. Accepted mockups in an undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

G. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that systems are installed per specified requirements.

1. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate systems.

1.08 CERTIFICATIONS

A. Contractor shall provide the following notarized affidavit jointly signed by corporate officers, with titles noted, of both the Contractor and installer

"we the undersigned certify that firestops and smoke seals have been installed in accordance with Contract Document requirements and manufacturer's instructions, and that materials used meet firestopping and smoke sealing requirements of the Contract Documents".

B. Manufacturer shall provide the following certification, executed by the appropriate person, with title and department noted:

"Products provided by (manufacturer) for the (name of project) are composed of the same ingredients and formulation or are of the same components and identical construction as products that have been tested by (the testing agency) for various fire resistive and other performance ratings, and when properly applied or installed in accordance with (manufacturer) instructions will perform in a manner consistent with results obtained in the tests conducted by (the testing agency)".

1.09 SEQUENCING AND SCHEDULING

A. Schedule installation of penetration firestopping and smoke sealing after completion of penetrant installation but prior to covering or concealing of openings. Schedule installation of joint firestopping and smoke sealing after completion of adjacent assemblies, but prior to covering or concealing of joints.

- B. Do not cover up those firestopping and smoke sealing installations that will become concealed behind other construction until authorities having jurisdiction have examined each installation.

1.10 PRECEDENCES

- A. Order of precedences: Firestopping, smoke sealing, acoustical/sound rating, other requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. A/D Fire Protection Systems, Inc.
 2. Bio Fireshield / The Rectorseal Corporation.
 3. Hilti, Inc.
 4. Grace / International Protective Coatings Corp.
 5. Isolatek International.
 6. Nelson Firestop Products / O - Z Gedney.
 7. NMP Corp.
 8. Specified Technologies Inc.
 9. Thermal Ceramics.
 10. 3M Fire Protection Products.
 11. Tremco Inc.
 12. Unifrax.

2.02 MATERIALS

- A. Firestopping and Smoke sealing: Provide systems composed of components that are compatible with each other, the substrates forming openings or joints, and the items, if any, penetrating the system under conditions of service and application, as demonstrated by system manufacturer based on testing and field experience. Provide systems of one or more of the following types:
 1. Ceramic-Fiber Mastic Coating and Sealant: Single-component formulation of ceramic fibers and inorganic binders.
 2. Collar: Factory-manufactured device consisting of a metal restricting collar housing a molded intumescent insert.
 3. Endothermic Latex Compound Sealant: Single-component, endothermic, latex formulation.
 4. Intumescent Latex Mastic Sealant: Single-component, intumescent, latex formulation.

5. Intumescent Polyurethane Foam Block: Pliable soft foam shaped block, intumescent formulation.
 6. Intumescent Putty: Nonhardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
 7. Intumescent Wrap Strip: Flexible elastomeric strip, intumescent. May be used in conjunction with a surface mounted restricting collar.
 8. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.
 9. Pillow/Bag: Re-usable, heat-expanding pillow/bag composed of a glass-fiber cloth or plastic case filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
 10. Silicone Sealant: Single-component, moisture-curing, silicone-based, neutral-curing elastomeric sealant, self-leveling and nonsag as appropriate.
- B. Identification: Provide pressure-sensitive, self-adhesive, preprinted vinyl identification labels for firestopping and smoke sealing systems, minimum 2 inch by 3 inch . Identification shall include:
1. Condition:
 - a. For penetration firestops, "Rated Penetration Firestop System - Do Not Disturb".
 - b. For joint firestops, "Rated Joint Firestop System - Do Not Disturb".
 - c. For smoke seals, "Smoke Seal System - Do Not Disturb".
 - d. For all, "Notify Building Management of any damage".
 2. System designation issued by the qualified testing and inspecting agency, and the name of the qualified testing and inspecting agency.
 3. System manufacturer's name.
 4. Contractor's name, address, and phone number.
 5. Installer's name, address, and phone number.
 6. Date of installation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Coordination: Sequence work to avoid need for removal of firestopping and smoke sealing by work of other trades.
- B. Preparation: Clean out openings and joints immediately prior to installing firestopping and smoke sealing. Prime substrates where recommended by manufacturer.
- C. Install forming/damming materials and other accessories of types required to support firestopping during application and in the position needed to produce the cross-sectional shapes and depths required to restore fire-resistance-rated construction. After installing firestopping and smoke sealing, remove combustible forming materials and other accessories not listed as permanent components of system.

- D. Install firestopping by proven techniques to restore fire-resistance-rated construction.
- E. Install materials in both fire rated and smoke barrier assemblies with sufficient pressure to properly fill and seal openings to ensure an effective cold smoke seal.

3.02 FIELD QUALITY CONTROL

- A. After installation, identify firestopping and smoke sealing systems at locations where each is installed. Attach labels permanently to surfaces of adjacent construction on both sides of each system installation where labels will be visible to anyone seeking to disturb the installation or adjacent construction.
- B. Inspect completed firestopping and smoke sealing for compliance with requirements, and issue written letter to Architect and Owner stating such.
- C. Do not proceed to cover or enclose firestopping and smoke sealing with other construction until reports of examinations are issued.
- D. Where deficiencies are found, repair or replace firestopping and smoke sealing so that it complies with requirements.

3.03 CLEANING AND PROTECTION

- A. Clean off excess materials adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of systems and of products in which opening and joint occurs.
- B. Protect firestopping and smoke sealing during and after installation from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping and smoke sealing immediately and install new materials to produce systems complying with specified requirements.

3.04 PENETRATION AND JOINT FIRESTOP SCHEDULE

- A. A combination of multiple details may be necessary to address a specific job condition, such as multiple or differing penetrants through a single opening or a head-of-wall joint with a penetration of the wall or horizontal assembly.
- B. The following basic system references are not intended to be exhaustive or exclusive. System numbers are from UL for convenience only.
- C. Blank Opening:

1. CMU: CAJ0004, CAJ0009, CAJ0011, CAJ0012, CAJ0014, CAJ0015, CAJ0033, CAJ0040, CAJ0041, CAJ0043, CAJ0050, CAJ0051, CAJ0053, CAJ0054, CAJ0055, CBJ0009.
 2. GWB: WL0001, WL0005.
- D. Metallic Pipe, Conduit or Tubing:
1. CMU: CAJ1001, CAJ1003, CAJ1031, CAJ1044, CAJ1079, CAJ1205, CAJ1213, CAJ1224, CAJ1226, CAJ1234, CAJ1235, CAJ1262.
 2. GWB: WL1001, WL1029, WL1030, WL1049, WL1054, WL1085, WL1089, WL1090, WL1091, WL1094, WL1105, WL1113, WL1115.
- E. Flexible Metal Conduit:
1. CMU: CAJ1052, CAJ1079, CAJ1176, CAJ1242.
 2. GWB: WL1017, WL1046, WL1049.
- F. Metal Pipe, Conduit or Tubing, With Cables:
1. CMU: CAJ3015, CAJ3016, CAJ3089, CAJ3093, CAJ3128, CAJ8001, CAJ8046.
 2. GWB: WL3005, WL3025, WL3032, WL3065, WL3088, WL8008.
- G. Non-Metallic Pipe, Conduit or Tubing – Plastics:
1. CMU: CAJ2001, CAJ2082, CAJ2088, CAJ2109, CAJ2124, CAJ2149, CAJ2163, CAJ2171, FA2024, WJ2040.
 2. GWB: WL2002, WL2038, WL2059, WL2070, WL2071, WL2078, WL2083, WL2133.
- H. Non-Metallic Pipe, Conduit or Tubing – Glass:
1. CMU: CAJ1032, CAJ2079, CAJ2118, CAJ2144.
 2. GWB: WL2112, WL2114.
- I. Electrical Cables – No Sleeve:
1. CMU: CAJ3003, CAJ3016, CAJ3030, CAJ3035, CAJ3043, CAJ3068, CAJ3083, CAJ3095, CAJ3103, CAJ3116.
 2. GWB: WL3011, WL3026, WL3030, WL3044, WL3060, WL3064, WL3065, WL3076, WL3087.
- J. Electrical Cables – Metal Sleeve:
1. CMU: CAJ3002, CAJ3030, CAJ3095, CAJ3116, CAJ3128, WJ3030.
 2. GWB: WL3005, WL3025, WL3032, WL3065, WL3072, WL3088, WL3106.
- K. Electrical Cables – Non-Metallic Sleeve:
1. CMU: CAJ2162, CAJ2163, CAJ3030, CBJ3003.
 2. GWB: Submit.

- L. Cable Trays:
1. CMU: CAJ4010, CAJ4023, CAJ4027, CAJ4029, CAJ4032, CAJ4035, CAJ4037, CAJ4038, CAJ8049, WJ4012.
 2. GWB: WL4001, WL4003, WL4004, WL4008, WL4010, WL4011, WL4012, WL4017.
- M. Insulated Metallic Pipe, Conduit or Tubing:
1. CMU: CAJ5001, CAJ5058, CAJ5080, CAJ5082, CAJ5088, CAJ5089, CAJ5091, CAJ5099, CBJ5008.
 2. GWB: WL5014, WL5029, WL5033, WL5039, WL5040, WL5050, WL5060, WL5065, WL5066, WL8007.
- N. Insulated Non-Metallic Pipe, Conduit or Tubing – Plastics:
1. CMU: CAJ5022, CAJ5042, CAJ5106.
 2. GWB: WL2002, WL5054.
- O. Insulated Non-Metallic Pipe, Conduit or Tubing – Glass:
1. CMU: CAJ5103.
 2. GWB: WL5051.
- P. Miscellaneous Electrical Penetrants:
1. CMU: CAJ6011, CAJ8001, CAJ8055.
 2. GWB: WL8002, WL8003, CLIV, UL Report 94NK15324.
- Q. Miscellaneous Mechanical Penetrants:
1. CMU: CAJ7005, CAJ7008, CAJ7009, CAJ7010, CAJ7013, CAJ7016, CAJ7027, CAJ7030, CAJ7036, WJ7001, WJ7002, WJ7003.
 2. GWB: WL7003, WL7006, WL7007, WL7008, WL7009, WL7010, WL7011, WL7022.
- R. Multiple Mixed Penetrants:
1. CMU: CAJ1140, CAJ3123, CAJ4010, CAJ8001, CAJ8012, CAJ8013, CAJ8042, CAJ8046, CAJ8049, CAJ8052, CAJ8053, CAJ8055, CAJ8056, CAJ8057, CAJ8059, WJ8004.
 2. GWB: CAJ8003, WL1031, WL1127, WL4017, WL8002, WL8003, WL8004, WL8007, WL8008, WL8010, WL8013.
- S. Floor-to-Floor Joints, Dynamic:
1. Concrete: FFD1001, FFD1004, FFD1005.
- T. Wall-to-Wall Joints, Dynamic:

1. Concrete, Masonry: WWD1002, WWD1004.
2. Frame: Submit.

U. Floor-to-Wall Joints, Dynamic:

1. Concrete-Concrete/Masonry: FWD0002, FWD1001, FWD1003, FWD1004.
2. Concrete-Frame: Submit.

V. Head-of-Wall Joints, Dynamic:

1. Concrete/Masonry – Concrete: HWD0006, HWD0007, HWD0008, HWD0017, HWD0022, HWD1001.
2. Frame – Concrete: HWD0003, HWD0010, HWD0011, HWD0015, HWD0016, HWD0019, HWD0020.

END OF SECTION

SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes, but is not limited to, sealants for the following applications and those specified by reference to this Section:
 - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Construction joints (control and expansion) in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in concrete unit masonry and brick in veneer.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - f. Control and expansion joints in ceiling and overhead surfaces.
 - g. Other joints as indicated or required.
 - 2. Exterior joints in the following horizontal traffic surfaces:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Tile control and expansion joints.
 - c. Joints between different materials listed above.
 - d. Other joints as indicated.
 - 3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Tile control and expansion joints.
 - d. Vertical joints on exposed surfaces of interior unit masonry, concrete walls and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors.

- f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - g. Other joints as indicated.
4. Interior joints in the following horizontal traffic surfaces:
- a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.

1.03 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- H. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the Notice to Proceed with the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- D. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
 - 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.06 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.03 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- D. Multicomponent Nonsag Neutral-Curing Silicone Sealant:
 - 1. Products:
 - a. Dow Corning Corporation; 756 H.P.
 - b. Other approved equivalent.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, and ceramic tile.

E. Single-Component Neutral-Curing Silicone Sealant:

1. Products:
 - a. Dow Corning Corporation; 799.
 - b. GE Silicones; UltraGlaze SSG4000.
 - c. GE Silicones; UltraGlaze SSG4000AC.
 - d. Polymeric Systems Inc.; PSI-631.
 - e. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus.
 - f. Tremco; Proglaze SG.
 - g. Tremco; Spectrem 2.
 - h. Tremco; Tremsil 600.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.

F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Products:
 - a. Pecora Corporation; 898.
 - b. Tremco; Tremsil 600 White.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.

2.04 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:
1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 2. Products:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
 - c. Or approved equal.

2.05 PREFORMED JOINT SEALANTS

- A. Preformed Silicone-Sealant System: Manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.
1. Products:
 - a. Dow Corning Corporation; 123 Silicone Seal.
 - b. GE Silicones; UltraSpan US1100.
 - c. Pecora Corporation; Sil-Span.
 - d. Tremco; Spectrem Ez Seal.
- B. Preformed Foam Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; is factory produced in precompressed sizes in roll or stick form to fit joint widths indicated; is coated on one side with a pressure-sensitive adhesive and covered with protective wrapping; develops a watertight and airtight seal when compressed to the degree specified by manufacturer; and complies with the following:
1. Products:
 - a. EMSEAL Joint Systems, Ltd.; Emseal 25V.
 - b. Illbruck Sealant Systems, Inc.; Wilseal 600.
 - c. Polytite Manufacturing Corporation; Polytite B.
 - d. Polytite Manufacturing Corporation; Polytite Standard.
 - e. Sandell Manufacturing Co., Inc.; Polyseal.
 2. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.
 - a. Density: Manufacturer's standard.

2.06 PREFORMED TAPE SEALANTS

- A. Back-Bedding Mastic Tape Sealant: Preformed, butyl-based elastomeric tape sealant with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Tape Sealant: Closed-cell, PVC foam tape sealant; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for applications in which tape acts as the primary sealant.
 2. Type 2, for applications in which tape is used in combination with a full bead of liquid sealant.

2.07 JOINT-SEALANT BACKING

- A. Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330. Provide any type approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.08 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or joint-sealant-substrate tests prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Installation of Preformed Tapes: Install according to manufacturer's written instructions.
- H. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.04 FIELD QUALITY CONTROL

A. EXAMINATION / INSPECTION

1. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
2. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.

- b. Whether sealants filled joint cavities and are free from voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
 - 3. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.
 - B. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements. Costs for retests and resultant required work will be paid for by Contractor.
- 3.05 CLEANING
- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- 3.06 PROTECTION
- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

Division 8

Doors and Windows

SECTION 08110
STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Standard steel doors and frames.
 - 2. Sidelight and borrowed light frames
 - 3. Fire-rated door and frame assemblies.
 - 4. Fire-rated window frames.
 - 5. Vision lites in doors.
 - 6. Louvers in doors and door frame transoms.

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide exterior metal doors and frames capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of components and supports, or permanent damage to fasteners and anchors.
 - 1. Wind loads shall be determined by the more restrictive of the following using the appropriate factors and coefficients. Wind load pressures shall be computed and applied using the design wind speed indicated by Wind Information located on Drawings.
 - a. ASCE 7
 - b. Florida Building Code

1.04 DEFINITIONS

- A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.05 SUBMITTALS

- A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.

- B. Shop Drawings: Show the following:
 - 1. Elevations of each door design.
 - 2. Details of doors including vertical and horizontal edge details.
 - 3. Frame details for each frame type including dimensioned profiles.
 - 4. Details and locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, accessories, joints, and connections.
 - 7. Coordination of glazing frames and stops with glass and glazing requirements.
- C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.
- D. Engineering calculations: Provide calculations for exterior doors, indicating compliance with performance requirements for systems to be installed, that bear the seal and signature of Structural Engineer registered in the State of Florida.

1.06 QUALITY ASSURANCE

- A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
 - 1. Test Pressure: Test at atmospheric pressure.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 3. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.
- C. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

- C. Store doors and frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

1.08 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of steel doors that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 - 1. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- C. Warranty Period: 7 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Doors and Frames:
 - a. Amweld Building Products, Inc.
 - b. Ceco Door Products; a United Dominion Company.
 - c. Curries Company.
 - d. Pioneer Industries Inc.
 - e. Republic Builders Products.
 - f. Steelcraft; a division of Ingersoll-Rand.

2.02 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

- C. Galvanized Steel Sheets: Zinc-coated carbon steel complying with ASTM A 526, commercial quality, or ASTM A 642, drawing quality, hot-dip galvanized according to ASTM A 525, with A 60 or G 60) coating designation, mill phosphatized.
- D. Insulating Material: From the following:
 - 1. Exterior: Polyurethane insulation, polystyrene insulation or mineral fiberboard.
 - 2. Sound Doors: Sound attenuating core, of minimum 9 lbs./sq. ft. density.

2.03 DOORS

- A. General: Provide doors of sizes, thicknesses, and designs indicated.
- B. Interior and Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).
 - 2. Insulate exterior doors.
- C. Door Construction: Vertical steel stiffeners.
- D. Sound Doors: Provide hardware for doors with an STC rating as part of the tested assembly. Architect will select where multiple items have been tested or approved.
- E. Door Louvers (Interior): Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.
 - 1. Sightproof Louvers: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.
- F. Door Louvers (Exterior): Provide louvers for exterior doors of welded inverted vee or y type construction providing 50% free area. Reinforce rectangular louver exceeding 18" in width at it's midpoint by a vertical rectangular steel bar at least 1/4" x 1-1/2". Vanes of no less than 12 gage metallic coated sheet and spaced so that no rigid flat instrument can be passed through them. Provide insert screens and/or flattened expanded metal not less than 12 gage on louvers in exterior locations.
- G. Vision Lite Systems: Manufacturer's standard kits consisting of glass lite moldings to accommodate glass thickness and size of vision lite indicated.

2.04 FRAMES

- A. Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

- B. Standard frames of minimum 16 gage for frames less than 42 in. wide, minimum 14 gage for frames over 42 in. wide steel sheet for:
 - 1. Level 3 steel doors.
- C. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames. Only push-in type are acceptable.
- D. Plaster Guards: Provide 0.016-inch- thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.
- E. Supports and Anchors: Fabricated from not less than 0.042-inch- thick, metallic-coated steel sheet.
 - 1. Wall Anchors in Masonry Construction: 0.177-inch- diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.
- F. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.05 FABRICATION

- A. Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from galvanized steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- thick, galvanized steel channels with channel webs placed even with top and bottom edges. [Insulate exterior doors.](#)
- C. Interior Door Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:
 - 1. Cold-rolled steel sheet unless otherwise indicated.
- D. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.
- E. Clearances for Fire-Rated Doors: As required by NFPA 80.
- F. Single-Acting, Door-Edge Profile: Square edge, unless beveled edge is indicated.

- G. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- H. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- I. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- J. Sound-Rated (Acoustical) Assemblies: Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested according to ASTM E 1408, and classified according to ASTM E 413.
1. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 33 or better.
 2. Provide hardware for doors with an STC rating as part of the tested assembly. Architect will select where multiple items have been tested or approved.
- K. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware. Prepare hollow metal frames for ANSI strike plates per A115.1-2 (4-7/8" high).
- L. Frame Construction: Fabricate frames to shape shown.
1. Fabricate frames with mitered or coped and continuously back welded corners and seamless face joints.
 2. Provide welded frames with temporary spreader bars.
- M. Reinforcement of Doors and Frames: Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site. Hinge preparation for door frames shall be mortised and reinforced with a minimum of 10 gauge reinforcement material. Door frames shall be reinforced for the door closer with 14 gauge minimum material. Hollow metal doors shall be reinforced with a maximum of 16 gauge material for either mortised or cylindrical locks as specified. Reinforce hollow metal doors to receive closers with 14 gauge minimum material. Six bolts may be utilized in lieu of 14 gauge reinforcing material.
- N. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- O. Glazing Stops: Manufacturer's standard, formed from 0.032-inch- thick steel sheet.
1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
 2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.
- P. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.06 FINISHES

- A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Exterior Installations: Install doors and frames in exterior walls to provide installations that comply with requirements of "Performance Requirements " Article.
- C. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
 - 2. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
 - 3. Install fire-rated frames according to NFPA 80.
 - 4. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.
- D. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
 - 1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
 - 2. Smoke-Control Doors: Install to comply with NFPA 105.

3.02 ADJUSTING AND CLEANING

- A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 08210
FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Solid-core doors with stain-grade wood-veneer faces.
 - 2. Bi-fold and sliding doors, when scheduled.
 - 3. Factory finishing flush wood doors.
 - 4. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 5. Vision lites for flush wood doors.
 - 6. Louvers for flush wood doors.

1.03 SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire ratings for fire doors.
- C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
 - 1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Louver blade and frame sections, 6 inches long, for each material and finish specified.
3. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors," or AWI's "Architectural Woodwork Quality Standards Illustrated."
 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 1. Test Pressure: Test at positive pressure.
 2. Oversize, Fire-Rated Wood Doors: When they occur, for door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.
 3. Temperature-Rise Rating: At exit enclosures, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flush Wood Doors:
 - a. Mohawk Flush doors – A Masonite Company (Basis of Design)
 - b. Algoma Hardwoods Inc.
 - c. Buell Door Company.
 - d. Eagle Plywood & Door Manufacturing, Inc.
 - e. Eggers Industries; Architectural Door Division.
 - f. Ideal Wood Products, Inc.
 - g. IPIK Door Company.
 - h. Lambton Doors.
 - i. Marshfield Door Systems, Inc.
 - j. Oshkosh Architectural Door Co.
 - k. Vancouver Door Company, Inc.
 - l. No substitutions.

2.02 DOOR CONSTRUCTION, GENERAL

- A. Doors for Transparent Finish:
1. Grade: Custom, with Grade A faces. Algoma Finish RA-1053 Basis of Design.
 2. Species and Cut: Red oak, plain sliced.
 3. Match between Veneer Leaves: Slip match.
 4. Assembly of Veneer Leaves on Door Faces: Balance match.
 5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

6. Room Match: Match door faces within each separate room or area of building. Corridor door faces do not need to match where they are separated by 10 feet or more.
7. Stiles: Same species as faces or a compatible species.

2.03 SOLID-CORE DOORS

A. Interior Veneer-Faced Doors:

1. Core: Minimum 32 psf density particle board.
2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

B. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated.
3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.
4. Pairs: Furnish intumescent seals when required by codes, for pairs of fire-rated doors.

2.04 LOUVERS AND LIGHT FRAMES

A. Metal Louvers:

1. Blade Type: Vision-proof, inverted V.
2. Metal and Finish: Extruded aluminum with Class II, clear anodic finish complying with AA-C22A31.

B. Wood Beads for Light Openings in Wood Doors:

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer's standard shape.

C. Wood-Veneered Beads for Light Openings in Fire Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire rating indicated. Include concealed metal glazing clips where required for opening size and fire rating indicated.

2.05 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

- B. Factory machine/ prepare doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Louvers: Factory install louvers in prepared openings.
- 2.06 FACTORY FINISHING
- A. Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.
 - B. Finish doors at factory.
 - C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-6 catalyzed polyurethane, unless directed or approved otherwise.
 - 3. Staining: Match Architect's sample.
 - 4. Effect and sheen: As selected by Architect

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Finish Hardware."

- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.03 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08311
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Non-rated and fire-rated wall access doors and frames.
 - 2. Non-rated and fire-rated ceiling access doors and frames.

1.03 SUBMITTALS

- A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
- B. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction:
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.05 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Access Doors:
 - a. Acudor Products, Inc.
 - b. J. L. Industries, Inc.
 - c. Karp Associates, Inc.
 - d. Larsen's Manufacturing Company.
 - e. Milcor Limited Partnership.

2.02 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M for uncoated base metal.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.
- D. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.
- E. Plaster Bead: Casing bead formed from 0.0299-inch zinc-coated steel sheet with flange formed out of expanded metal lath and in size to suit thickness of plaster.

2.03 PAINT

- A. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.04 ACCESS DOORS AND FRAMES

- A. Flush, Insulated, Fire-Rated Access Doors and Trimless Frames: Fabricated from steel or metallic-coated steel sheet.
 - 1. Locations: Where indicated.
 - 2. Fire-Resistance Rating: As indicated or required for conditions.
 - 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 - 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 - 5. Frame: Minimum 0.060-inch- thick sheet metal with drywall bead or plaster bead.
 - 6. Hinges: Continuous piano hinge.
 - 7. Automatic Closer: Spring type.
 - 8. Latch: Self-latching bolt operated by key with interior release.

- B. Flush Access Doors and Trimless Frames: Fabricated from steel or metallic-coated steel sheet.
 - 1. Locations: As indicated.
 - 2. Door: Minimum 0.060-inch- thick sheet metal, set flush with surrounding finish surfaces.
 - 3. Frame: Minimum 0.060-inch- thick sheet metal with drywall bead or plaster bead as required.
 - 4. Hinges: Continuous piano hinge.
 - 5. Latch: Screwdriver-operated cam latch.

2.05 FABRICATION

- A. Provide access door assemblies manufactured as integral units ready for installation.

- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

- C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 - 1. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. For trimless frames with plaster bead for full-bed plaster applications, provide zinc-coated expanded metal lath and exposed casing bead welded to perimeter of frames.
 - 3. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction.

- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.06 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.07 METALLIC-COATED STEEL FINISHES

- A. Galvanizing of Steel Shapes and Plates: Hot-dip galvanize items indicated to comply with applicable standard listed below:
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pretreating.

2.08 STEEL FINISHES

- A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.02 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install access doors with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.

3.03 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08332 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes manually operated overhead coiling counter doors.

1.3 DEFINITIONS

- A. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.4 PERFORMANCE REQUIREMENTS

- A. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles and for 10 cycles per day.
 - 1. Include tamperproof cycle counter.

1.5 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
- B. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's product data.
- C. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Atlas Door; Div. of Clopay Building Products Company, Inc.
 2. Cookson Company.
 3. Cornell Iron Works Inc.
 4. McKeon Rolling Steel Door Company, Inc.
 5. Overhead Door Corp.
 6. Raynor.
 7. Wayne-Dalton Corp.
 8. Windsor Door, a MAGNATRAX Corporation.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling door curtain of interlocking slats, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Aluminum Door Curtain Slats: **ASTM B 209 (ASTM B 209M)** or **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 - a. Aluminum Extrusion Thickness: Not less than **0.051 inch (1.30 mm)**.
 2. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.
 3. Inside Curtain Slat Face: To match material of outside metal curtain slat.
- B. Endlocks for Counter Doors: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar for Counter Doors: Manufacturer's standard continuous channel or tubular shape, either stainless-steel or aluminum extrusions to suit type of curtain slats.
1. Astragal: Provide a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene; for placement between angles or fitted to shape, as a cushion bumper for interior door.
- D. Curtain Jamb Guides for Counter Doors: Fabricate curtain jamb guides of material and finish to match curtain slats, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.

2.3 HOODS AND ACCESSORIES

- A. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
1. Fabricate hoods for aluminum doors, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; **0.032-inch (0.8-mm)** minimum thickness, complying with **ASTM B 209 (ASTM B 209M)**.
- B. Integral Frame, Hood, and Fascia: Provide welded assemblies of the following sheet metal:
1. Fabricate from minimum **0.064-inch- (1.6-mm-)** thick, hot-dip galvanized steel sheet with **G90 (Z275)** zinc coating, complying with ASTM A 653/A 653M.
 2. Fabricate from minimum **0.0625-inch- (1.6-mm-)** thick stainless-steel sheet, Type 304, complying with ASTM A 240/A 240M or ASTM A 666.
- C. Integral Sills: Fabricate sills as integral part of frame assembly of same sheet metal; **0.078-inch (2.0-mm)** minimum thickness.
- D. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.
1. Provide pull-down straps or pole hooks for doors more than **84 inches (2130 mm)** high.
- E. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- F. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
1. Locking Bars: Full-disc cremone type, both jamb sides operable from outside only.
 2. Lock cylinder is specified in Division 08 Section "Door Hardware."

2.4 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than **0.03 in./ft. (2.5 mm/m)** of span under full load.
- C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.
- D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

- E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate.

2.5 MANUAL DOOR OPERATORS

- A. Push-up Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed **25 lbf (111 N)**.

2.6 FINISHES, GENERAL

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, Dark Bronze coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports.

3.2 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors. Refer to Division 01 Section "Demonstration and Training".

END OF SECTION 08332

SECTION 08410
ALUMINUM ENTRANCES, STOREFRONTS,
AND WINDOW SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
1. Exterior aluminum storefront, window and entrance systems.
- B. Related sections include the following:
1. Section 07920: "Joint Sealants" for joint sealants installed as part of aluminum entrance and storefront systems.
 2. Section 08710: "Finish Hardware."
 3. Section 08800: "Glazing."

1.03 SYSTEM DESCRIPTION

- A. Provide aluminum entrance, storefront and window systems capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:
1. Air infiltration and water penetration exceeding specified limits.
 2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.
- B. Wind Loads: Provide systems, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7, "Minimum Design Loads for Buildings and Other Structures," 6.4.2, "Analytical Procedure," whichever are more stringent.
1. Static-Pressure Test Performance: Provide systems that do not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
 - a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
 - b. Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.

- C. Dead Loads: Provide system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
 - D. Live Loads: Provide systems, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads required without failure of materials or permanent deformation.
 - E. Air Infiltration: Provide systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft.
 - F. Water Penetration: Provide systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 6.24 lbf/sq. ft.. Water leakage is defined as follows:
 - 1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
 - G. Thermal Movements: Provide systems, including anchorage, that accommodate thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 - H. Structural-Support Movement: Provide systems that accommodate structural movements including, but not limited to, sway and deflection.
 - I. Condensation Resistance: Provide systems with condensation resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.1.
 - J. Dimensional Tolerances: Provide systems that accommodate dimensional tolerances of building frame and other adjacent construction.
- 1.04 SUBMITTALS
- A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

- B. Shop Drawings: For entrance, storefront and window systems. Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.
 - 1. For entrance systems, include coordination with hardware schedule and indicate operating hardware types, quantities, and locations.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
- D. Samples for Verification: Of each type of exposed finish required in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing systems similar to those required for this Project and who is acceptable to manufacturer.
- B. Source Limitations: Obtain each type of system through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of entrance and storefront systems and are based on the specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Section 01600: "Product Requirements," Article - Substitutions.
 - 1. Do not modify intended aesthetic effect, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code--Aluminum."

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.07 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance, storefront and curtainwall systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
1. Structural failures including, but not limited to, excessive deflection.
 2. Failure of system to meet performance requirements.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Failure of operating components to function normally.
 5. Water leakage through fixed glazing and frame areas.
- C. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Kawneer Company, Inc.; Trifab VG 450 Flush Front and VG451; Basis of Design.
 2. Vistawall Architectural Products
 3. EFCO Corporation

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Bars, Rods, and Wire: ASTM B 211.
 5. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Glazing as specified in Section 08800: "Glazing."
- C. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.

2.03 COMPONENTS

- A. Doors: Provide manufacturer's standard 1-3/4 inch thick glazed doors with minimum 0.125-inch thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
 - 1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.
 - 2. Medium Stile Design: Design Basis – Kawneer. (Hardware provided under Section 8710). Include 10" ADA bottom rail.
- B. Storefront and Window Framing System: Design Basis - Trifab VG 450 Flush Front 2 in. back member width and 4 1/2 in. overall depth.
- C. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.
- D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Reinforce members as required to retain fastener threads.
 - 2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing, compatible with adjacent materials, and of type recommended by manufacturer.
- G. Weatherstripping: Manufacturer to furnish and install it's standard replaceable weather stripping as follows:
 - 1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.
 - 2. Sliding Weather Stripping: Molded neoprene complying with ASTM D2000 requirements or molded PVC complying with ASTM D 2287 requirements.
- H. Hardware: To be installed by aluminum door manufacturer as part of the work of this section.

2.04 FABRICATION

- A. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After

fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

- B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
- C. Prepare components to receive concealed fasteners and anchor and connection devices.
- D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
- E. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- G. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Storefront: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- I. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
 - 1. Exterior Doors: Provide compression weather stripping at fixed stops at other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.

2.05 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance

of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - 1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range of choices for color and gloss.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- D. Install components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
- E. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction, unless otherwise indicated. Comply with requirements of Section 07920: "Joint Sealants."
- F. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.

- G. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturer's written instructions.
 - 1. Install concealed and surface mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible. Refer to Section 08710: "Finish Hardware"
- H. Install glazing to comply with requirements of Section 08800: "Glazing," unless otherwise indicated.
- I. Erection Tolerances: Install storefront systems to comply with the following maximum tolerances:
 - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 - 3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.02 ADJUSTING AND CLEANING

- A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.
- B. Remove excess sealant and glazing compounds, and dirt from surfaces.

3.03 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08710
FINISH HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work in this Section shall include furnishing of all items of finish hardware as hereinafter specified or obviously necessary to complete the building, except those items that are specifically excluded from this Section of the specification.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Hollow Metal Doors and Frames.
- B. Aluminum Doors and Frames.
- C. Wood Doors and Frames.

1.04 DESCRIPTION OF WORK

- A. Furnish labor and material to complete hardware work indicated, as specified herein, or as may be required by actual conditions at building.
- B. Include all necessary screws, bolts, expansion shields, other devices, if necessary, as required for proper hardware application. The hardware supplier shall assume all responsibility for correct quantities.
- C. All hardware shall meet the requirements of Federal, State and Local codes having jurisdiction over this project, notwithstanding any real or apparent conflict therewith in these specifications.
- D. Fire-Rated Openings:
 - 1. Provide hardware for fire-rated openings in compliance with A.I.A. (NBFU) Pamphlet No.80, NFPA Standards No.101, UBC 702 (1997) and UL10C. This requirement takes precedence over other requirements for such hardware. Provide only hardware that has been tested and listed by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.
 - 2. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating Fire Door to be equipped with fire exit Hardware and provide UL label on exit device indicating "Fire Exit Hardware".
- E. FASTENERS:
 - 1. Hardware as furnished shall conform to published templates generally prepared for machine screw installation.
 - 2. Furnish each item complete with all screws required for installation. Typically, all exposed screw installation.

3. Insofar as practical, concealed type fasteners for hardware units that have exposed screws shall be furnished with Phillips flat head screws, finished to match adjacent hardware.
4. Door closers and exit devices to be installed with closed head through bolts (sexbolts).

1.05 QUALITY ASSURANCE

- A. The finish hardware supplier shall prepare and submit to the architect six (6) copies of a complete schedule identifying each door and each set number, following the numbering system and not creating any separate system himself. He shall submit the schedule for review, make corrections as directed and resubmit the corrected schedule for final approval. Approval of schedule will not relieve contractor of the responsibility for furnishing all necessary hardware, including the responsibility for furnishing correct quantities.
- B. No manufacturing orders shall be placed until detailed schedule has been submitted to the architect and written approval received.
- C. After hardware schedule has been approved, furnish templates required by manufacturing contractors for making proper provisions in their work for accurate fitting, finishing hardware setting. Furnish templates in ample time to facilitate progress of work.
- D. Hardware supplier shall have an office and warehouse facilities to accommodate the materials used on this project. The supplier must be an authorized distributor of the products specified.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Wrap/protect finished hardware items for shipment. Deliver to manufacturing contractors the hardware items required by them for their application; deliver balance of hardware to job, store in designated location. Each item shall be clearly marked with it's intended location.

1.07 WARRANTY

- A. The material furnished shall be warranted for one (1) year after installation, or longer, as the individual manufacturer's warranty permits.
- B. Overhead door closers shall be warranted in writing by the manufacturer against failure due to defective materials and workmanship, for a period of ten (10) years commencing on the Date of Final Completion and Acceptance. In the event of failure, the manufacturer is to promptly repair or replace the defective closer with no additional cost to the owner.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. To the greatest extent possible, obtain each kind of hardware item from only one manufacturer.
- B. All numbers and symbols used herein have been taken from the current catalogs of the following manufacturers:

HINGES				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Continuous Hinge	Stanley	661HD/662HD High Frequency Exterior Use 661/662 Interior Use	628 628	Pemko, Hager/Roton
Mortise Hinge	Stanley	CB1961R x NRP (Exterior Heavy Use Doors) CB1901R x NRP (Exterior Light Use Doors) CB1900R (Interior Light Use Doors)	630 630 652	Hager, Ives, McKinney, Lawrence

SECURING DEVICES				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Lock Sets	Best	Heavy Duty Mortise 45H, 14R Trim Heavy Duty Cylindrical 93K, 14D Trim Mortise Lock Functions: 1. A/AB Function (At typical offices) 2. D Function (At typical Storage and Mechanical, Electrical & Janitor Rooms) 3. R Function (At typical classrooms) 4. L Function (At single restrooms) 5. N Function (At passage doors)	626 626	No Substitution
Padlocks	Best	21B722		No Substitution
Cabinet/ Drawer Locks	Best	Type as required for application	626	Olympus (w/ 7 pin I/C small format)
Key System	Best	Existing Patented MX8		No Substitution

EXIT DEVICES				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Exit Device	Precision	2103 or 08 as required CD (at single doors) 2102 x 2103 or 08 as required CD x KR822 (at pairs) 4900B Trim Add FL on Fire Rated Doors	630 630 626	Sargent (8800 series) Von Duprin (98 series)
Automatic Flush Bolts	Trimco	3810 (Automatic) (metal doors) 3815 (Automatic) (wood doors)	626 626	Hager, Ives
Manual Flush Bolts	Hager	3917 (Manual) (metal doors) 3913 (Manual) (wood doors)	626 626	Ives
Removable	Sargent	980L Aluminum		Von Duprin

Mullions				5764
CLOSING DEVICES				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Surface Closer	Stanley	D-4550 CS or EDA (Exterior Outswing) D-4550 EDA on interior out swing hard traffic openings D-4551 Reg on Interior inswing openings (All door frames to be reinforced) Furnish SN	689 689 689	LCN 4011/4111 EDA

OPENING DEVICES				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Automatic Operators	Stanley	D-4990		Horton Power Plus 7000 Series
Activating Plates	Stanley	CL4163		

STOPS AND HOLDERS				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Door Stops	Trimco	1270CX (Wall Stop) 1211 (Floor Stop) (Use floor stops only as required)	630 626	Hager, Ives, Glynn Johnson FS438

ACCESSORIES				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Push/ Pull/ Kick Plates	Trimco	1001-3 x 1015-3B x 8" CTC 4" x 16" (CFC where required)	630	Hager, Ives, Glynn Johnson, Von Duprin
Door Silencers	Trimco	1229A (Metal Frames) 1229B (Wood Frames)	Gray Gray	Hager, Ives, Glynn Johnson
Coordinators	Hager	3094B x Mounting Brackets	Black	Ives
Thresholds	Pemko	171A (1/2" x 5" Saddle Threshold) Field verify threshold depth.		No Substitution
Seals	Pemko	S88D Pressure Sensitive Mounting		No Substitution
Weatherstripping	Pemko	45061CNB (at head and jambs–surface mount) 18061CNB (at sill on door-surface mount)		No Substitution
Astragal	Pemko	18041CNB (Wood doors) (where required) *Astragal by door manufacturer at HM door		No Substitution
Drip Cap	Pemko	346C (4" wider than door width)		No

				Substitution
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MISCELLANEOUS				
PRODUCT	SPECIFIED MANUF.	MODEL/ SERIES	FINISH	ALTERNATE MANUF.
Key Cabinet	Telkee	Aristocrate Cabinet – wall mounted with key capacity 50% over lock quantity.		Lund, HPC

- C. If material manufactured by other than that specified or listed herewith as an equal is to be bid upon, permission must be requested from the architect seven (7) days prior to bidding. If substitution is allowed, it will be so noted by addendum.

2.02 HINGES

- A. Exterior Butts shall be Stainless Steel. Butts on all out swinging doors shall be furnished with non-removable pins (NRP).
- B. Interior Butts shall be as listed.
- C. Doors 5' or less in height shall have two (2) butts. Furnish one (1) additional butt for each 2'6" in height or fraction thereof.
- D. All hinges shall be the ball bearing type.

2.03 CYLINDERS AND KEYING

- A. All locks and cylinders shall be removable core.
- B. Comply with Owner's instructions for master keying and except as otherwise indicated, provide individual change keys for each lock which is not designated to be keyed alike with a group of related locks.
- C. Key Material: Provide keys of nickel silver only.
- D. Key Quantity: Furnish three (3) change keys for each lock; five (5) master keys for each master key system; five (5) grand master keys for each grand master key system; and twelve (12) construction master keys.
 - 1. Deliver all permanent keys and key blanks to the Owner's representative.
- E. Visual Key Control: Stamp the key set symbol on the key bow ONLY of all the cut keys.

2.04 LOCKSETS

- A. Locks & Latches shall comply with NFPA 101, SEC. 7.2.1.5

2.05 EXIT DEVICES

- A. Exit devices must be listed under "Panic Hardware" in accident equipment list of

Underwriters Laboratories. Labeled doors with "Fire Exit Hardware" must have labels attached and be in strict accordance with Underwriters Laboratories.

2.06 DOOR CLOSERS

- A. Door closers shall have non-ferrous covers, forged steel arms, separate valves for adjusting back check, closing and latching cycles and adjustable spring to provide up to 50% increase in spring power. Closers shall be furnished with parallel arm mounted on all doors opening into corridors or other public spaces and shall be mounted to permit 180 degrees door swing wherever wall conditions permit. Furnish with non-hold open arms unless otherwise indicated.
- B. Door closer cylinders shall be of high strength cast iron construction to provide low wear operating capabilities of internal parts throughout the life of the installation. All door closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified testing laboratory. Mount closers to doors with thru-bolt fasteners.
- C. It will be the Hardware Supplier's responsibility to furnish the correct arms and brackets required to mount the closers on the proper side of the opening.

2.07 TRIM AND PLATES

- A. Kick plates, mop plates and armor plates shall be .050 gauge. Kick plates to be 8" high, mop plates to be 4" high. All plates shall be two (2) inches less full width of door.
- B. Push plates, pull plates, door pulls and miscellaneous door trim shall be shown in the hardware schedule.

2.08 DOOR STOPS

- A. Door stops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Furnish floor or wall stops as required and/or as specified in the hardware schedule.

2.09 THRESHOLDS AND WEATHERSTRIP

- A. Thresholds and weatherstrip shall be as listed in the hardware schedule.

2.10 DOOR SILENCERS

- A. Furnish rubber door silencers for interior door frames, two (2) per pair and three (3) per single door frame.

2.11 KEY CONTROL SYSTEM

- A. Furnish a complete key control system, sufficient for number of keys in project plus 50%.

2.12 HARDWARE FINISHES

- A. Provide matching finishes for hardware at each door or opening to the greatest extent

possible, and except as otherwise indicated. Reduce differences in color and texture as much as possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for latch and lock set (or push/pull units if no latch/lock sets) for color and texture.

- B. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

PART 3 - EXECUTION

3.01 DELIVERIES

- A. General: Stockpile all items sufficiently in advance to ensure their availability and make all necessary deliveries in a timely manner to ensure orderly progress of the total work.

3.02 INSTALLATION

- A. All hardware shall be applied and installed in accordance with the Finish Hardware Schedule. Care should be exercised not to mar or damage adjacent work.
- B. Contractor to provide a secure lock-up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items that are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses both before and after installation.
- C. No hardware is to be installed until the hardware manufacturers have provided a pre-installation class. This is to insure proper installation of the specified products.
- D. The manufacturer's representative for the locking devices and closing devices must inspect and approve, in writing, the installation of their products. Hardware installed incorrectly must be reported to the architect prior to the architect's final punch list.

3.03 ADJUSTING AND CLEANING

- A. Contractor shall adjust all hardware in strict compliance with manufacturer's instructions. Prior to turning project over to Owner, contractor shall clean and make any final adjustments to the finish hardware.

3.04 PROTECTION

- A. Contractor shall protect the hardware, as it is stored on construction site in a covered and dry place.
- B. Contractor shall protect exposed hardware installed on doors during the construction phase.

DOOR HARDWARE ASSIGNMENTS:

HW 1

DOORS: 101A, 101B, 101D, 138
EACH TO HAVE:

- 6 HINGES
- 1 EXIT DEVICE
- 1 EXIT DEVICE
- 1 CYLINDER TEMP I.C. CORE
- 1 CYLINDER TEMP I.C. CORE
- 2 PERMANENT CORE
- 2 CLOSER
- 2 OH STOP
- 1 WEATHERSTRIP
- 1 THRESHOLD

HW 2

DOORS: 102A, 102B, 122B
EACH TO HAVE:

- 3 HINGES
- 1 EXIT DEVICE
- 1 CYLINDER TEMP I.C. CORE
- 1 PERMANENT CORE
- 1 CLOSER
- 1 OH STOP
- 1 WEATHERSTRIP
- 1 THRESHOLD

HW 3

DOORS: 115B, 136
EACH TO HAVE:

- 3 HINGES
- 1 LOCK
- 1 CLOSER
- 1 OH STOP
- 1 WEATHERSTRIP
- 1 THRESHOLD

HW 4

DOORS: 103A
EACH TO HAVE:

- 6 HINGES
- 1 LOCK
- 1 CLOSER
- 1 OH STOP
- 1 WEATHERSTRIP

1 THRESHOLD

HW 5

DOORS: 103B, 106, 107, 115A, 116A, 117A, 118A119A, 126A
EACH TO HAVE:

3 HINGES
1 LOCK
1 CLOSER
1 KICK PLATE
1 WALL STOP
3 SILENCERS

HW 6

DOORS: 102E, 102H, 111A, 114, 125A, 125B, 127A, 128A, 129A, 130A, 131A, 132A,
133A, 134A
EACH TO HAVE:

3 HINGES
1 LOCK
1 WALL STOP
3 SILENCERS

HW 7

DOORS: 102C, 102D
EACH TO HAVE:

6 HINGES
2 EXIT DEVICE
2 RIM CYLINDER
2 CLOSER
2 KICK PLATE
2 FLOOR STOP
1 PERIMETER SEAL
1 GASKETING
6 SILENCERS

HW 8

DOORS: 102F, 102G
EACH TO HAVE:

3 HINGES
1 EXIT DEVICE
1 RIM CYLINDER

- 1 CLOSER
- 1 KICK PLATE
- 1 FLOOR STOP
- 1 PERIMETER SEAL
- 1 GASKETING
- 3 SILENCERS

HW 9

DOORS: 112A, 113A
EACH TO HAVE:

- 3 HINGES
- 1 LATCH SET
- 1 CLOSER
- 1 KICK PLATE
- 1 WALL STOP
- 3 SILENCERS

HW 10

DOORS: 122A
EACH TO HAVE:

- 3 HINGES
- 1 EXIT DEVICE
- 1 RIM CYLINDER
- 1 CLOSER
- 1 KICK PLATE
- 1 FLOOR STOP

HW 11

DOORS: 110A (HALF-DOOR AT RECEPTION DESK)
EACH TO HAVE:

- 2 HINGES
- 1 LATCH SET
- 1 WALL STOP
- 2 SILENCERS

HW 12

DOORS: 108A, 109A
EACH TO HAVE:

- 3 HINGES
- 1 LOCK (CLASSROOM FUNCTION)

- 1 CLOSER
- 1 FLOOR STOP
- 3 SILENCERS

HW 13

DOORS: 104A, 104B, 105A
EACH TO HAVE:

- 6 HINGES
- 1 LOCK
- 2 FLUSH BOLT
- 1 DUST PROOF STRK
- 1 OH STOP
- 1 ASTRAGAL
- 2 SILENCERS

HW 14

MISCELLANEOUS:

- 1 KEY CABINET

END OF SECTION

SECTION 08800
GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Entrance Doors.
 - 3. Interior borrowed lites.

1.03 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: Wind loads shall be determined by the more restrictive of the following using the appropriate factors and coefficients. Wind load pressures shall be computed and applied using the design wind speed indicated by Wind Information located on Drawings.
 - 1) ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 6.4.2, "Analytic Procedure".
 - 2) Florida Building Code.
 - b. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection

at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

- 1) For monolithic-glass lites heat treated to resist wind loads.
- c. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm, unless required otherwise.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.

1.05 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Clear Glass: Obtain clear and tinted float glass from one primary-glass manufacturer.
- C. Glazing Publications: Comply with published recommendations of glass product manufacturers and industry organizations, unless more stringent requirements are

indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards. As a minimum comply with:

1. Federal Standard 16 CFR 1201: Federal Safety Standard for Architectural Glazing Materials.
 2. FGMA: Glazing Manual.
- D. Safety Glass: Products complying with requirements of 16 CFR Part 1201 for Category II materials.
1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.
 2. Glass in Hazardous Locations (per FBC 2406.3) shall be safety glazing as required in FBC Section 2406 – Safety Glazing.
- E. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested per ASTM E 2074, labeled and listed by testing and inspecting agency acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.09 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Visteon Glass Division.
 2. AFG Industries Inc.
 3. Guardian Industries Corp.
 4. Pilkington Libby Owens Ford.

5. PPG Industries.
- C. Exterior Glass: One sheet of ¼ inch thick tinted float glass strengthened in accordance with ASTM C158, Kind CS, and/or ASTM C1048, Kind HS,
 1. Provide PPG Solarcool (1) Gray Glass.
 - a. Shade Coefficient: 0.43
 - b. Solar Heat Gain Coefficient: 0.37
 - c. Visible Light: 36%
 - d. Winter U-Value: 1.03
 - e. Summer U-Value: 0.93

2.02 PRIMARY FLOAT GLASS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select).
- B. Clear Float Glass: Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).
 1. Thickness: ¼-inch.
- C. **Tinted Float Glass:** Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select).

2.03 HEAT-TREATED FLOAT GLASS

- A. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated or required.

2.04 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.05 ELASTOMERIC GLAZING SEALANTS

- A. Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range for this characteristic.
- B. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with ASTM C 920 requirements for Type, Grade, Class and Uses.
1. Glazing Joints - Non-Structural: One-part silicone sealant, non-sag, Class A.
 - a. Elongation Capacity $\pm 50\%$
 - b. Service Temperature Range -40 to 180° F
 - c. Shore A Hardness Range 20 to 35
 2. Glazing Joints - Structural: One-part silicone sealant, non-sag, Class A; capable of autobonding.
 - a. Elongation Capacity $\pm 25\%$
 - b. Service Temperature Range -40 to 180° F
 - c. Shore A Hardness Range 20 to 35

2.06 MISCELLANEOUS GLAZING MATERIALS

- A. Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.07 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.03 GLAZING INSTALLATION

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
- C. Glazing channel dimensions: Provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- H. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- J. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.04 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.05 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.06 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.07 GLAZING SCHEDULE

GLASS TYPE	LOCATION	REMARKS
Heat-treated; Kind - FT (fully tempered). Clear or tinted.	Use at all locations required by codes.	See Note 1.
Heat-treated; Kind - HS (heat strengthened). Clear.	Use at all interior glazing, unless noted or required otherwise.	See Note 1.
Heat-treated; Kind - HS (heat strengthened). Tinted.	Use at exterior aluminum framed windows and aluminum entrances, unless noted or required otherwise.	See Note 1.

Note 1: Refer to Part 2 Articles for glass type product requirements.

END OF SECTION

Division 9

Finishes

SECTION 09220
PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior portland cement plasterwork (stucco) on metal lath plaster bases and accessories.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealants" for sealants.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Provide drawings and details.
- C. Material Certificates: Submit certificate signed by manufacturer for each kind of plaster aggregate certifying that materials comply with requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 PROJECT CONDITIONS

- A. Comply with ASTM C 926 requirements.
- B. Exterior Plasterwork:
 - 1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

2. Apply plaster when ambient temperature is greater than 40 deg F (4.4 deg C).
 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 METAL LATH

- A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
1. Diamond-Mesh Lath: Flat and self furring:
 - a. Weight: 3.4 lb/sq. yd. (1.8 kg/sq. m).
 2. Flat Rib Lath: Rib depth of not more than 1/8 inch (3.1 mm).
 - a. Weight: 3.4 lb/sq. yd. (1.8 kg/sq. m).
- B. Paper Backing: FS UU-B-790, Type I Grade D, Style 2 vapor-permeable paper.
1. Provide paper-backed lath at all exterior locations.

2.2 ACCESSORIES

- A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Zinc and Zinc-Coated (Galvanized) Accessories:
1. External-Corner Reinforcement: Expanded, large-mesh, diamond-metal lath fabricated from zinc-alloy and specially formed to reinforce external corners of portland cement plaster on exterior exposures while allowing full plaster encasement.
 2. Cornerbeads: Fabricated from zinc.
 - a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
 3. Casing Beads: Fabricated from zinc; square-edged style; with expanded flanges.
 4. Control Joints: Fabricated from zinc; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 5. Expansion Joints: Fabricated from zinc; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.

6. Two-Piece Expansion Joints: Fabricated from zinc; formed to produce slip-joint and square-edged reveal that is adjustable from **1/4-to-5/8-inch (6.34-to-16-mm)** wide; with perforated flanges.

2.3 MISCELLANEOUS MATERIALS

- A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, **1/2 inch (13 mm)** long, free of contaminants, manufactured for use in portland cement plaster.
- C. Bonding Compound: ASTM C 932.
- D. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of not fewer than three exposed threads.
- E. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.
- F. Isolation Strip at Exterior Walls:
 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch (3.1 mm)** thick, in width to suit steel stud size.

2.4 PLASTER MATERIALS

- A. Portland Cement: ASTM C 150, Type II.
- B. Masonry Cement: ASTM C 91, Type N.
- C. Portland and Masonry Cement Mixes Cement Color: Gray.
- D. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- E. Sand Aggregate: ASTM C 897.
- F. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.
 1. Color for Finish Coats: Gray.

2.5 PLASTER MIXES

- A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. ft. (16 kg of fiber/cu. m) of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
1. Portland Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 0 to 3/4 parts lime. Use 3 to 5 parts aggregate per part of cementitious material (sum of separate volumes of each component material).
 2. Masonry Cement Mixes:
 - a. Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate.
 3. Portland and Masonry Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material (sum of separate volumes of each component material).
- C. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

3.3 INSTALLING METAL LATH

- A. Expanded-Metal Lath: Install according to ASTM C 1063.
 - 1. On Solid Surfaces, Not Otherwise Furred: Install self-furring diamond-mesh lath.

3.4 INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Reinforcement for External Corners:
 - 1. Install lath-type external-corner reinforcement at exterior locations.
 - 2. Install cornerbead at interior and exterior locations.
- C. Control Joints: Install control joints at locations indicated on Drawings and as follows:
 - 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
 - b. Horizontal and other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).
 - 2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
 - 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 - 4. Where control joints occur in surface of construction directly behind plaster.
 - 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.
- D. Caulk accessory joints at splices, and abutting or terminating points prior to application of stucco.

3.5 PLASTER APPLICATION

- A. General: Comply with ASTM C 926.
 - 1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6.4 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.
 - 2. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, before lathing where necessary. Except where

full grouting is indicated or required for fire-resistance rating, grout at least **6 inches (152 mm)** at each jamb anchor.

3. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
4. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Plaster Finish Coats: Apply to provide finish to match Architect's sample.

3.6 CUTTING AND PATCHING

- A. Cut, patch, replace, and repair plaster as necessary to accommodate other work and to restore cracks, dents, and imperfections. Repair or replace work to eliminate blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

SECTION 09260
GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
 - 2. Tile backing panels.
 - 3. [Impact-resistant wallboard.](#)
 - 4. Non-load-bearing steel framing.
 - 5. Sound attenuation blankets for STC rated gypsum board installations.

1.03 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products," UL's "Fire Resistance Directory," or GA-600, "Fire Resistance Design Manual."
- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

1.08 PRECEDENCES

- A. Firestopping requirements take precedence over acoustical or other requirements.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Framing and Furring:
 - a. Clark Steel Framing Systems.
 - b. Dale Industries, Inc. - Dale/Incor.
 - c. Dietrich Industries, Inc.
 - d. MarinoWare; Division of Ware Ind.
 - e. National Gypsum Company.
 - f. Unimast, Inc.
 - 2. Gypsum Board and Related Products:
 - a. American Gypsum Co.
 - b. G-P Gypsum Corp.
 - c. National Gypsum Company.
 - d. United States Gypsum Co.

2.02 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch- diameter wire.

- C. Hanger Attachments to Concrete: As follows:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
- D. Hangers: Optional as follows, except where indicated or required otherwise:
1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
 2. Rod Hangers: ASTM A 510, mild carbon steel.
 - a. Protective Coating: ASTM A 153/A 153M, hot-dip galvanized.
 3. Flat Hangers: Commercial-steel sheet, ASTM A 653/A 653M, G40, hot-dip galvanized.
 4. Angle Hangers: ASTM A 653/A 653M, G60, hot-dip galvanized commercial-steel sheet.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch- wide flange, with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
1. Depth: As indicated or required for conditions.
- F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
1. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, 3/4 inch deep.
 2. Steel Studs: ASTM C 645.
 - a. Minimum Base Metal Thickness: 0.0312 inch at locations receiving tile. Other conditions as recommended by manufacturer.
 - b. Depth: As indicated.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base Metal Thickness: 0.0312 inch at locations receiving tile. Other conditions as recommended by manufacturer.
- G. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - b. Chicago Metallic Corporation; Drywall Furring 640 or Drywall Furring 660 System.
 - c. USG Interiors, Inc.; Drywall Suspension System.

2.03 STEEL PARTITION AND SOFFIT FRAMING

- A. Components, General: As follows:
 - 1. Comply with ASTM C 754 for conditions indicated.
 - 2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.
- B. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0312 inch at locations receiving tile, hung cabinets, fire doors, and doors over 48 inches wide. Other conditions as recommended by manufacturer.
 - 2. Depth: As indicated.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base Metal Thickness: 0.0312 inch thickness, unless indicated otherwise
- E. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange.
 - 1. Depth: 1-1/2 inches, unless indicated otherwise.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base Metal Thickness: 0.0312 inch at locations receiving tile, hung cabinets, fire doors, and doors over 48 inches wide. Other conditions as recommended by manufacturer.
 - 2. Depth: As indicated.
- G. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.04 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
 - 1. Regular Type:
 - a. Thickness: 5/8 inch, unless indicated otherwise.
 - b. Long Edges: Tapered.
 - 2. Type X:
 - a. Thickness: 5/8 inch.
 - b. Long Edges: Tapered.

- C. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.
- D. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M.
 - 1. Core: Regular or fire-resistive and in thicknesses as required by installations.
- E. Proprietary Abuse-Resistant Gypsum Wallboard: ASTM C 36, manufactured to produce greater resistance to surface indentation and through-penetration than standard gypsum panels.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.
 - b. United States Gypsum Co.; SHEETROCK Brand Abuse-Resistant Gypsum Panels.
 - 2. Core: 5/8 inch, Type X.
 - 3. Long Edges: Tapered.
 - 4. Location: As indicated or scheduled.

2.05 TILE BACKING PANELS

- A. Panel Material and Size: Provide tile backing board selected from products below. Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Water-Resistant Backing Board: Glass-Mat type or other Architect approved; Unless approved otherwise comply with ASTM C 1178/C 1178M.
 - 1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to:
 - a. "Dens-Shield Tile Backer" as manufactured by G-P Gypsum Corp.
- C. Cementitious Backer Units: ANSI A118.9.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Custom Building Products; Wonderboard.
 - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - c. United States Gypsum Co.; DUROCK Cement Board.
 - 2. Thickness: 5/8 inch, unless indicated or required otherwise.

2.06 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. LC-Bead (J-Bead): Use at exposed panel edges.
 - c. Expansion (Control) Joint: Use where indicated.

2.07 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels: As recommended by manufacturer.

2.08 ACOUSTICAL SEALANT

- A. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
 - 2. Acoustical Sealant for Concealed Joints:
 - a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
 - b. Pecora Corp.; BA-98.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.

- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.09 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Isolation Strip at Exterior Walls:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2.10 FIRESTOPS AND SMOKESEALS

- A. Firestop and smoke seal devices and systems are the work of Division 7 Section "Firestopping".

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

3.03 STEEL FRAMING INSTALLATION

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Coordinate installations of support framing specified in Section 05500 for TV mounting brackets, specified elsewhere in Section 11135, with wall and ceiling framing.
- D. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
 - 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 - 2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
 - a. Use deep-leg deflection track where indicated.
- E. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
- F. Space studs and furring at not over 16 inches at locations receiving tile, wall hung cabinets, and wall hung shelving.

3.04 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Suspend ceiling hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Secure other type hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to steel deck tabs.
 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
- C. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.
- D. **Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.**

3.05 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.
1. Where studs are installed directly against exterior walls, install asphalt-felt or foam-gasket isolation strip between studs and wall.
- B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at, or 6 inches above, suspended ceilings as required. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. Cut studs 1/2 inch short of full height to provide perimeter relief.

2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
- D. Install steel studs and furring at the following spacings:
 1. Single-Layer and Multilayer Construction: As required by conditions
 2. Cementitious Backer Units: 16 inches o.c., unless otherwise indicated.
 - E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
 - F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 1. Install two studs at each jamb, unless otherwise indicated.
 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above. Where required.
 - G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3.06 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install sag resistant ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install regular, water resistant, Type X, and abuse-resistant type panels at locations required and specified. Install gypsum panels with face side out where applicable. Unless manufacturer requires otherwise, butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
 - 1. Sealing of perimeters and penetrations in sound walls which are identified as also being fire-rated or smoke-resistant is the work of Division 7 Section "Fire-stopping". Fire and smoke requirements take precedence.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
 - 1. Space screws a maximum of 12 inches o.c. for vertical applications.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.
- N. Identify rated (and smoke) walls above ceiling with the note: "Fire (and smoke) barrier - protect all openings", complying with requirements of local jurisdictions.

3.07 PANEL APPLICATION METHODS

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - B. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 - E. Multilayer Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.
 - F. Tile Backing Panels:
 1. Install at all tile areas and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.
 2. Install glass-mat type or cementitious type backer units at areas to receive tile that are subject to wetting such as showers, tubs, and where otherwise indicated.
 - a. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.
- 3.08 INSTALLING TRIM ACCESSORIES
- A. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 - B. Control Joints: Install control joints at locations indicated on Drawings or as otherwise required by conditions. Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.09 FINISHING GYPSUM BOARD ASSEMBLIES

- A. Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for indicated locations or as otherwise directed.
 - 1. Level 1: Use at the following locations. Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 2: Use at the following locations. Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
 - 3. Level 3: Use for surfaces to receive medium or heavy textured finishes before painting or applying heavy wallcoverings where lighting conditions are not critical. Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges.
 - 4. Level 4: Use for surfaces receiving light textured finish wallcovering and flat paints. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
 - 5. Level 5: Use for surfaces receiving gloss and semi-gloss enamels and surfaces subject to severe lighting. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface.

3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
 - 2. Prior to notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.

- c. Installation of air duct systems.
- d. Installation of air devices.
- e. Installation of mechanical system control air tubing.
- f. Installation of ceiling support framing.
- g. Firestopping of penetrations and joints in fire rated assemblies.
- h. Smoke sealing of penetrations and joints in smoke resistant assemblies.

END OF SECTION

SECTION 09310
CERAMIC / PORCELAIN TILE AND MARBLE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Porcelain floor tile.
 - 2. Ceramic mosaic tile.
 - 3. Quarry tile.
 - 4. Marble for window sills.
 - 5. Tile base, accessories and, metal trim installed as part of tile installations.

1.03 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:
 - 1. Level Surfaces: Minimum 0.6.
 - 2. Ramp Surfaces: Minimum 0.8.

1.04 SUBMITTALS

- A. Product Data: For each type of tile, adhesive, mortar, grout, and other products specified.
- B. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.
 - 1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Architect.
 - 2. Full-size units of each type of trim and accessory for each color required.
 - 3. Stone thresholds and marble in 6-inch lengths.

- C. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- D. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.
- E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.
- F. Tile Test Reports: Indicate and interpret test results for compliance of special-purpose tile with specified requirements.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:
 - 1. Joint sealants.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Section 01310: "Project Management and Coordination," Article - Project Meetings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish 1 unopened box of each primary size and color installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers and products that may be incorporated into the Work include, but are not limited to, those indicated for each tile type Design Basis, included in this Section.

2.02 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Provide Architect's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.
 - 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.

- D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

2.03 TILE PRODUCTS

- A. Porcelain Floor Tile, Wall Tile and Base: Provide tile complying with the following requirements:
1. Manufacturer (Basis of Design): Dal-Tile, or approved equivalent.
 2. Product Line: 'Colorbody' Porcelain Tile
 3. Style: 'City View'
 - a. Standard: ANSI / TCA - A137.1.
 - 1.) Type / Size: Thru color rectified porcelain. Refer to floor pattern drawings for floor and wall base tile sizes and patterns.
 - 2.) Colors: CY02 – 'Skyline Grey'; CY05 – 'Neighborhood Park'; CY07 – 'Village Café'. Refer to floor pattern drawings for floor and wall base tile patterns.
 - 3.) Finish: Matte
 - 4.) Installation Method: Thinset method. 1/8" joints.
 - 5.) Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes selected from manufacturer's standard, from matching dye lot of field tile.
- B. Ceramic Mosaic Unglazed Floor and Wall Tile: Provide tile complying with the following requirements:
1. Manufacturer (Basis of Design): Dal-Tile, or approved equivalent
 2. Series: 'Permatones'
 3. Standard: ANSI / TCA - A137.1.
 - 1.) Size: 2 in. x 2 in. Shape: square.
 - 2.) Edge: modified square.
 - 3.) Surface Finish: Matte
 - 4.) Moisture absorption: 0 to 0.5 percent.
 - 5.) Colors: 'Urban Putty'; 'Elemental Tan'. Refer to finish schedule and pattern plans for locations.
 - 6.) Mounted sheet size: 12 in. x 12 in.
 - 7.) Installation Method: Thinset method.
 - 8.) Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes selected from manufacturer's standard, from matching dye lot of field tile.
- C. Unglazed Quarry Tile: Provide tile complying with the following requirements:
1. Manufacturer (Basis of Design): Dal-Tile, or approved equivalent
 2. Series: 'Suretread and Pavers'

3. Color: 0Q87 'Bronze Clay Paver' – Smooth Surface
4. Standard: ANSI / TCA - A137.1.
 - 1.) Size: 6 in. x 6 in. Shape: square.
 - 2.) Edge: modified square.
 - 3.) Surface Finish: Smooth
 - 4.) Thickness: 3/8 inch
 - 5.) For furan-grouted tile, precoat w/ temporary protective coating.
 - 6.) Installation Method: Mud set method.
 - 7.) Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes selected from manufacturer's standard, from matching dye lot of floor tile.

2.04 SETTING AND GROUTING PRODUCTS

A. Setting And Grouting Materials For All Areas Except Restroom And Kitchen Areas:

1. Adhesive Manufacturers and Type: as recommended by tile manufacturer; Kind: Organic adhesive - ANSI/TCA A 136.1, Type 2; thinset bond type.
2. Mortar and Grout Manufacturers: Design Basis - TEC Product Cementitious with latex.
3. Mortar Materials: ANSI / TCA A 118.1 and ANSI A 118.4; Portland Cement, sand, latex additive and water. Color Admixture - Manufacturer's recommended type; color as selected; submit full color range for selection by Architect.
4. Grout Materials:
 - a. Grout: Cementitious type with latex additive, in accordance with ANSI A 118.6 and A 108.10 and compatible with setting materials. Provide sanded grout, unless approved otherwise.
 - b. Color Additive: Manufacturer's recommended type; color as selected; submit full color range for selection by Architect.

NOTE - Grouting process is not completed until the grout residue (or grout haze) is completely removed from the tile surface.

B. Setting And Grouting Materials For Restroom And Kitchen Areas:

1. Setting / Adhesive Materials: Epoxy adhesive - ANSI A 118.3, thinset bond type.
2. Acceptable Adhesive Manufacturers:
 - a. American Olean Tile Co., Inc.; Product - A020000 Epoxy Adhesive.
 - b. Atlas Minerals & Chemicals, Inc.; Product - Epoxy Adhesive.
 - c. Summitville Tiles Inc.; Product - 5300 Epoxy Adhesive.
3. Grouting Materials: Chemical-resistant, water-cleanable, ceramic tile-setting and -grouting epoxy, complying with [ANSI A118.3](#) and compatible with setting materials.

2.05 WINDOW SILLS

- A. Marble Window Sills: Provide marble window sills complying with recommendations and requirements of MIA and with a minimum abrasive-hardness value of 10 per ASTM C 241. Provide matched marble from a single quarry for each type, variety, color and quantity required.
 - 1. Selection: Unless scheduled or directed otherwise, provide "White Cherokee" as produced by Georgia Marble Co., Dimension Stone Group, Nelson, Georgia.

2.07 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Tile and Carpet Joiners: 'Schluter-Schiene' profiles, as indicated or selected by Architect.

2.08 MIXES

- A. Mix and proportion pre-mix setting bed, grout materials, and adhesives in accordance with manufacturer's written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- B. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.
 1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:
 1. Petroleum paraffin wax or grout release.

3.03 INSTALLATION

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Do not use tile pieces less than 1/2 of full unit width. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.
- F. Lay out tile wainscots, when used, to next full tile beyond dimensions indicated.
- G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated or required by referenced standards, during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Prepare joints and apply sealants to comply with requirements of Section 07920: "Joint Sealants."
- H. Grout tile to comply with the specified standards and manufacturer's requirements.
- I. Install tile at restroom showers and similar wall areas subject to wetting, over wall board selected from specified tile backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated. Refer to Division 9 Section: "Gypsum Board Assemblies."

3.04 TILE INSTALLATION

- A. Unless indicated or required otherwise, install tile to comply with TCA installation methods and ANSI A108 series of tile installation standards.
- B. Joint Widths: Install tile on floors with 1/8" joint widths.
- C. Joint Widths: Install tile on walls with 1/16 inch joint widths, unless recommended otherwise by material manufacturer for tile type selected.
- D. Stone Thresholds, if any: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.

- E. Installation Method for Porcelain Floor Tile: TCA F 113 or F 115 (for use where epoxy materials are indicated), thin set method.
- F. Installation Method for Ceramic Mosaic Floor Tile: TCA F 122, thin set.
- G. Installation Method for Ceramic Wall Tile: TCA W 242 or W 244 (for use over cementitious backer units), thin set.

3.05 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
 - 3. When used, remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.
 - 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
 - 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION

SECTION 09510
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems.
- B. Related Sections include the following:
 - 1. Section 09260: "Gypsum Board Assemblies."
 - 2. Division 15 and 16 Sections for HVAC, sprinklers and lighting.

1.03 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. 12 inch- square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch- long samples of exposed suspension system members, including moldings, for each color and system type required.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
 - 2. Products are identified with appropriate markings of applicable testing and inspecting agency.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Section 01310: Article - "Project Meetings."

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.07 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following manufacturers:
- B. Suspension Grid System:
 - 1. Armstrong World Industries Inc. (Design Basis).
 - 2. Chicago Metallic Corporation.
 - 3. USG Interiors Inc.
 - 4. Hunter Douglas
 - 5. Substitutions submitted in compliance with Section 01600.
- C. Acoustical Panels:
 - 1. Armstrong World Industries Inc. (Design Basis).
 - 2. USG Interiors Inc.
 - 3. Celotex Corporation.
 - 4. Hunter Douglas
 - 5. Substitutions submitted in compliance with Section 01600.
- D. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated as Design Basis, or those producing acceptable equivalent products, for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.02 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.03 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Metal Suspension System Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3.

- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- D. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- G. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
 - 1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 2. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.
- H. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

- A. Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
 - 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings-- Seismic Zones 0-2."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
 - 5. Do not attach hangers to steel deck tabs.
 - 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, for fire-resistance ratings, and to retain panels tight to grid system within 15 feet of an exterior door. Space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.
 5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.04 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.05 ACOUSTICAL PANEL CEILING AND SUSPENSION SYSTEM SCHEDULE

- A. Suspension System for Acoustical Panel Ceiling: Where scheduled or indicated, provide non-fire rated and fire-resistance-rated acoustical panel ceiling suspension system complying with the following:
1. Products: Design Basis.
 - a. "Suprafine" as manufactured by Armstrong Ceilings, with characteristics and requirements as follow:
 2. Narrow-Face, Single-Web, Extruded-Aluminum Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with 9/16-inch- wide faces; other characteristics as follows:

- a. Structural Classification: Intermediate-duty system, components die cut and interlocking.
 - b. Face Finish: Unless indicated or directed otherwise, painted white.
- B. Acoustical Panels: Where scheduled or indicated, provide acoustical panels complying with the following:
1. Ceiling Designation CA1 Product: Design Basis. All locations unless noted otherwise.
 - a. "Optima Open Plan," Number 3251, as manufactured by Armstrong Ceilings, with characteristics and requirements as follows:
 - b. Classification: Panels fitting ASTM E 1264, Class A, fiber base with factory applied finish.
 - c. Light reflectance: .90
 - d. NRC Rating: .95.
 - e. Color: White.
 - f. Edge Detail: tegular.
 - g. Size: 24 by 24 inches.
 - h. Thickness: 1 inch.
 2. Ceiling Designation CA2 Product: Design Basis. In Kitchen.
 - a. "Ceramaguard Unperforated," Number 605, as manufactured by Armstrong Ceilings, with characteristics and requirements as follows:
 - b. Light reflectance: .88.
 - c. NRC Rating: N/A.
 - d. Edge Detail: Square.
 - e. Size: 24 by 24 inches.
 - f. Thickness: 5/8 inch.
 3. Ceiling Designation CA3 Product: Design Basis. In Multi-Purpose Room.
 - a. "Techstyle E", as manufactured by Hunter Douglas, with characteristics and requirements as follows:
 - b. Light reflectance: .81
 - c. NRC Rating: .85
 - d. Edge Detail: Square, snap-on
 - e. Size: 48 by 48 inches.
 - f. Color: Off-White

END OF SECTION

SECTION 09650
RESILIENT TILE FLOORING,
BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Vinyl composition floor tile.
 - 2. Resilient wall base and accessories, including,
- B. Related Sections include the following:
 - 1. Section 09680: "Carpet Tile"

1.03 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.
- C. Samples for Verification: Full-size tiles of each different color and pattern of resilient floor tile, base, stair tread and risers specified, showing the full range of variations expected in these characteristics.
 - 1. For resilient accessories, manufacturer's standard-size samples, but not less than 12 inches long, of each resilient accessory color and pattern specified.
- D. Product Certificates: Signed by manufacturers of resilient products certifying that each product furnished complies with requirements.
- E. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Slip Resistance: FTC slip resistance classification required. Product must pass ASTM D 2047 testing.
- D. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F.
- C. Store tiles on flat surfaces.
- D. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.06 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F or more than 95 deg F in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 deg F or more than 95 deg F.
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
- D. Install tiles and accessories after other finishing operations, including painting, have been completed.

- E. Where demountable partitions and other items are indicated for installation on top of resilient tile flooring, install tile before these items are installed.
- F. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

1.07 EXTRA MATERIALS

- A. When allowed by governing regulations, furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.08 WARRANTIES

- A. Provide manufacturer's standard 20-year commercial warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Finish drawings and Color Schedule issued by Architect.
- B. Acceptable tile manufacturers and types:
 - 1. Centiva, a Tarkett Company (Basis of Design)
 - 2. Approved equivalent manufacturer
- C. Acceptable base manufacturers:
 - 1. Allstate Rubber (Basis of Design)
 - 2. Armstrong World Industries
 - 3. Burke Mercer Flooring Products
 - 4. Johnson Rubber Co.
 - 5. Mannington
 - 6. R. C. Musson Rubber
 - 7. Roppe

2.02 RESILIENT TILE

- A. Vinyl Composition Tile: Comply with ASTM F 1700 and the following:

1. Products, color(s) and pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for tile complying with requirements indicated.
2. Class: Class III (solid vinyl tile)
3. Wearing Surface: Smooth.
4. Surface Texture: Sawn (SW)
5. Thickness: Unless indicated or approved otherwise, minimum .120 inch overall
6. Wearlayer: .032" clear rigid high density PVC.
7. Size: Refer to finish pattern drawings and schedule information.
8. Edge: Square, slight bevel

2.03 RESILIENT BASE AND ACCESSORIES

- A. Vinyl Wall Base: Products complying with FS SS-W-40, Type II and complying with the following:
 1. Products and colors: As selected by Architect from manufacturer's full range of colors and patterns produced for tile complying with requirements indicated.
 2. Style: Cove with top-set toe, unless indicated otherwise.
 3. Minimum Thickness: Unless approved otherwise, 0.090 inch.
 4. Height: 4 inches.
 5. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet.
 6. Outside and Inside Corners: Job formed.
 7. Surface: Smooth.
- B. Vinyl Accessory Moldings: When required, as selected by Architect.

2.04 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions of Project.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
 2. Subfloor finishes comply with requirements specified in Section 03300: "Cast-in-Place Concrete" for slabs receiving resilient flooring.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Comply with resilient product manufacturer's written installation instructions for preparing new substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 TILE INSTALLATION

- A. Comply with tile manufacturer's written installation instructions.
- B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
 1. Lay tiles square with room axis, unless otherwise indicated.
- C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- E. Extend tiles into toe spaces, door reveals, closets, and similar openings.

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.
- G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- H. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Hand roll tiles when recommended by manufacturer and according to tile manufacturer's written instructions.

3.04 RESILIENT ACCESSORY INSTALLATION

- A. Install resilient accessories according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 3. Do not stretch base during installation.
 - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 5. When required, install premolded outside and inside corners before installing straight pieces.
 - 6. When job formed corners are approved, form outside corners on job from straight pieces of maximum lengths possible, without whitening at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
 - 7. Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

- C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.
- D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.
- E. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.05 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by flooring manuf.
 - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring, base and accessories against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
 - 1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.
 - a. Use commercially available product acceptable to flooring manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
 - 2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.
 - 3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.
 - 1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.

2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with Owner's maintenance program.

END OF SECTION

SECTION 09680
TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes modular carpet tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Existing flooring materials to be removed.
 - 3. Existing flooring materials to remain.
 - 4. Carpet tile type, color, and dye lot.
 - 5. Type of subfloor.
 - 6. Type of installation.
 - 7. Pattern of installation.
 - 8. Pattern type, location, and direction.
 - 9. Pile direction.
 - 10. Type, color, and location of insets and borders.
 - 11. Type, color, and location of edge, transition, and other accessory strips.
 - 12. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, delamination and stain resistance.
 - 3. Warranty Period: 15 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 2 percent of amount installed for each type, color, and pattern indicated, but not less than 10 sq. yd. (8.3 sq. m) of each, for Owner use as maintenance stock.

1.9 MAINTENANCE

- A. Carpet tile manufacturer shall provide a representative to demonstrate cleaning and stain removal processes to Owner maintenance personnel at: (1) 30 days prior to Substantial Completion; (2) at 6 months from date of Substantial Completion and; (3) at 11 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Products: Subject to compliance with requirements, Substitutions from basis of design must be similar color ways, multiple pattern options within color way, and coordinating solid accents:
 - 1. Basis of Design: Shaw Contract Group – or approved equivalent
 - a. Style: 59529 “Brilliance Tile”.
 - b. Collection: “Shades”
 - c. Color: 29858 “Cinnamon”.

- B. Fiber Content: 100 percent nylon, Type 6,6.
- C. Fiber Type: Branded type, Eco Solution Q[®], Invista[®], Solutia[®], Universal[®].
- D. Dye Method: 100% solution dyed.
- E. Backing System: Manufacturer's standard vinyl or thermoplastic hard-backed or integral – cushion thermoplastic backing system, recyclable content, maintaining a 100% true moisture barrier between secondary backing and the floor substrate below, passing the British Spill Test, Method E. Pre-adhered backing system may be used as an alternate without an applied releasable adhesive to surface substrate.
- F. Size: 24" x 24" square.
- G. Stain Resistance: AATCC-175, must pass Acid Red 40 spot test with an 8 or better.
- H. Antimicrobial Treatment: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC-174, Part II, AATCC 138 Washed; AATCC 174 Parts 2 & 3.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:
 - a. Total VOCs: 10.00 mg/sq. m x h.
 - b. Formaldehyde: 0.05 mg/sq. m x h.
 - c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch (3 mm)** wide or wider and protrusions more than **1/32 inch (0.8 mm)**, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Install carpet tile and walk-off tile using direct glue-down method, non directional.**
- 1. Provide water-resistant, mildew-resistant, non-staining, pressure-sensitive adhesive or pre-adhered adhesive system to suit products and subfloor conditions indicated; that complies with flammability requirements for installed carpet tile and recommended by carpet tile manufacturer for releasable installations.**

2. As an alternate, provide pre-adhered, water-resistant, mildew resistant, nonstaining, pressure-sensitive carpet tile to suit subfloor conditions indicated; that complies with flammability requirements for installed carpet tile and recommended by carpet tile manufacturer for releasable installations.
3. Provide rubber or metal carpet tile transition divider strip/nosing between carpet tile and walk-off tile when total thickness of each material is not equal. Divider strip nosing and typed selected by Architect.

- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Toilet enclosures.
 - c. Finished mechanical and electrical equipment.
 - d. Light fixtures.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas (excluding STC rated assemblies).
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.

- e. Bronze and brass.
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 5. Labels: Do not paint over UL, FMG, and other code-required labels and equipment name, identification, performance rating, and nomenclature plates.
- D. Related Sections include the following:
1. Division 04 Section "Unit Masonry" for unit masonry pores to be sealed in STC-rated assemblies.
 2. Division 05 Section "Metal Fabrications" for shop priming ferrous metal.
 3. Division 09 Section "Gypsum Board" for surface preparation of gypsum board.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. D 16 - Standard Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
 2. D 523 - Standard Test Method for Specular Gloss.
 3. D 2016 - Standard Test Methods for Moisture Content of Wood.

1.04 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.
- B. "Paint" as used herein means all coatings systems materials, including primers, emulsions, epoxies, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.
- C. "Exposed surfaces" means surfaces exposed to view, and includes areas visible when permanent or built-in fixtures, covers, grilles, mechanical and electrical equipment housings, ducts and conduits, are in place within areas to be painted; surfaces in back of movable equipment and furniture; and interior surfaces of ducts visible through grilles, interior surfaces visible through equipment covers, blank-off panels, and visible duct metal behind registers and grilles.

1.05 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application.

- Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Initial Selection: For each type of finish-coat material indicated.
1. After color selection, Architect will furnish color chips for surfaces to be coated.
- C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
- D. Qualification Data: For Applicator.
- E. Manufacturer's Certification for Hazardous Materials and VOC Compliance.
- F. Record Documents:
1. As-built Information: Provide two bound catalogs to include the location, product, and color for all finishes applied. The catalog is to contain both interior and exterior coatings, along with actual samples of each color used (size 3 1/2 inches by 2 inches) assembled in indexed form by location.
 2. Contractor's Statement of Compliance: The Painting Sub-Contractor (Applicator) shall provide certification that the specified materials have been installed in the required number of coats, and that they were applied to the minimum coating thicknesses in accordance with the Contract Documents and the manufacturer's instructions.
- 1.06 QUALITY ASSURANCE
- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- C. Coordination of Work: Review other Sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings systems for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.
- D. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft.
 - b. Small Areas and Items: Architect will designate items or areas required.
2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
3. Final approval of colors will be from benchmark samples.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.08 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
- D. Lighting: Maintain 80 foot candles minimum on surfaces being finished.

1.09 WARRANTY

- A. Texture coating Manufacturer shall warrant the texture coating against cracking and fading for a minimum of five (5) years.

1.010 EXTRA MATERIALS

- A. Furnish extra paint materials prior to or at Substantial Completion, from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents and Architect's paint schedule color locations where applied. Deliver extra materials to Owner.
 - 1. Quantity: Furnish Owner with extra paint materials, as applicable, in quantities indicated below:
 - a. One (1) gallon of each type of exterior and interior paint color and gloss applied. Label with permanent ink that shall state the following: Project Name, Architect's Color Schedule No., Color Formula/Manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Manufacturer: The design is based on specific products from the indicated manufacturer. Subject to compliance with requirements, provide products from either the named manufacturer or comparable products by one of the other manufacturers specified.
 - 1. Sherwin Williams (S-W) - Basis-of-Design.
 - 2. Moore: Benjamin Moore & Co. (Moore).
 - 3. Pittsburgh Paint; PPG Industries, Inc. (PPG).
 - 4. Textured Coatings of America, Inc. (Tex-cote).
 - 5. Tnemec Company, Inc. (Tnemec).

2.02 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best quality paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. **Environmental Standards:** Comply with local restrictions when more stringent.

1. Zero VOC coatings where specified, a maximum amount of VOC's of 150 g/L for all Interior coatings (except WB Epoxy at 245 g/L) and 200 g/L for all Exterior coatings.
 - a. Exterior Texture Coating for concrete is excluded.
 2. Products supplied are free of lead, chromates, mercury and other hazardous materials.
- D. Colors: Provide custom colors of the finished paint systems to match

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION

- A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents.

- Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
- a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors, when scheduled to be painted, with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Blast clean steel surfaces as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

- A. Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer. Make as many applications of materials as necessary to obtain the required minimum dry film thickness specified.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
 1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:
 1. Switchgear.
 2. Panelboards.
 3. Conduit.
 4. Plywood backboards.
 5. Hangers and supports.
 6. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
 1. STC-Rated Assemblies: Fill all pores in both faces of unit masonry assemblies indicated to have an STC rating, whether exposed to view or not.
- I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

- K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
 - 1. Provide satin finish for final coats.
- L. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- N. Lifesafety Markings: Identify rated and smoke walls above ceiling with the note: "Fire Barrier, Fire and Smoke Barrier, or Smoke Barrier - Protect all Openings" as appropriate, complying with requirements of local jurisdictions.

3.04 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
 - 1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:
 - 3. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.05 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.06 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.07 SCHEDULE - GENERAL

- A. OSHA Safety Code Colors: Color mark all items constituting a physical hazard and all protective, fire-fighting and safety equipment to comply with requirements of ANSI Z53.1, Section 3, "Color Definitions" and OSHA Section 1910.144, "Safety Color Code for Marking Physical Hazards".

1. Number of coats specified in this Section are minimum. Apply additional coats as required to cover completely and comply with quality specified at no additional cost.

1. Apply each coat in minimum dry film thickness specified in this Section, unless greater thickness is recommended by manufacturer of coating material being applied.

3.08 EXTERIOR PAINT SCHEDULE

- A. Provide the following Paint systems for the various substrates, as indicated.
- B. Non wall panel Concrete: Dry film thickness as recommended by the paint manufacturer, but not less than 5.0 mils dft.
 1. First Coat: Loxon Conditioner A24W100.
 2. Second Coat: DuraCraft Ext Acrylic S-G B21.
 3. Third Coat: DuraCraft Ext Acrylic S-G B2.
- C. Masonry: Dry film thickness as recommended by the paint manufacturer, but not less than 12.0 mils dft.
 1. First Coat: Heavy Duty Block Filler B42W46. Apply filler coat at a rate to ensure complete coverage with pores filled.
 2. Second Coat: DuraCraft Ext Acrylic S-G B21.
 3. Third Coat: DuraCraft Ext Acrylic S-G B21.
- D. Stucco: Dry film thickness as recommended by the paint manufacturer, but not less than 13.5 mils dft.
 1. First Coat: Loxon Acrylic Primer A24W300.
 2. Second Coat: SherLastic Elastomeric A5.
- E. Ferrous and Galvanized Metal: Dry film thickness as recommended by the paint manufacturer, but not less than 6.4 mils dft.
 1. First Coat: Pro-Cryl Acrylic Metal Primer P66-310.
 2. Second Coat: Fast Clad HB Acrylic.
- F. Aluminum: Dry film thickness as recommended by the paint manufacturer, but not less than 6.3 mils dft.
 1. First Coat: Fast Clad HB Acrylic.
 2. Second Coat: Fast Clad HB Acrylic.
- G. Tilt Concrete Wall Panels: Textured Coating: Dry film thickness as recommended by the paint manufacturer, but not less than 20 mils dft.
 1. First Coat: UrtraCrete Solvent Borne w/ Smooth Texture.

2. Second Coat: UltraCrete Solvent Borne w/ Medium Texture.

3.09 INTERIOR PAINT SCHEDULE

A. Concrete, Cast-in-Place and Precast, and Portland Cement Plaster (Stucco):

1. Semi-Gloss Acrylic Enamel Finish: 3 Coats with total dry film thickness not less than 5.5 mils.
 - a. First Coat: PrepRite Masonry Primer B28W300.
 - b. Second Coat: ProMar 200 Interior Latex Semi-Gloss Enamel B31W200.
 - c. Third Coat: ProMar 200 Interior Latex Semi-Gloss Enamel B31W200.
2. Epoxy Finish: Dry film thickness as recommended by the paint manufacturer.
 - a. First Coat (primer): Waterbase Tile Clad Amine Epoxy Primer B73.
 - b. Second Coat: Waterbase Tile Clad Amine Epoxy Primer B73.

B. Concrete Masonry Units:

1. Semi-Gloss Acrylic Enamel Finish: 2 Coats over filled surface with total dry film thickness not less than 4.0 mils, excluding filler coat.
 - a. Filler Coat: PrepRite Interior/Exterior Block Filler B25W25. Apply filler coat at a rate to ensure complete coverage with pores filled.
 - b. Second Coat: Harmony S/G B10 Series.
 - c. Third Coat: Harmony S/G B10 Series.
2. Epoxy Finish: Dry film thickness as recommended by the paint manufacturer.
 - a. Filler Coat: Heavy Duty Acrylic Latex Block Filler B42W46.
 - b. Second Coat: Waterbase Tile Clad Amine Epoxy B73-100.
 - c. Third Coat: Waterbase Tile Clad Amine Epoxy B73-100.

C. Gypsum Drywall:

1. Satin Finish: 3 Coats with total dry film thickness not less than 4.5 mils.
 - a. First Coat (primer): Prep Rite 200 Latex Primer B28W200.
 - b. Second Coat: ProMar 200 Interior Latex Satin Enamel B20W200.
 - c. Third Coat: ProMar 200 Interior Latex Satin Enamel B20W200.
2. Semi-Gloss Finish: 3 Coats with total dry film thickness not less than 6.0 mils.
 - a. First Coat (primer): Harmony Latex Primer B11W900.
 - b. Second Coat: Harmony S/G B10 Series.
 - c. Third Coat: Harmony S/G B10 Series.
3. Epoxy Finish: Dry film thickness as recommended by the paint manufacturer.
 - a. First Coat (primer): Harmony Latex Primer B11W900.
 - b. Second Coat: Waterbase Catalyzed Epoxy B70-200/B60V25.
 - c. Third Coat: Waterbase Catalyzed Epoxy B70-200/B60V25.

D. Ferrous Metal:

1. Semi-Gloss Finish: 3 Coats with total dry film thickness not less than 5.5 mils.
 - a. First Coat (primer): Kem Kromik Universal Metal Primer B50.
 - b. Second Coat: Pro Mar 200 Latex Semi-Gloss B31W200.
 - c. Third Coat: Pro Mar 200 Latex Semi-Gloss B31W200.
2. Gloss Finish: 3 Coats with total dry film thickness not less than 4.5 mils.
 - a. First Coat (primer): Kem Kromik Universal Metal Primer B50WZ.
 - b. Second Coat: ProMar 200 Interior Latex Gloss Enamel B21W201.
 - c. Third Coat: ProMar 200 Interior Latex Gloss Enamel B21W201.
3. Epoxy Finish: Dry film thickness as recommended by the paint manufacturer.

- a. First Coat (primer): Touch-up Shop-Coat Primer or Pro-Cryl Acrylic Metal Primer B66-310.
 - b. Second Coat: Fast Clad WB Epoxy B70-800/B70V800.
 - c. Third Coat: Not required for SW.
- E. Zinc-Coated Metal:
1. Semi-Gloss Finish: Dry film thickness as recommended by the paint manufacturer.
 - a. First Coat: DTM Primer Finish B66W1.
 - b. Second Coat: DTM Acrylic Semi-Gloss B66.
 2. Gloss Finish: 3 Coats with total dry film thickness not less than 4.5 mils.
 - a. First Coat: Galvite HS B50WZ30.
 - b. Second Coat: ProMar 200 Interior Latex Gloss Enamel B21W201.
 - c. Third Coat: ProMar 200 Interior Latex Gloss Enamel B21W201.
 3. Epoxy Finish: Dry film thickness as recommended by the paint manufacturer.
 - a. First Coat (primer): Touch-up Shop-Coat Primer or Pro-Cryl Acrylic Metal Primer B66-310.
 - b. Second Coat: Fast Clad WB Epoxy B70-800/B70V800.
 - c. Third Coat: Not required for SW.
- F. Wood:
1. Transparent Finish: Dry film thickness as recommended by the paint manufacturer.
 - a. First Coat: Wood Classics Oil Stain.
 - b. Second Coat: Wood Classics Polyurethane (gloss as selected).
 - c. Third Coat: Wood Classics Polyurethane (gloss as selected).
- G. Plywood Backboards: Provide the following finish system on plywood backboards:
1. First (Prime) Coat: Latex type primer applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils.
 2. Second and Third Coats: Flat, intumescent type, fire retardant latex paint, applied at the spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 4 mils for each coat (total 8 mils).
- H. Exposed Structure / Ceilings: Provide the following finish system on exposed overhead surfaces:
1. Surface Preparation and Primer Coat: As recommended by manufacturers of structural steel framing, joists, metal deck and other items, in compliance with specifications. Touch up with original primer.
 2. First and Second Finish Coats: Modified alkyd rust inhibitive primer/finish.
 - a. Apply each finish coat to achieve 2 - 3.5 mils each, for a minimum total thickness of 4 mils.
 3. The coating system must provide a luminous reflectance of at least 83 percent in accordance with ASTM E 308. The coating system must be intended for direct application to a variety of surfaces including concrete, galvanized deck and other primed metals.
 - a. Dry fall type products are not acceptable.

END OF SECTION

Division 10 Specialties

SECTION 10100
MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section for miscellaneous specialties includes the following:
 - 1. Key control lockbox.
 - 2. Building Plaque.
 - 3. Pre-Manufactured Wall Ladder.

1.03 SUBMITTALS

- A. Product Data: For each specialty item specified and indicated. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: For each specialty item.
 - 1. Include dimensioned plans, elevations and details, sections of typical members, and other components. Show anchors, grounds, reinforcement and layout, and indicate finishes. Include installation details and instructions.
 - 2. Include setting drawings, templates, and directions for installing anchor bolts and other anchorages to be installed as a unit of Work in other Sections.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available for the following:
 - 1. Aluminum Trim and Accessories: 4-inch- long sections of extrusions and not less than 2-inch squares of sheet or plate for each exposed metal surface showing available metal finishes.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage experienced installers who are authorized or can demonstrate successful experience with installations of items similar to those required by this Project.

1.05 PROJECT CONDITIONS

- A. Field Measurements: When possible, verify rough openings for specialty items by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS

A. Key Control Lockbox Design Basis:

1. Type: High security type with UL listed tamper switch; anti-theft locking mechanism with drill resistant hardplat lock protector, thru-wall mounting with anchor bolts furnished by manufacturer.
2. Construction: 1/4 inch thick steel plate housing, 5/8 inch thick steel door, 11 gage recessed flange, weatherproof gasket on inside door, 1/8 inch stainless steel lock cover with tamper seal mounting.
3. Size: 7 inch square x 5 inch deep, 60 cubic inch capacity.
4. Lock: Double action rotating tumblers and hardened steel pins, accessed by a blas-cut key to withstand 55 inch pounds twist before failure.
5. Finish: Zinc phosphate primer with weather resistant polyester powder coating, color as selected by Architect from manufacturer's standard array.
6. Manufacturer and Model: Series 4400 by Knox-Vault Company.
7. Location: Station front entrance area as determined by Architect.
8. Subject to compliance with requirements, other manufacturers with equivalent products may be considered, when approved by Architect.

B. Pre Mfg. Wall Ladder:

1. Type: Wall mounted aluminum ladder with rail extension.
2. Finish: Aluminum, clear anodized finish.
3. Manufacturer and Model: O'Keefe; Model: 502 Tubular Rail Low Parapet Access Ladder with Roofover Rail Extensions
4. Provide a hinged expanded metal grating security cover, with padlock latch.

C. Building Plaque:

1. Material and Construction: Cast bronze, 85-5-5-5 standard U.S. bronze alloy, 0.30 inch thick overall tablet thickness.
2. Tablet Size: 20 inches wide x 24 inches high, 1/16 inch raised letters and single line beveled edges.
3. Letter Style: To be determined. Minimum 12 lines of text as provided by Owner. Include County Seal.
4. Plaque Finish: Letters and edges with satin finish on oxidized dark background with pebble texture; provide two coats of clear aluminum lacquer.
5. Mounting: Concealed mount with threaded studs, flush mounting to masonry.
6. Manufacturers:
 - a. The Southwell Company
 - b. OMC Industries
 - c. ANDCO Industries
 - d. Other manufacturers with equivalent product as approved by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine wall surfaces, with the Installer present, for compliance with requirements and other conditions affecting installation of building miscellaneous specialties.
 - 1. Do not proceed with installations until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install specialty units plumb and level, in locations and with mountings shown or required. Securely attach to supporting structure with concealed fasteners, according to accepted shop drawings and manufacturer's written installation instructions for each item.

3.03 CLEANING AND PROTECTING

- A. At completion of installation, clean surfaces according to manufacturer's written instructions.
- B. Protect installed specialty items from damage until acceptance by Owner at the time of Substantial Completion.

END OF SECTION

SECTION 10155
TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes solid-polymer units as follows:
 - 1. Toilet Enclosures: Ceiling hung.
 - 2. Urinal Screens: Wall hung.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for supports that attach ceiling-hung units to overhead structural system.
 - 2. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: Of each type of color and finish required for units, prepared on 6-inch- (150-mm-) square Samples of same thickness and material indicated for Work.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall, floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 SOLID-POLYMER UNITS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Accurate Partitions Corporation.
 2. Ampco.
 3. Bradley Corporation; Mills Partitions.
 4. Capitol Partitions, Inc.
 5. Comtec Industries.
 6. Santana Products, Inc.
- B. Door, Panel, and Pilaster Construction: Solid, polypropylene (PP) or high-density polyethylene (HDPE) panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range of colors and patterns.
- C. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer or stainless steel.
1. Polymer Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns.
- D. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; polymer or extruded aluminum.
 - a. Polymer Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns.
- E. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
- F. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
1. Material: Chrome-plated brass.

- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- B. Doors: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.
 - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).

- B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- C. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10155

SECTION 10165
TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes toilet compartments and screens as follows:
 - 1. Type: Plastic laminate.
 - 2. Compartment and Screen Style: Overhead braced and floor anchored.
- B. Related Sections include the following:
 - 1. Section 10810: "Toilet Room Accessories" for toilet paper holders, grab bars, purse shelves, and similar accessories.

1.03 SUBMITTALS

- A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.
- B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.
- D. Samples for Verification: Of each compartment or screen color and finish required, prepared on ~~6-inch-~~ (150-mm-) square Samples of same thickness and material indicated for Work.

1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Accurate Partitions Corporation.
 2. Ampco Products, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Crane Plumbing; Sanymetal.
 5. Partition Systems, Inc.; Columbia Partitions.

2.02 MATERIALS

- A. Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.
- B. Plastic Laminate: NEMA LD 3, GP-50, 0.050-inch (1.27-mm) nominal thickness, color and pattern as follows:
1. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range of colors and patterns.
- C. Core Material for Plastic Laminate: ANSI 208.1, Type M-2 particleboard with 45-lb (20.4-kg) density in thicknesses required to provide minimum nominal thicknesses for components as follows:
1. Doors, Panels, and Screens: 1 inch (25 mm).
 2. Pilasters: 1-1/4 inches (32 mm).
 - a. Reinforce pilasters with minimum 0.1196-inch- (3.0-mm-) thick steel sheet.
- D. Pilaster Shoes and Sleeves (Caps): ASTM A 666, Type 302 or 304 stainless steel, not less than 0.0312 inch (0.8 mm) thick and 3 inches (75 mm) high, finished to match hardware.
- E. Stirrup Brackets: Manufacturer's standard ear or U-brackets for attaching panels to walls and pilasters of the following material:
1. Material: Stainless steel.
- F. Full-Height (Continuous) Brackets: Manufacturer's standard design for attaching screens to walls and pilasters of the following material:
1. Material: Stainless steel.

- G. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of the following material:
 - 1. Material: Stainless steel.
- H. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile in manufacturer's standard finish.
- I. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.03 FABRICATION

- A. Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.
- B. Plastic-Laminate Compartments and Screens: Pressure laminate facing sheets to core material without splices or joints in facings or cores. Apply laminate to edges before broad surfaces to seal edges and prevent laminate from being pried loose. Seal exposed core material at cutouts to protect core from moisture.
- C. Overhead-Braced-and-Floor-Anchored Compartments: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- D. Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as compartment panels, unless otherwise indicated.
- E. Floor-and-Ceiling-Anchored Screens: Provide pilasters and panels of same construction and finish as toilet compartments. Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- F. Doors: Unless otherwise indicated, provide minimum 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be handicapped accessible.
 - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold door open at any angle up to 90 degrees.

2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumpers at out-swinging doors or entrance screen doors.
5. Door Pull: Manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than **1/2 inch (13 mm)** between pilasters and panels and not more than **1 inch (25 mm)** between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.
 1. Secure panels to walls and panels with not less than 2 stirrup brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced-and-Floor-Anchored Compartments: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than 2 fasteners. Hang doors and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.02 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.
- B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 10226
MOVABLE PARTITIONS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Operable panelized partitions and suspension systems.

1.03 RELATED WORK BY OTHERS

- A. Preparation of opening will be by General Contractor. Any deviation of site conditions contrary to approved shop drawings must be called to the attention of the architect.
- B. All header, blocking, support structures, jambs, track enclosures, surrounding insulation, and sound baffles as required in 1.04 Quality Assurance.
- C. Prepunching of support structure in accordance with approved shop drawings.
- D. Paint or otherwise finishing all trim and other materials adjoining head and jamb of operable partitions.

1.04 PERFORMANCE REQUIREMENTS

- A. Standard panel construction shall have obtained an STC rating of 51.

1.05 SUBMITTALS

- A. Complete shop drawings are to be provided prior to fabrication indicating construction and installation details. Shop drawings must be submitted within 60 days after receipt of signed contract.

1.06 QUALITY ASSURANCE

- A. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions
- B. The partition STC (Sound Transmission Classification) shall be achieved per the standard test methods ASTM E90.
- C. Noise isolation classifications shall be achieved per the standard test methods ASTM E336 and ASTM E413.
- D. Noise Reduction Coefficient (NRC) ratings shall be per ASTM C423.
- E. Rack testing for 10 years. (tensional strength stress test)
- F. The manufacturer shall have a quality system that is registered to the ISO 9001 standards.

- G. Acoustical performance shall be tested at a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Proper storage of partitions before installation and continued protection during and after installation will be the responsibility of the General Contractor.

1.08 WARRANTY

- A. Partition system shall be guaranteed for a period of two years against defects in material and workmanship, excluding abuse.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Upon compliance with the criteria specified in this section, Manufacturers wishing to bid products equal to the product specified must submit to the architect 10 days prior to bidding complete data in support of compliance and a list of three past installations of products similar to those listed. The submitting manufacturer guarantees the proposed substituted product complies with the performance items specified and as detailed on the drawings.

2.02 MATERIALS

- A. BASIS OF DESIGN: Product to be top supported Series 631 individual, omnidirectional panels as manufactured by Hufcor Inc.
 - 1. Panels shall be nominally 3" [76] thick and to 48" [1219] in width.
 - 2. Panel faces shall be laminated to appropriate substrate to meet the STC requirement in 2.04 Acoustical Performance.
 - 3. Frames shall be of 16 gauge [1.42mm] painted steel with integral factory applied aluminum vertical edge and face protection.
 - 4. Vertical sound seals shall be of tongue and groove configuration, ensure panel-to-panel alignment and prevent sound leaks between panels.
 - 5. Horizontal top seals shall be fixed continuous contact dual 4-finger vinyl.
 - 6. Horizontal bottom seals shall be retractable, provide up to 2" [50] nominal operating clearance, and exert downward force when extended.
 - Optional Seals:
 - (a) Horizontal bottom seals shall be automatic and provide up to 2" [50] nominal operating clearance.
 - (b) Horizontal bottom seals shall be fixed continuous contact dual 4-finger vinyl.
 - 7. Horizontal trim shall be of aluminum.
- B. Weight of the panels shall be 5.7-10.2 lbs. per sq. ft. [27.8-49.8kg/sq.m] based on options selected.

C. Suspension system:

1. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be connected to the structural support by pairs of minimum 3/8" [10] dia. threaded steel hanger rods. Pairs of rods are directly attached to the track, no single point attachment allowed. L, T, or X intersections shall be factory assembled and welded.
 - a. Each panel shall be supported by two 2-wheeled counter-rotating horizontal carriers. Wheels to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires.
 - (1) Optional Type 38 (for X, L, or T intersections and panels weighing up to 400 lbs. [182 kg]): Each panel shall be supported by two 1-wheel horizontal rotating carriers. Wheel to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires.
 - (2) Optional Type 38 (for curves and diverts and panels weighing up to 600 lbs. [272 kg]): Each panel shall be supported by two 4-wheel carriers.

D. Finishes

1. Face finish shall be:
 - a. Factory applied reinforced vinyl fabric with woven backing, weighing not less than 15 oz. per lineal yard [465 g/m]. Color shall be selected from manufacturer's standard color selectors.
2. Exposed metal trim and seal color shall be
 - a. 'Lamb's Wool'
3. Aluminum track shall be clear anodized

E. Available Accessories/Options

1. ADA compliant pass door of the same thickness and construction as the basic panels. Pass door panel legs require bottom seals that provide downward force to maintain stability during door operation. Pass door leaf has perimeter trim to protect face finish and to provide visual identification as required by International Building Code. Pass door leaf incorporates a self-adjusting retractable bottom seal providing sound control when door is closed.
 - a. Automatic door closer
 - b. Door lock
 - c. Exit sign

2.03 OPERATION

- A. Panels are manually moved from the storage area, positioned in the opening, and seals set.
- B. Retractable Horizontal Seals

1. Retractable horizontal seals shall be activated by a removable quick-set operating handle located approximately 42" [1067] from the floor in the panel edge. Seal activation requires approximately 15 lbs. [6.8 kg] of force per panel and approximately a 190 degree turn of the removable handle. Top and bottom retractable seals on each panel shall be operated simultaneously.
- C. Automatic Floor Seals
1. Horizontal seals shall be activated by pressing the edge of the panel into the edge of the adjacent panel or wall.
 2. Seal activation requires approximately 15 lbs. [6.8 kg] of force per panel.
- D. Final partition closure to be by:
1. Lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. [113.4 kg] seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45" [1143] from the floor in the panel face and be accessed from either side of the panel. The jamb is equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4"-6" [100-152] by turning the removable operating handle.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Prepare opening to receive operable panel partition. Report deviations of site conditions contrary to approved shop drawings to the Architect.
- B. Provide header, blocking, support structures, jambs, track enclosures, surrounding insulation, and sound baffles as required in 1.04 Quality Assurance.
- C. Pre-punch support structure in accordance with approved shop drawings.

3.01 INSTALLATION

- A. The complete installation of the operable wall system shall be by an authorized factory-trained installer and be in strict accordance with the approved shop drawings and manufacturer's standard printed specifications, instructions, and recommendations.
- B. Paint or otherwise finish trim and other materials adjoining head and jamb of operable partitions.

3.02 CLEANING

- A. Wipe track and panel surfaces clean and free of handprints, grease, and soil.
- B. Remove installation debris to onsite waste collection area.

3.03 TRAINING

- A. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.
- B. Provide operating handle and Owners manuals to Owner's representative.

END OF SECTION

SECTION 10260
WALL CORNER GUARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes wall corner guards.

1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.
- B. Shop Drawings: For each impact-resistant wall-protection unit showing locations and extent. Include sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Wall Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps.
- E. Maintenance Data: For each impact-resistant wall-protection unit to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.
- F. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic sheet material out of direct sunlight.
 - 3. Store plastic wall-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
 - a. Store covers in a horizontal position.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall-protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at for not less than 72 hours before beginning installation and for the remainder of the construction period.
- B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of plastic and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

1.07 EXTRA MATERIALS

- B. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than six units.
- C. Include all accessory components. Replacement materials shall be from same production run as installed units.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Extruded Rigid Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC; thickness as indicated.
 - 1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
 - 2. Chemical and Stain Resistance: Tested according to ASTM D 543.
 - 3. Self-extinguishing when tested according to ASTM D 635.
 - 4. Flame-Spread Index: 25 or less.
 - 5. Smoke-Developed Index: 450 or less.
- B. Fasteners: Stainless Steel screws of type recommended by manufacturer for use with material being fastened to substrate indicated.

2.02 FABRICATION

- A. Fabricate impact-resistant wall-protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of work.
 - 1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 2. For impact-resistant wall-protection units attached with screws, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.03 INSTALLATION

- A. Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Provide corner guards at all “outside wall corners” in public areas of the building (including, but not limited to hallways, corridors, exposed freestanding rectangular columns) and as indicated.
- C. Corner guards will be installed directly above the wall base material and extend up the wall for their full length.
 - a. Wall Guards: 48” above wall base.

3.04 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

END OF SECTION

SECTION 10425
SIGNAGE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Provide labor, materials, and equipment necessary for the complete installation of identifying devices as indicated on the Drawings and specified herein.
 - 1. Exterior Building Numbers.
 - 2. Interior signage. Plate signs, mounted on door or wall surfaces as specified, indicated or required. Owner will assign Room Names and Numbers. Provide one plate at entrance of each space shown on Room Finish Schedule, unless indicated or directed otherwise.

1.03 SUBMITTALS

- A. Furnish required shop drawings and other submittals as required for Architect selection in accordance with Division I requirements.
- B. Samples:
 - 1. Interior room number and name signs.
 - 2. Exterior Building Numbers.
 - 3. Sample of attachment or mounting method materials.
- C. Signage Listing: Contractor shall provide a comprehensive list of all room names and numbers for each building space as well as quantities and locations for all other signs specified.

1.04 QUALITY ASSURANCE

- A. Reference Codes and Specifications: Standard Building Code.

1.05 AMERICANS WITH DISABILITIES ACT (ADA) REQUIREMENTS

- A. Signage shall be provided to conform with ADA requirements. ADA requirements supersede Technical Specifications in this Section, if not in agreement. Manufacturer shall conform to tactile, braille, letter size, and other requirements as may be required by ADA Accessibility Guidelines for Buildings and Facilities, Section 4.30, Signage, and other applicable sections; and State and Local Codes and Regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturer's products that may be incorporated into the Work include, but are not limited to, the following
1. Andco Industries Corp., Greensboro, North Carolina
 2. A.R.K. Ramos
 3. Best Sign Systems, Montrose, Colorado
 4. Metallic Arts, Inc.
 5. Design-A-Sign Co., Inc.
 6. Spanjer Brothers, Inc.

2.02 INTERIOR SIGNAGE

- A. Plate Signage Material: Plastic Laminate: High pressure plastic laminate engraving stock with face and core plies in contrasting colors, in finishes and color combinations indicated or, if not indicated, as selected from the manufacturer's standard array.
- B. Comply with requirements indicated for materials, thicknesses, finishes, color, designs, shapes, sizes, and details of construction. Surfaces shall be constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.
- C. Unframed Identification Plates: Fabricate signs with edges mechanically and smoothly finished to conform with the following:
1. Edge Condition: Square cut.
 2. Edge Color for Plastic Laminate: Same as background.
 3. Corner Condition: Square corners.
- D. Graphic Content and Styles: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes and color of letters, numbers and other graphic devices.
1. Message Content: Center message content on sign.
 2. Lettering Style and Size: Uppercase Helvetica type style in the following letter heights for each of the following sign types:
 - a. For Door / Room Signs: 1 1/2 inch letter height.
 - b. For Fire Extinguisher and Fire Alarm Signs: 1 inch letter height.
 - c. Plastic laminate shall be 1/8 inch unframed.
- E. Mounting: Unless required and approved otherwise, mount with silicone adhesive recommended by manufacturer

2.03 ADA COMPLIANT SIGNAGE

- A. Letters: Letters and numbers shall have width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 and 1:10.
- B. Letters and numbers shall be raised 1/32 inch, upper case, Sans Serif or simple Serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be 5/8 inch high minimum and 2 inches high maximum. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. The standard dimensions for literary Braille are as follows:
 - 1. Dot diameter: .059 inch.
 - 2. Inter dot spacing: .090 inch.
 - 3. Horizontal separation between cells: .241 inch.
 - 4. Vertical separation between cells: .395 inch.
- C. Finish and Contrast: Characters and backgrounds of plates must be eggshell, matte, or other non-glare surface. Characters and symbols shall contrast with their background. Contrasting minimum 50 %. All signage will strive to attain the greatest readability through the use of light-colored characters on a dark background.

2.04 EXTERIOR SIGNAGE

- A. Material: Brushed stainless steel.
 - 1. Letter Style: Times New Roman. 675; height, 8 inches.
 - a. Depth: 3/4 inch.
 - b. Stroke: 9/16 to 1 1/4 inch
 - c. Average width: 7 1/4 inches
 - d. Lwr Case: Used
 - 2. Mounting: Unless required and approved otherwise, mount with concealed mechanical fasteners as recommended by the manufacturer.

PART 3 - EXECUTION

3.01 - INSTALLATION

- A. Provide full size mounting and installation kits for mounting building letters.
- B. Mount exterior and interior building letters in conformance with manufacturer's instructions using only approved materials and methods.
- C. Install interior signage in accordance with approved shop drawings, ADA requirements, and at locations indicated on the Architect's Drawings and in conformance with manufacturer's instructions using only approved materials and methods.

- D. Install level, plumb and at heights indicated or approved, and with sign surfaces free from distortion or other defects in appearance.
- E. Provide all items and accessories as required for a complete installation in every respect.
- F. At completion of installation, clean soiled sign surfaces, and related adjacent surfaces soiled from this installation, in accordance with manufacturers instructions.
- G. Protect from damage until acceptance by Owner.
- H. Remove and dispose of excess materials, litter and debris, and leave work areas in clean condition.

END OF SECTION

SECTION 10520
FIRE EXTINGUISHERS, CABINETS
AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes, but is not limited to fire extinguishers, cabinets and accessories, and frames.
 - 1. Locations of items are indicated on drawings.
- B. Definition: "Fire extinguishers" as used in this Section refers to units which can be hand-carried as opposed to those which are equipped with wheels or that are fixed to fire extinguishing systems.
- C. Types of products required include:
 - 1. Fire extinguishers and cabinets, including recessed and semi-recessed fire extinguisher cabinets for installation in masonry or stud walls, and recessed and semi-recessed fire valve cabinets for installation in masonry or stud walls.
 - 2. Fire extinguishers and mounting brackets.
- D. Fixed fire protection systems, hoses and cabinets are specified in Division-15 Sections.

1.03 SUBMITTALS

- A. Product Data:
 - 1. For cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials and finishes.
 - 2. For extinguishers show type / style, bracket data (for extinguishers without cabinets), finishes, dimensions and other related data.

1.04 QUALITY ASSURANCE

- A. Regulatory requirements: Comply with all specified and other governing codes and applicable regulations for fire extinguishers and installations.
- B. Single Source Responsibility: Obtain products in this Section from one manufacturer.

- C. Coordination: Verify that fire extinguisher cabinets are sized to accommodate fire extinguishers of type and capacity indicated.
- D. UL-Listed Products: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

- A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
 - 1. J. L. Industries.
 - 2. Larsen's Manufacturing. Co.
 - 3. Modern Metal Products, Division of Technico, Inc.
 - 4. Potter-Roemer, Division of Smith Industries, Inc.

2.02 FIRE EXTINGUISHERS

- A. Fire extinguishers: Multi-Purpose Dry Chemical Type; UL-rated 3A: 40B:C, 10 pound nominal capacity, in enameled steel container for Class A, Class B and Class C fires.
 - 1. Provide fire extinguishers for each extinguisher cabinet and mounting bracket, at locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.
- B. Fill and service extinguishers to comply with requirements of governing authorities and manufacturer's requirements.
- C. Abbreviations indicated above identify extinguisher types related to UL classification and rating system and not, necessarily, to type and amount of extinguishing material contained in extinguisher.

2.03 EXTINGUISHER CABINETS

- A. Provide manufacturer's standard cabinets, recessed and semi-recessed as shown on the construction documents or required. Provide rated units if installed in rated wall assemblies. Inside box dimensions - 9 inches wide x 24 inches high x 5 3/4 inches deep; units to be constructed of sheet steel. Provide door with full length piano hinge and lock.
- B. Other Cabinet Features:
 - 1. Door and Frame: Stainless steel, Type 304, satin finish.
 - 2. Design: Duo-vertical panel with side break glass.
 - 3. Glazing: Full glass door, tempered safety glass. Color: Clear.
 - 4. Mounting: Flush (recessed).
 - 5. Design Basis Model: [Potter-Roemer Inc.; Atlas Series, Model No. 7060-DV-2-](#)

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2.04 MOUNTING BRACKETS

- A. Provide manufacturer's standard brackets designed to prevent accidental dislodgment of extinguisher, of sizes required for type and capacity of extinguisher indicated, in manufacturer's standard plated finish.
- B. Provide brackets for extinguishers not located in cabinets.

PART 3 -EXECUTION

3.01 EXAMINATION

- A. Examine rough-in for cabinets and verify locations prior to cabinet installation.
 - 1. Examine walls and partitions for thickness and framing for cabinets to verify cabinet depth and mounting prior to cabinet installation.
- B. Do not proceed until unsatisfactory conditions have been corrected.
- C. Follow manufacturer's printed instruction for installation.
 - 1. Prepare recesses in walls for cabinets as required by type, size of cabinets, and style of trim.

3.02 INSTALLATION

- A. Securely fasten mounting brackets and fire extinguisher cabinet to structure, square and plumb, to comply with manufacturer's instructions.
- B. Locations by types, unless indicated otherwise: Locations as acceptable to governing authorities.
 - 1. Bracket type: Mechanical rooms and as otherwise indicated on Drawings.
 - 2. Cabinet type: At locations indicated on Drawings.

END OF SECTION

SECTION 10730
PRE-ENGINEERED METAL WALKWAY CANOPY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Pre-engineered aluminum walk-way canopy.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Layout and erection drawings showing roof framing, deck panels, cross sections, and trim details.
 - 1. Calculations: Include structural analysis and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Qualification Data: For Installer and manufacturer.
- D. Maintenance Data: To include in maintenance manuals.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide aluminum walk-way canopy capable of withstanding wind pressures calculated according to the following.
 - 1. Wind Loads: In accordance with Florida Building Code (current edition), and as indicated on drawings.
- B. Thermal Movements: Provide aluminum walk-way canopy systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- C. Connect aluminum walk-way canopy system to primary structure so as to minimize introduction of flexural and torsional forces.

1.5 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of five years experience as a manufacturer of specialty aluminum, with not less than three projects similar to the type herein.
- B. Installer Qualifications: Minimum two years experience in erecting canopies of the type specified.

PART 2-PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
 1. American Aluminum Products Company, Inc.; Austell, Georgia.
 2. American Walkway Covers L.L.C.; Pompano Beach, Florida.
 3. Childers Carports & Structures, Inc.; Houston, Texas.
 4. Dittner Architectural Aluminum; Winter Springs, Florida.
 5. Mason – Florida, LLC; 2415 W. Griffin Rod, Leesburg, Florida.
 6. Peachtree Protective Products; Hiram Georgia.
 7. Perfection Architectural Systems; Winter Park, Florida.
 8. Sundance Manufacturing, Inc.; Orlando, Florida.

2.2 MATERIALS

- A. Aluminum Extrusions: 6063 alloy, T-6 temper.
- B. Grout: 1 part portland cement, 3 parts masonry sand; minimum 2,000 pounds per square inch (13.8 MPa) compressive strength.
- C. Foam Block-Outs: Rigid foam blocks sized as required for column embedment depth and shape.
- D. Attachments: Attached components shall be solid extruded aluminum machined to form tie plates and connecting fittings. Anchor mounts shall be aluminum plates bolted to a steel plate designed to be field welded to building steel or embedded plates. Teflon pads shall isolate the aluminum to steel interface to prevent galvanic action. Anchor steel shall be A-36.
- E. Fasteners:

1. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8" outside dimension, conical washer.
2. Trim Rivets: Minimum 3/16" by 1/2" grip range aluminum rivets, with aluminum mandrel, finish to match fascia.
3. Other Fasteners: Type 18-8 stainless steel, type recommended by manufacturer for specific condition.
4. Trim Screws: Not permitted.

2.3 FABRICATION

- A. Shop Assembly: Fabricate cross beams and columns into one-piece rigid bents with corners mitered and heli-arc welded.
 1. Included under the Work of this Section are structural tubular aluminum beams, columns, canopy downspouts, and their placement within any architectural columns supporting the canopies.
- B. Bent Construction: Bents shall be straight and true. Extruded structural ties shall be rigidly installed on top of all beam sections and shall also serve as closures between draining deck sections.
- C. Roof Deck: Deck shall be interlocking extruded aluminum, 3" high by 6" wide in profile. Self-flashing and interlocking joints shall be rigidly fastened.
 1. Expansion Joints: Expansion joints shall have no metal-to-metal contact.
 2. Provide welded endplate water dams where sections terminate at other than drainage channels.
- D. Fascia: Manufacturer's standard extruded aluminum fascia sections indicated and as required to complete the installation resulting in a neat finished appearance.
- E. Concealed Drainage: Water shall drain internally from the deck into the beams into predetermined columns for discharge at or below ground level.
- F. Flashing: Aluminum sheet, thickness as recommended by manufacturer for specific condition.
- G. Finish:
 1. Aluminum: Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Steel: Prepare steel by SSPC SP-6 sandblast, and prime with moisture cured zinc rich urethane primer.

- H. Apply a shop applied dip-coat of clear acrylic enamel to each column end terminating in concrete to insulate from electrolytic reaction. Column ends shall be pierced to "key" grout to bent for maximum uplift protection.

2.4 FINISHES

- A. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces and connection points prior to the start of installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect aluminum surfaces that are to come in contact with dissimilar materials with one coat of asphaltic emulsion paint in addition to factory protection.

3.3 INSTALLATION

- A. Install aluminum walk-way canopy system to provide installations that comply with requirements of "Performance Requirements" Article. Erect aluminum walk-way canopy system plumb, level, and true to line, providing for structural and thermal movement.
- B. Field weld anchor mounts per AISC requirements.
- C. Power tool clean (SSPC SP-3) welds. Touch up welds and abraded areas on steel with zinc rich urethane primer.
- D. Touch up damaged aluminum finishes to match the factory finish.
- E. Install closures, gasketing and sealants continuous, tightly butted, and properly tooled to prevent penetration of water.
- F. Where metal surfaces come in contact with non-compatible metals, keep surfaces from direct contact by use of a permanent non-deteriorating isolation material.

3.4 PROTECTION

- A. Protect finished aluminum surfaces from damage due to subsequent construction operations.
- B. Remove component parts which have been damaged beyond repair, and replace with new materials.

END OF SECTION

SECTION 10735
SHADING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Design, engineering, fabrication and erection of extruded aluminum and sheet aluminum shading devices having a pre-determined area, geometry type, and features, under a single source responsibility.

1.3 PERFORMANCE REQUIREMENTS:

- A. **Structural Loads:** Provide aluminum shading devices capable of withstanding wind pressures calculated according to the Wind Information located on Drawings, using the appropriate factors and coefficients.
- B. **Thermal Movements:** Provide aluminum shading devices, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints, failure of joint sealants, damaging loads and stresses on connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.
 - 1. **Temperature Change (Range):** 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.
- C. **Connections:** Provide connections for shading devices to primary structure so as to minimize introduction of flexural and torsional forces.

1.4 SUBMITTALS

- A. Submit shop drawings showing the dimensions, sizes, thicknesses, materials, finishes, joint connections, and anchor brackets. Identify components by same number coding as that which will be used for field assembly.
- B. Submit structural calculations signed and sealed by a Florida licensed structural engineer for information. Calculations shall include loads, member stresses, support reactions, and deflections, and shall be keyed to number of coding system.

- C. Provide templates to be used in the erection of and connection to the supporting structural components.
- D. Submit four (4) sets of samples of the proposed finish.

1.5 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of five years experience as a manufacturer of specialty aluminum systems, with not less than three projects similar to the type herein.
- B. Shading device manufacturer shall perform installation utilizing full-time construction division personnel. Subletting of installation is not acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package shading devices and attachments in such a manner as to protect them during transportation and while in storage.
- B. Handle and store materials as recommended by manufacturer to prevent damage.

1.7 GUARANTEE

- A. Furnish written certification that work was furnished and installed in accordance with Contract Document requirements.
- B. Furnish a written guarantee that the installation will be free of defects for one (1) year from the date of Substantial Completion.
- C. Should defects develop during the guarantee period, such defects shall be repaired at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. YKK Architectural Products (Basis of Design) – ThermaShade, with 30” projection. Refer to drawings for fascia and blade profiles.
 - 2. Dittmer Architectural Aluminum, 1006 Shepard Road, Winter Springs, Florida 32708 Telephone (407) 699-1755; FAX (407) 695-4430.
 - 3. STAR*NET International, 200 Hope Street, Longwood, Florida 32750 Telephone (407) 830-1199; FAX (407) 830-1817.

4. Royal Aluminum, 1746 East Main Street, Leesburg, Florida 34789 Telephone (352) 787-4000; FAX (352) 787-6031.

2.2 MATERIALS:

- A. Structural components shall be Alloy 6063-T5 extruded aluminum.
- B. Sheet shall have minimum 0.050 inch wall thickness.
- C. Attached components shall be solid extruded aluminum machined to form tie plates and connecting fittings.
- D. Anchor mounts shall be aluminum plates bolted to a steel plate designed to be field welded to building steel or embedded plates. Teflon pads shall isolate the aluminum to steel interface to prevent galvanic action. Anchor steel shall be A-36.
- E. Accessories: Rivets, socket screws, cover clips, and other accessories required for a functional and weather resistant installation as recommended by manufacturer.
- F. Hardware shall be stainless steel or cadmium plated SAE grade 5 steel to anchor to support steel.
- G. Fasteners shall be stainless steel.
- H. FINISHES:
 1. Aluminum: Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
 - a. Class II, Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.
 - b. Color to match aluminum storefront window frame system.

2.3 FABRICATION:

- A. Shop fabricate and construct shading devices to shapes shown using extruded and sheet aluminum components and alloys. Use procedures and processes required to fulfill structural loading and performance requirements.
- B. Prepare shading devices for field assembly with bolts or pins.
- C. Number code components for easy field installation.
- D. Apply isolation material on concealed surfaces where direct contact with non-compatible materials could result in corrosion or deterioration of either material or finish.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Coordinate the anchor mount locations and requirements with the building structure. Inspect the support system to receive the anchor mounts to ensure it is properly prepared and ready to receive the shading devices, tolerances are acceptable and anchorage loadings can be achieved.

3.2 INSTALLATION

- A. Install shading devices in accordance with Contract Documents, approved shop drawings and as may be required for an installation meeting wind loading requirements. Erect shading devices plumb, level, and true to line, providing for structural and thermal movement.
- B. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
- C. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process.
- D. Field weld anchor mounts per AISC requirements.
- E. Power tool clean (SSPC SP-3) welds. Touch up welds and abraded areas on steel with zinc rich urethane primer. Finish per Division 09 Section "Painting".
- F. Install closures, gasketing and sealants continuous, tightly butted, and properly tooled to prevent penetration of water.
- G. Where metal surfaces come in contact with non-compatible metals, keep surfaces from direct contact by use of a permanent non-deteriorating isolation material.
- H. Erection Tolerances:
 - 1. Variation from level: +/- 1/8" maximum in any column to column space or 20'-0" runs, non-cumulative.
 - 2. Offsets in end-to-end or edge-to-edge alignment of consecutive members 1/32".

3.3 PROTECTION

- A. Protect surfaces against stains, discolorations, surface abrasion and other construction abuses.
- B. Maintain cleaning operations to prevent fasteners, cuttings, filings, or scraps from accumulating on or marring finish surfaces.

3.4 DAMAGED MATERIAL

- A. Remove shading devices and component parts which have been damaged beyond acceptable repair. Replace with new materials.

END OF SECTION

SECTION 10810
TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes, but is not limited to:
 - 1. Toilet room accessories.
 - 2. Metal framed mirrors in toilet rooms.
 - 3. Mop racks in janitor rooms.
 - 4. Framed glass shower doors.

1.03 QUALITY ASSURANCE

- A. Reference specifications and standards:
 - 1. ASTM: A123 Zinc (Hot-Dip) Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM: A167 Stainless and Heat-Resisting Chromium Nickel Steel Plate, Sheet and Strip.
 - 3. NAAMM: Metal Finishes Manual.

1.04 SUBMITTALS

- A. Shop drawings: Indicate dimensions and details, including joining and forming details for custom-fabricated items.
- B. Product data (manufacturer's detailed literature): Manufacturer's catalog cuts and data sheets, complete parts list, and installation requirements for each accessory item specified.
- C. Maintenance data, operating instructions, and keys required for each type of equipment and lock.

1.05 PRODUCT HANDLING

- A. Maintain protective coverings on all items until installation has been completed.

1.06 WARRANTY

- A. Warrant mirrors against silver spoilage for 15 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Accessories:
 - 1. A J Washroom Accessories.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.

2.02 MATERIALS

- A. Stainless steel: ASTM A167 Type 302/304; 400 series is not acceptable. NAAMM No. 4, polished finish.
- B. Concealed mounting devices: Carbon steel with hot-dip galvanized coating in accord with ASTM A123 or stainless steel.
- C. Provide each item complete with stainless steel screws and fittings, including concealed anchorage as required to provide a secure mechanical attachment.
- D. Sanitary sealants: Mildew-resistant silicone as specified in Section: "Joint Sealants."

2.03 FABRICATION

- A. Fabricate recessed units with seamless one-piece flange on exposed face.
- B. Locked dispensing units: Key alike for all accessories and in accord with Architect / Owner requirements.
- C. Coin-operated dispensing units: Key coin boxes separately from dispensing unit.
- D. Weld corners, grind welds smooth, and finish to match adjacent finish surfaces.
- E. Eliminate exposed cutting edges.

2.03 SCHEDULE OF ACCESSORIES

- A. Glass Shower Doors: Framed style; fabricated from Type 304 polished stainless steel, or clear anodized aluminum, of indicated or required sizes.
 - 1. Glass: Tempered 1/4 inch, obscure.
 - 2. Hardware: Manufacturer's standard polished stainless steel or clear anodized aluminum. Provide non-corrosive piano style hinges.
- B. Refer to Schedule in Contract Drawings for all other accessory items.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check openings scheduled to receive recessed units for correct dimensions, plumbness of blocking, backing plates or frames, and preparation that would affect installation of accessories.
- B. Check areas to receive surface-mounted units for conditions that would affect quality and execution of work.
- C. Verify spacing of plumbing fixtures and toilet partitions that affect installation of accessories.
- D. Do not begin installation of toilet accessories until openings and surfaces are acceptable.

3.02 INSTALLATION

- A. Locate accessories accurately, set plumb and level, and attach securely in position.
- B. Drill holes to correct size and application that is concealed by item, with 1/8 in. tolerance.
- C. Mount recessed accessories, if any, into wall openings with sheet metal screws into metal frames.
- D. Plumb, align, and mount surface-mounted accessories, if any, to backup with fasteners appropriate for fastening conditions.
- E. Set accessories with continuous bead of sanitary sealant.

3.03 ADJUST AND CLEAN

- A. Adjust accessories for proper operation.
- B. After completion of installation, clean and polish all exposed surfaces.
- C. Remove protective covers at final cleaning of installation and immediately prior to acceptance by Owner.
- D. Deliver keys and instruction sheets to Owner.

END OF SECTION

Division 11 Equipment

SECTION 11300
KITCHEN EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Range/ oven
2. Dishwasher
3. Disposal
4. Type 1 Grease Hood
5. Ice Machine
6. Refrigerator/ Freezer
7. Reach-In Cooler
8. Warming Cabinet

1.2 SUBMITTALS

A. Product Data:

1. Catalog brochures of equipment specified
2. Model number and technical requirements of each unit
3. Manufacturers written installation instructions
4. Rough-in dimensions
5. Color selections (if not specified)

B. Sample warranties

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in manufacturers unopened containers with model numbers on equipment packaging.
- B. Store up off floor on wood skids.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: GE Appliances by General Electric Company, Louisville, Kentucky.
- B. The following manufacturers are also acceptable provided compliance with technical specifications of specified products.
 1. Hotpoint, Louisville, Kentucky
 2. Magic Chef, Cleveland, Tennessee
 3. Frigidaire, Dublin, Ohio
 4. Amana/Speed Queen, Amana, Iowa

- C. Ice Machine Basis of Design: Products specified are based on those as manufactured by Manitowoc Ice, Inc., Manitowoc, Wisconsin.
1. The following manufacturers are also acceptable for the ice machine provided compliance with technical specifications of specified products:
 - a. Hoshizaki
 - b. Or approved equal.

2.2 KITCHEN EQUIPMENT

A. Drop-in range

1. GE #PD00DPWW Drop-In Electric Range with self-cleaning oven – white.
2. Provide all standard features for above listed model.
3. Power Requirements: 240 Volt. Coordinate with Electrical Drawings.

B. Type 1 Grease Hood Basis of Design: Greenheck. Refer to mechanical drawings.

1. The following manufacturers are also acceptable for the Type 1 Grease Hood, provided compliance with the specifications indicated in the mechanical plans:
 - a. Greasemaster
 - b. Gaylord

C. Dishwasher

1. GE #GSD3900 built-in dishwasher - White.
2. Solid State control types, nine touchpads/pushbuttons, nine cycles, potscrubber, normal wash, light wash, crystal cycles, rinse only cycles, temperature sensor system, 1/4 inch wood insert, 120 degree hot water inlet capability, 10 year tub warranty, super rack system, cup shelf, three wash levels.
3. Power Requirements: 120 volt, 60 hertz, 8.6 amps.

D. Disposal

1. GE #GFC720S heavy-duty food waste disposal.
2. Permanent magnet motor type, foam pad, wall switch, continuous feed, direct wire, dual swivel impellers, jamb resistant, stainless steel, nylon hopper, removable splash guard, 2700 RPM, 3/4 H.P., 60 hertz, 115 volt, 6.0 amps.

E. Refrigerator / Freezer

1. GE #GTK18ICDBS, 18 cu. ft. top freezer model, stainless steel finish.

F. Reach-In Cooler

1. Arctic Air AR49 (or approved equal), 120 volts, 11 Amps.

G. Warming Cabinet Basis of Design: Alto-Shaam 1220 UP. Two compartment holding cabinet. Stainless steel finish, with casters. 120 volts, 16 Amps.

1. The following manufacturers are also acceptable, provided compliance with the

specifications indicated in the mechanical plans:

- a. True
- b. Lockwood

2.3 ICE MACHINE

- A. Basis of Design: Manitowoc SD-0502A, or approved equal. Provide front opening B-400 bin, with ice scoop holder #76-2207-3. 120 volts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- B. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- C. Built-In Equipment: Securely anchor units to supporting cabinetry or countertops and concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- D. Provide all items and accessories as required for a complete installation in every respect.
- E. The General Contractor shall provide all required up-fit provisions (ie. plumbing, power and exhaust venting, etc.) required for the owner to install all other residential equipment as shown on the drawings that is to be provided and installed by the owner. The General Contractor shall coordinate with the owner all specific requirements for each owner provided and installed piece of equipment.

END OF SECTION

SECTION 11520
PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Front-projection screens.
- B. Related Sections include the following:
 - 1. Division 16 Sections for electrical service and connections including metal device boxes for switches and conduit, where required, for low-voltage control wiring.

1.3 DEFINITIONS

- A. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.
- B. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 SUBMITTALS

- A. Product Data: For each type of screen specified.
- B. Shop Drawings: Show layouts and types of projection screens. Include the following:
 - 1. Location of screen centerline relative to ends of screen case.
 - 2. Location of seams in viewing surfaces.
 - 3. Drop length.
 - 4. Connections to supporting structure for pendant- and recess-mounted screens.
 - 5. Anchorage details.
 - 6. Details of juncture of exposed surfaces with adjacent finishes.
 - 7. Accessories.
 - 8. Wiring Diagrams: For electrically operated units.

- C. Maintenance Data: For projection screens to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

1.7 COORDINATION

- A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 FRONT-PROJECTION SCREENS

- A. Electrically Operated Screens, General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Low-Voltage Control: System consisting of a control unit with 24-V power supply, remote 3-button or 3-position switches, and interconnecting wiring. Switches are installed in recessed metal device boxes with flush cover plates matching other electrical device cover plates in room where switch is installed.
 - a. Provide locking cover plates for switches.
 - b. Provide key-operated power-supply switch.
 - c. Provide infrared remote control consisting of battery-powered transmitter and receiver for use with low-voltage control system.
 - d. Integral Electric Brake to prevent 'Coasting'.

2. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- (9.5-mm-) diameter metal rod with ends of rod protected by plastic caps, manually operated screens.
 - a. Roller for end-mounted motor supported by self-aligning bearings in brackets.
 - b. Roller for motor in roller supported by vibration- and noise-absorbing supports.
 3. Tab Tensioning: Units have stainless-steel tensioning cables on both sides of screen connected to edges of screen by tabs to pull screen flat horizontally.
 4. Electrically Operated Screens: Tensioned bottom: Bottom of fabric to be inserted into a custom Aluminum slat bar with added weight for vertical tension on the screen surface.
 5. Electrically Operated Screens: Slat ends to be protected by Heavy Duty Plastic Caps enclosing a preset and adjustable mechanism for screen tensioning.
- B. Recessed, Electrically Operated Screens without Ceiling Closure: Motor in roller or end-mounted motor units with bottom of case entirely or partially open under screen compartment.
1. Available Products:
 - a. Da-Lite Screen Co., Inc.; Tensioned Professional Electrol.
 - b. Draper Inc.; Access/Series E, Access/Series V, or Rolleramic.
 - c. Stewart Filmscreen Corporation; Model B or C.
 2. Provide metal or metal-lined motor enclosure on units with end-mounted motor.
 3. Provide metal or metal-lined wiring compartment on units with motor in roller.
 4. Screen Case: Made from metal, wood, wood products, and fire-retardant materials.
 5. Provide screen case with trim flange to receive ceiling finish.
 6. Prime paint surfaces of screen case that will be exposed to view in the finished work.
- C. Screen Material and Viewing Surface:
1. Matte-White Viewing Surface: Peak gain of 0.9 to 1.0, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.
 - a. Products:
 - 1) Bloch Enterprises, Inc.; Matte White.
 - 2) Bretford Manufacturing, Inc.; Matte White.
 - 3) Da-Lite Screen Co., Inc.; Matte White.

- 4) Draper Inc. Fiberglass Matte White.
2. Material: Vinyl-coated glass-fiber fabric.
3. Mildew Resistance: Rating of 0 or 1 when tested according to ASTM G 21.
4. Flame Resistance: Passes NFPA 701.
5. Seams: Where length of screen indicated exceeds maximum length produced without seams in material specified, provide screen with horizontal seam placed as follows:
 - a. At top of screen at juncture between extra drop length and viewing surface.
6. Seamless Construction: Provide screens, in sizes indicated, without seams **where possible**.
7. Edge Treatment: Black masking borders.
8. Provide extra drop length of dimension indicated to comply with the following requirements for fabric color and location of drop length:
 - a. Color: Black.
 - b. Location: At top of screen.
9. Size of Viewing Surface: As follows.
 - a. Electrically Operated Screens: 105h" x 140w".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.
 1. Install low-voltage controls according to NFPA 70 and manufacturer's written instructions.
 - a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
 2. Test electrically operated units to verify that screen controls, limit switches, closure, and other operating components are in optimum functioning condition.

3. Test manually operated units to verify that screen operating components are in optimum functioning condition.

3.2 PROTECTING AND CLEANING

- A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION

Division 12 Furnishings

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Room darkening and sunscreen double roller shades.

1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Wood blocking and grounds for mounting roller shades and accessories.
- B. Section 09260 - Gypsum Board Assemblies: Coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.
- C. Section 09510 - Acoustical Ceilings: Coordination with acoustical ceiling systems for installation of shade pockets, closures and related accessories.
- D. Division 16 - Electrical: Electric service for motor controls.

1.3 REFERENCES

- A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. NFPA 70 - National Electrical Code.
- C. NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. [[Product Data](#)]: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 3. Storage and handling requirements and recommendations.
 - 4. Mounting details and installation methods.
 - 5. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable..
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- E. Selection Samples: For each finish product specified, one set of shade cloth options

and aluminum finish color samples representing manufacturer's full range of available colors and patterns.

- F. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.
- G. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.
- B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- C. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- D. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.
- E. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.
- F. Mock-Up: Provide a mock-up (manual shades only) of one roller shade assembly for evaluation of mounting, appearance and accessories.
 - 1. Locate mock-up in window designated by Architect.
 - 2. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

- A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating twenty-five year limited warranty.

- B. Standard Shadecloth: Manufacturer's standard twenty-five year warranty.
- C. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five year warranty.
- D. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. MechoShade Systems, Inc. (Basis of Design): 42-03 35th St.; Long Island City, NY 11101; Tel: 718-729-2020; www.mechoshade.com
 - a. Suburban/ 2 Shade System (Basis of Design): One black-out shade and one 10% open fabric shade.
2. Window Interiors, Inc. – Orlando, FL; www.windowinteriors.com
3. Hunter Douglas – 800-727-8953; www.hunterdouglascontract.com

B. Requests for substitutions will be considered in accordance with Division 01 sections.

C. ROLLER SHADE TYPES

D. Motorized Shades:

1. Mounting: Surface mounted with pocket.
2. Configuration: Double solar and blackout shadecloth.
3. Solar Shadecloths:
 - a. Fabric: ThermoVeil 2100, 10 percent open, 2 by 2 open basket-weave pattern.
 - b. Color: Selected from manufacturer's standard colors.
4. Blackout Shadecloths:
 - a. Fabric: Selected from manufacturer's standard fabrics.
 - b. Color: Selected from manufacturer's standard colors.
5. Controls: Electrically operated, standard line voltage switches.

2.2 SHADE CLOTH

- #### A. Visually Transparent Shadecloth: MechoShade Systems, Inc., ThermoVeil series, single thickness non-raveling 0.030-inch (0.762 mm) thick vinyl fabric, woven from 0.018-inch (0.457 mm) diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl.

2.3 SHADE BAND

- #### A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
2. Shade Band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch (39.37 mm) in diameter for manual shades, and less than 2.55 inches (64.77 mm) for motorize shades are not acceptable.
 - b. Provide for positive mechanical engagement with drive / brake mechanism.
 - c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
 - d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
 - e. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

2.4 SHADE FABRICATION

- A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
- B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design. Fabricate hem as follows:
 1. Exposed blackout hembar with light seal.
- C. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shadebands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.
- D. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect. Seams shall be properly located. Furnish battens in place of plain seams when the width, height, or weight of the shade exceeds manufacturer's standards. In absence of such standards, assure proper use of seams or battens as required to, and assure the proper tracking of the railroaded multi-width shadebands.
- E. Provide battens for railroaded shades when width-to-height (W:H) ratios meet or exceed manufacturer's standards. In absence of manufacturer's standards, be responsible for proper use and placement of battens to assure proper tracking and roll of shadebands.

- F. Blackout shadebands, when used in side channels, shall have horizontally mounted, roll-formed stainless steel or tempered-steel battens not more than 3 feet (115 mm) on center extending fully into the side channels. Battens shall be concealed in a integrally-colored fabric to match the inside and outside colors of the shadeband, in accordance with manufacturer's published standards for spacing and requirements.
1. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.
 2. Batten pockets shall be self-colored fabric front and back RF welded into the shade cloth. A self-color opaque liner shall be provided front and back to eliminate any see through of the batten pocket that shall not exceed 1-1/2 inches (38.1 mm) high and be totally opaque. A see-through moire effect, which occurs with multiple layers of transparent fabrics, shall not be acceptable.

2.5 COMPONENTS

- A. Access and Material Requirements:
1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
 3. Use only Delrin engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester will not be acceptable.
- B. Motorized Shade Hardware and Shade Brackets:
1. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.
 2. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
 3. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).

2.6 SHADE MOTOR DRIVE SYSTEM

- A. Shade Motors:
1. Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
 2. Conceal motors inside shade roller tube.
 3. Maximum current draw for each shade motor of 2.3 amps.
 4. Use motors rated at the same nominal speed for all shades in the same room.
- B. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

2.7 ACCESSORIES

- A. Roller Shade Pocket: For recessed mounting in acoustical tile, or drywall ceilings as indicated on the Drawings.
 - 1. Provide either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.
 - a. Provide "Vented Pocket" such that there will be a minimum of four 1 inch (25.4 mm) diameter holes per foot allowing the solar gain to flow above the ceiling line.
- B. Pocket Accessories: As indicated on the Drawings.
- C. Room Darkening Channels:
 - 1. Side Channels, ElectroShade: Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Units 2-1/2 inches (63.5 mm) wide by 1-3/16 inches (30.1 mm) deep; two-band center channels 5 inches (127 mm) wide by 1-3/16 inches (30.1 mm) deep. The 2-5/8-inch (66.6 mm) double-center channels may be installed at center-support positions of multi-band-shade ElectroShades. MechoShade side channels 2-5/8 inches (66.6 mm) may be used as center supports for ElectroShades. Also provide for use with manually operated room darkening MechoShades over 8 feet (2438 mm) in height.
 - a. Blackout Lightseal Hembar: Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure light control.
 - 2. Channel Color: Selected from manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.
- B. Turn-Key Single-Source Responsibility for Motorized Interior Roller Shades: To control the responsibility for performance of motorized roller shade systems, assign the design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single

manufacturer and their authorized installer/dealer. The Architect will not produce a set of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage), shall be provided by the roller shade installer/dealer, in accordance with the requirements provided by the manufacturer. Coordinate the following with the roller shade installer/dealer:

1. Contractor shall provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings.
 2. Contractor shall coordinate with requirements of roller shade installer/dealer, before inaccessible areas are constructed.
 3. Roller shade installer/dealer shall run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated by roller shade dealer.
 4. Roller shade installer/dealer shall provide and run all line voltage (from the terminating points) to the motor controllers, wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/ control locations designated by the Architect. All above-ceiling and concealed wiring shall be plenum-rated, or installed in conduit, as required by the electrical code having jurisdiction.
 5. Contractor shall provide conduit with pull wire in all areas, which might not be accessible to roller shade contractor due to building design, equipment location or schedule.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- D. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- E. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SPECIFICATION MANUAL
BID PACKAGE 'B'**

**ORANGE COUNTY
HOLDEN HEIGHTS COMMUNITY
CENTER**

19th STREET IMPROVEMENTS



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Bid Documents
February 22, 2013



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BIDDING / CONTRACTING REQUIREMENTS

DOCUMENT	TITLE
<i>00300</i>	<i>Information Available to Bidders</i> <i>Summary of Quantities and Unit Costs</i>

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DIVISION 2 - SITE CONSTRUCTION

SECTION	TITLE
02210	Site Preparation and Earthwork
02220	Excavating, Backfilling and Compacting
02232	Limerock Base
02234	Soil Cement Base
02240	Stabilized Subgrade
02480	Sodding, Seeding, & Mulching
02500	Asphalt Concrete Paving and Resurfacing
02700	Concrete Gutter, Curb Elements, and Traffic Separator
02710	Concrete Sidewalk
02720	Storm Drainage System

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**Information Available to
Bidders**

Summary of Quantities and Unit Costs bound herein.

HOLDEN HEIGHTS COMMUNITY CENTER
 BID PACKAGE 'B'
 19TH STREET IMPROVEMENTS
 SCHEDULE OF UNIT PRICES

BID ITEM	ID #	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	TOTAL PRICE
1	101-1	MOBILIZATION (10%) See note at the end of this schedule listing.	1	EA		
2	102-1	MAINTENANCE OF TRAFFIC	1	LS		
3	104-14	PREVENTION, CONTROL, AND ABATEMENT OF EROSION AND WATER POLLUTION	1	LS		
4	110-1-1	CLEARING AND GRUBBING	1	LS		
5	120-4	SUBSOIL EXCAVATION	337	CY		
6	120-9	EXCAVATION, EMBANKMENT, AND GRADING	1	LS		
7	160-4	STABILIZATION TYPE B (12") (MIN LBR 40)	853	SY		
8	334-1-13B	TYPE SP SUPERPAVE ASPH. CONC. (TRAFFIC C) (1 1/2")	808	SY		
9	400-1-15	CLASS I CONCRETE (MISC) (CONTINGENCY)	25	CY		
10	425-10	YARD DRAINS	38	EA		
11	520-2-1	CONCRETE CURB, RIBBON	747	LF		
12	522-2	CONCRETE SIDEWALK, 6" THICK	292	SY		
13	570-1-2	PERFORMANCE TURF, SOD (MATCH EXISTING)	1154	SY		
14	711-11-125	THERMOPLASTIC, STANDARD, WHITE, SOLID, 24"	8	LF		
15	711-11-211	THERMOPLASTIC, STANDARD, YELLOW, SOLID, 6"	30	LF		
16	900-1	AS-BUILT PLANS ON MYLARS (BLACK-LINES)	1	LS		
17	900-2	INDEMNIFICATION	1	LS		

A. ESTIMATED BASE BID FOR 19TH STREET IMPROVEMENTS:

Division 2

Site Construction

SECTION 02200
MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Maintain traffic within the limits of the project for the duration of the construction period, including any temporary suspensions of the works. Provide facilities for access to residents, businesses, etc., along the project. Furnish and install work zone pavement markings for maintenance of traffic in construction areas. Provide any other special requirements for safe expeditious movement traffic specified on the plans.
- B. Maintenance of Traffic includes all facilities, devices and operations as required for safety and convenience of the public within the work zone.
- C. Do not maintain traffic over those portions of the project where no work is to be accomplished or where construction operations will not affect existing roads. Do not obstruct or create a hazard to any traffic during the performance of the work, and repair any damage to existing pavement open to traffic. ng the site, including roads, drives, building sites, paved areas and open areas to the lines and grades shown on drawings.

1.03 REFERENCED STANDARDS

- A. Florida Department of Transportation (FDOT) Design Standards, latest edition.

1.04 SPECIFIC REQUIREMENTS

- A. Temporary Traffic Control Devices: Use only the materials meeting the requirements of FDOT Design Standards Section 990 and the Manual of Uniformed Traffic Control Devices (MUTCD).

- B. Worksite Traffic Supervisor: Provide a Worksite Traffic Supervisor in accordance with FDOT Design Standards Section 105. The Worksite Traffic Supervisor will have at his disposition all equipment and materials needed to set up, take down, maintain traffic control, and handle traffic-related situations. The Worksite Traffic Supervisor will perform his duties in accordance with FDOT Design Standards Section 102.
- C. Traffic Control Plan: Contractor to submit a Traffic Control Plan in conformance with and in the form outlined in the current version of FDOT Roadway Plans Preparation Manual. The Traffic Control Plan will be signed and sealed by a Professional Engineer registered in Florida and in the employ of the Contractor.
- D. Contractor's Responsibility: Maintenance of Traffic starts on the day Contractor begins work on the project.

PART 2 - PRODUCTS

2.01 TEMPORARY TRAFFIC CONTROL DEVICES

- A. All temporary traffic control devices must meet the requirements of National Cooperative Highway Research Program Report 350 (NCHRP 350) and current Federal Highway Administration (FHWA) directives.
- B. Work Zone Signs: Signs in accordance with the plans and FDOT Design Standards, latest edition

PART 3 - EXECUTION

3.01 TRAFFIC CONTROL

- A. Crossings and Intersections: Provide and maintain adequate accommodations for intersecting and crossing traffic.
- B. Access for Residences and Businesses: Provide continuous access to all residences and all places of business.
- C. Protection of the Work from Injury by Traffic: Where traffic would be injurious to a base, surface course, or structure constructed as a part of the work, maintain all traffic

outside the limits of such areas until the potential for injury no longer exists.

- D. Flagger: Provide trained flagger in accordance with FDOT Design Standards Section 105, latest edition.
- E. Vehicle and Equipment Visibility: Equip all pickups and automobiles used on the project with a minimum of one Class 2 amber or white warning light that meets the Society of Automotive Engineers Recommended Practice SAE J845 dated March, 1992 or SAE J1318 dated April, 1986 and incorporated herein by reference.
- F. Driveway Maintenance: Ensure that each residence and/or business has safe, stable, and reasonable access. Place, level, manipulate, compact and maintain the material, to the extent appropriate for the intended use. As permanent driveway construction is accomplished at a particular location, the Contractor may salvage and reuse previously placed materials that are suitable for reuse on other driveways.

END OF SECTION

SECTION 02220
EXCAVATING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. The work included under this Section consists of clearing, excavating, grading and backfilling as required for the construction of building pads, roadways, and utility systems consisting of, but not limited to, water mains, sanitary sewers, manholes, drainage structures, ponds, swales and appurtenances and irrigation lines as shown on Drawings and specified herein.

- B. Related Sections: The following sections contain requirements that related to this section.

- 1. Section 02210 – Site Preparation and Earthwork

- C. Definitions:

- 1. Maximum Density: Maximum weight in pounds per cubic foot of a specific material.
- 2. Optimum Moisture: Percentage of water in a specific material at maximum density.
- 3. Suitable: Suitable materials for fills shall be a non-cohesive, non-plastic granular local sand and shall be free from vegetation, organic material, marl, silt or muck. The Contractor shall furnish all additional fill material required.
- 4. Unsuitable: Unsuitable materials are highly organic soil (peat or muck) classified as A-8 in accordance with AASHTO Designation M 145.

- D. Plan for Earthwork: The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrate, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the work, the general and local conditions and all other matters which can in any way affect the

work under this Contract.

1.03 QUALITY ASSURANCE

- A. A Testing Laboratory employed by Owner will make such tests as are deemed advisable. The Contractor shall schedule his work so as to permit a reasonable time or testing before placing succeeding lifts and shall keep the laboratory informed of his progress. Costs for all testing shall be paid by the Owner. However, any and all test which have to be repeated because of the failure of the tested materials to meet specification shall be paid for by Contractor and the cost of any tests shall be deducted from payments due to Contractor.

1.04 JOB CONDITIONING

- A. Test borings made on the site and the surface exploration data are available upon request and are for the Contractor's information only.
- B. If, in the opinion of Owner, conditions encountered during construction warrant a change in footing elevations, or in the depth of removal of unsuitable material from that indicated on the Drawings, an adjustment will be made in the contract price.

1.05 PROTECTION

- A. Sheeting and Bracing:

- 1. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, power poles, etc. from undermining, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other approved methods. If Owner is of the opinion that at any points sufficient or proper supports have not been provided, he may order additional supports put in at the expense of Contractor, and compliance with such order shall not relieve or release Contractor from his responsibility for the sufficiency of such supports. Where soils cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to Owner.
- 2. The Contractor shall construct the sheeting outside the neat lines of the foundation unless indicated otherwise to the extent he deems it desirable for his method of operation. Sheeting shall be plumb and securely braced and tied in

position. Sheeting and bracing shall be adequate to withstand all pressure to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected by Contractor at his own expense so as to provide necessary clearances and dimensions.

3. Where sheeting and bracing is required to support the sides of excavations for structures, Contractor shall engage a Professional Geotechnical Engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design, and certification of this shall be provided by the Professional Engineer.
4. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
5. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which Owner may direct in writing to leave in place at any time during the progress of the work for purpose of preventing injury to structures, utilities, or property, whether public or private. Owner may direct that timber used for sheeting and bracing be cut off at any specified elevation.
6. All sheeting and bracing not left in place shall be carefully removed in such a manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed by Owner.
7. The right of Owner to order sheeting and bracing left in place shall not be construed as creating any obligation on this part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
8. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than 1 foot above the top of any pipe.

B. Pumping and Drainage:

1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep

such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such an extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. The Contractor shall engage a Geotechnical Engineer registered in the State of Florida, to design the dewatering systems for all structures. The Contractor shall submit to Owner for review a plan for dewatering systems prior to commencing work. The dewatering system installed shall be in conformity with the overall construction plan, and certification of this shall be provided by the Professional Engineer. The Professional Engineer shall be required to monitor the performance of the dewatering systems during the progress of the work and required such modifications as maybe required to assure that the systems are performing satisfactorily.

2. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation and to preserve the integrity of adjacent structures. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soil from the surrounding ground.
3. Water entering the excavation from surfaces runoff shall be collected in the shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
4. The Contractor shall take all additional precautions to prevent uplift of an structure during construction.
5. The conveying of water in open ditches or trenches will not be allowed. Permission to use any storm sewers, or drains, for water disposal purposes shall be obtained from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. However, the Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by Owner or the authority having jurisdiction, at no cost to Owner.
6. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.
7. Removal of dewatering equipment shall be accomplished after the system is no longer required; the material and equipment constituting the system, shall be removed by Contractor.

8. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on the groundwater quality.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. All fill material shall be subject to the approval of Owner.
2. All fill material shall be free of organic material, trash, or other objectionable material. Excess or unsuitable material shall be removed from the job site by Contractor.

- B. Common Fill Material: Common fill shall be sand and shall not contain stones, rock, concrete to other rubble larger than two (2) inches in diameter. It shall have physical properties which allow it to be easily spread and compacted.

- C. Structural Fill: Structural fill shall be reasonably well graded sand to gravelly sand having the following gradation:

<u>U.S. Sieve Size</u>	<u>Percent Passing By Weight</u>
1 - in	100
No. 4	75 - 100
No. 40	15 - 80
No. 100	0 - 30
No. 200	1 - 12

- D. Class I Soils*: Manufactured angular, granular material, 1/4 to 1-1/2 inches (6 to 4 mm) size, including materials having significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells. Sieve analysis for crushed stone is given below separately.

Crushed Stone: Crushed stone shall consist of clean mineral aggregate free from clay, loam or organic matter, conforming with ASTM C33 stone size No. 89 and with particle size limits as follows:

<u>U.S. Sieve Size</u>	<u>Percent Passing By Weight</u>
1/2	100
3/8	90 - 100

No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 50	0 - 5

E. Class II Soils**:

1. GW: Well-graded gravels and gravel-sand mixtures, little or no fines. Fifty (50) percent or more retained on No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.
2. GP: Poorly graded gravels and gravel-sand mixtures, little or no fines. Fifty (50) percent or more retained on No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.
3. SW: Well-graded sand and gravelly sands, little or no fines. More than fifty (50) percent passes No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.
4. SP: Poorly graded sand and gravelly sands, little or no fines. More than fifty (50) percent passes No. 4 sieve. More than 95 percent retained on No. 200 sieve. Clean.

* Soils defined as Class I materials are not defined in ASTM D2487.

** In accordance with ASTM D2487, less than 5 percent pass No. 200 sieve.

F. Coarse Sand: Sand shall consist of clean mineral aggregate with particle size limits as follows:

<u>U.S. Sieve Size</u>	<u>Percent Passing By Weight</u>
No. 10	100
No. 20	0 - 30
No. 40	0 - 5

G. Other Material: All other materials, not specifically described, but required for proper completion of the work shall be selected by the Contractor and approved by Owner.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clearing:

Holden Heights Community Center 02220-6
 19th Street Improvements
 CTHA Project No. 1204.00

EXCAVATING, BACKFILLING,
 AND COMPACTING

1. The construction areas shall be cleared of all obstructions and vegetation including large roots and undergrowth, within 10 feet of the lines of the excavation.
2. Strip and stockpile topsoil on the site at the location to be determined by Owner.

3.02 EXCAVATION

A. Excavating for Roadways and Utilities:

1. Immediately document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during the course of construction.
2. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Drawings and should anticipate the encounter of unknown obstructions during the course of the work.
3. Encounters with subsurface obstructions shall be hand excavated.
4. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support of structures as a result of inadequate dewatering or other construction methods, shall be removed and replaced by crushed stone as required by Owner at the Contractor's expense.
5. The bottom of excavation shall be rendered firm and dry before placing any structure. Excavated material not suitable for backfill shall be removed from the site and disposed of by the Contractor.
6. All pavements shall be cut prior to removal, with saws or approved power tools.
7. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered.
8. All locations and elevations as required herein must be permanently documented by the Contractor, on the Record Drawings prior to Owner's approval of the Application for Payment for that work.
9. When force main or sanitary sewer pipe crosses less than 10 feet from a water main, the depth of cover shall be increased to 5 feet or 18 inches below the water main, whichever is greater. When force mains or sanitary sewers are laid parallel to water main, the sanitary line is to be installed per Section 02730C.

3.03 DRAINAGE

- A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations, and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition. The dewatering method used shall prevent disturbance of earth below grade.
- B. All water pumped or drained from the work shall be disposed of in a suitable manner with our undue interference with other work, without damage to surrounding property, and in accordance with pertinent rules and regulations.
- C. No construction, including pipe laying, shall be allowed in water. No water shall be allowed to contact masonry or concrete within 24 hours after being placed. The Contractor shall constantly guard against damage due to water and take full responsibility for all damage resulting from his failure to do so.
- D. The Contractor will be required at this expense to excavate below grade and refill with approved fill material if the Owner determines that adequate drainage has not been provided.

3.04 UNDERCUT

- A. If the bottom of any excavation is below that shown on the Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due to the Contractor's excavation methods, he shall refill to normal grade with fill at his own cost. Fill material and compaction shall be as directed by Owner.

3.05 FILL AND COMPACTION

- A. Compact and backfill excavations and construct embankment according to the following schedule. Backfill schedule for pipes is listed in Table 02200-A. (Standard shall be ASTM D-1557):

STRUCTURES AND ROADWORK

<u>Area</u>	<u>Material</u>	<u>Compaction</u>
Beneath Structures	Structural Fill	12" lifts, compacted to 95% maximum density. Fill should not be placed over any in place soils until those deposits have been compacted to 95% maximum density.
Around Structures	Structural Fill	8" lifts, 95% of maximum density. Use light rubber-tired or vibratory plate compactors.
From Cleared Existing Surface to Subgrade for Paved and Gravel Surfaces	Common Fill	12" lifts, 95% of maximum density.

- B. Pipe shall be laid in open trenches unless otherwise indicated on the Drawings or elsewhere in the Contract Documents.
- C. Excavations shall be backfilled to the original grade or as indicated on the Drawings. Deviation from this grade because of settling shall be corrected. Backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard.
- D. Embankments shall be constructed true to lines, grades and cross sections shown on the plans or ordered by Owner. Embankments shall be placed in successive layers of not more than 8 inches in thickness, loose measure, for the full width of the embankment. As far as practicable, traffic over the work during the construction phase shall be distributed so as to cover the maximum surface areas of each layer.
- E. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified herein, such request shall be in writing to Owner. Approval will be considered only after Contractor has performed tests, at Contractor's expense, to identify the material used and density achieved throughout the backfill area utilizing the method of backfill requested. Owner's approval will be in writing.

END OF SECTION

SECTION 02232
LIMEROCK BASE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.02 SUMMARY

- A. This Section includes furnishing, providing all labor, materials, equipment, transportation and performing all work necessary to construct a base course composed of limerock upon the prepared subgrade in accordance with these Specifications and with the lines, grades, notes and typical cross sections shown on the Drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 - Site Preparation and Earthwork
 - 2. Section 02240 - Stabilized Subgrade
 - 3. Section 02500 - Asphalt Concrete Pavement and Resurfacing

1.03 QUALITY ASSURANCE

- A. Furnish complete laboratory analysis and obtain approval of the material by Owner prior to placement.
- B. Construct the base course in accordance with the applicable provisions contained in the Florida Department of Transportation Standard Specifications For Road and Bridge Construction, (FDOT Specifications), 2013 edition and as specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Source: Miami Oolite Formation or Ocala Formation at the Contractor's option. Use only one formation on any project.

- B. Composition: Limerock material showing no significant tendency to air slake or undergo any chemical change under exposure to weather and containing:
 - 1. Not more than 0.5 percent of organic material or objectionable matter,
 - 2. Not less than 70 percent of carbonates of calcium and magnesium,
 - 3. Not more than 3 percent of water sensitive clay material.
- C. Gradation: Graded uniformly down to dust with at least 97 percent (by weight) passing the 3 1/2-inch sieve and the fine material consisting entirely of dust of fracture.
- D. Quality:
 - 1. Uniform in quality and not containing cherty or other extremely hard pieces or lumps, balls or pockets of sand or clay size material in sufficient quantity as to prevent proper bonding, finishing or strength of the limerock base.
 - 2. Nonplastic with liquid limit not exceeding 35.
 - 3. Average LBR value not less than 100.

PART 3 - EXECUTION

3.01 GENERAL

- A. Equipment: As necessary for the proper construction of the work, in first-class working condition, and as approved by Owner prior to its use.
- B. Limits Of Construction: Construct the base to the full dimensions shown on the Drawings.

3.02 PERFORMANCE

- A. Transporting limerock: Transport limerock to the point where it is to be used, over rock previously placed if practicable, and dump on the end of the preceding spread. No hauling over the subgrade or dumping on the subgrade will be permitted.
- B. Spreading Limerock:
 - 1. Spread limerock uniformly, and remove and replace all segregated areas of fine or coarse rock with well-graded rock.

2. When the specified compacted thickness of the base is greater than 6-inches, construct the base in two courses with the first course approximately one-half the total thickness of the finished base, but not less than the thickness required to bear the weight of the construction equipment without disturbing the subgrade.

C. Compacting And Finishing Base:

1. Single Course Base: After spreading is completed, scarify the entire surface and then shape to produce the required grade and cross section after compaction.
2. Double Course Base: After placing and compacting the first course, clean the first course of foreign material, blade and bring to a surface cross section approximately parallel to that of the finished base. Prior to the spreading of any material for the upper course, conduct the density tests for the lower course and determine that the required compaction has been obtained. After the spreading of material for the second course is completed, finish and shape its surface so as to produce the required grade and cross section after compaction, free of scabs and laminations.
3. Moisture Content: When the material does not have the proper moisture content to insure the required density, wetting or drying will be required. If the material is deficient in moisture, add water and uniformly mix in by discing the base course to its full depth. If the material contains an excess of moisture, allow to dry until the required moisture content is attained before being compacted. In wetting or drying operations manipulate the entire width and depth of the base as a unit.
4. Density Requirements: As soon as proper conditions of moisture are attained, compact the material to a density of not less than 98 percent of the maximum density as determined by AASHTO T 180.
5. Density Tests:
 - a. During final compacting operations, if blading of any areas is necessary to obtain the true grade and cross section, complete the compacting operations for such areas prior to making the density determinations on the finished base.
 - b. Make at least three density determinations on each day's final operations on each course, and at more frequent intervals if deemed necessary by Owner.
6. Correction Of Defects:
 - a. If at any time the subgrade material should become mixed with the base course material, dig out and remove the mixture, replace the materials removed with clean base material, and shape and compact the subgrade as specified above.

- b. If cracks or checks appear in the base, either before or after priming, which in the opinion of Owner would impair the structural efficiency of the base course, remove such cracks or checks by rescarifying, reshaping, adding base material where necessary and recompacting.
- D. Testing Surface: Check the finished surface with a template cut to required crown and cross section and with a 10-foot straightedge laid parallel to the centerline of the road. Correct all irregularities greater than 1/4-inch by scarifying and by removing or adding limerock as may be required, and recompacting the entire area as specified herein before.
- E. Thickness Determinations:
 - 1. Measure the thickness of the compacted limerock base at intervals of not more than 100-feet at various points on the cross sections, prior to the application of the prime coat.
 - 2. Take the measurements in holes through the base of not less than 3-inches in diameter. Where the compacted base is deficient by more than 1/2-inch from the thickness called for on the Drawings, correct such areas by scarifying and adding limerock for a distance of 50-feet in each direction from the edge of the deficient area. Bring the affected areas to the required state of compaction and to the required thickness and cross section.
- F. Priming and Maintaining:
 - 1. Apply the prime coat only when the base is firm and unyielding, meets the specified density requirements and the moisture content in the top half of the base does not exceed 90 percent of the optimum moisture content of the base material.
 - 2. Prior to applying the surface course, check that the crown and grade are true, with no rutting or other distortion, and that the base meets all the specified requirements.

END OF SECTION

SECTION 02234
SOIL CEMENT BASE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. The work specified in this Section consists of the construction of a base course composed of a combination of soil and Portland cement, uniformly mixed, moistened, compacted, finished, and cured, in accordance with these specifications, and shaped to reasonable close conformance with the lines, grades, thicknesses, and typical cross sections shown on the Drawings or established by Owner.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 - Site Preparation and Earthwork
 - 2. Section 02240 - Stabilized Subgrade
 - 3. Section 02500 - Asphalt Concrete Pavement and Resurfacing

1.02 QUALITY ASSURANCE

- A. Laboratory analysis shall be complete, and the material accepted by Owner prior to use.
- B. The storage building, bin or silo for cement shall be weatherproof and shall be located convenient to the work to be performed.
- C. Cement which has been damaged, which is partially set, or which is lumpy or caked, shall not be used, and the entire contents of the sack of cement or the container of bulk cement, which contains damaged, partially set, or lumps of caked cement, will be rejected for use. Cement salvages from discarded or used sacks shall not be used.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cement: The cement used in the work shall be domestic Portland cement that conforms to the requirements of AASHTO Designation M 85, Type I. The cement may be delivered in bags or in bulk.
- B. Water:
 - 1. Water for use with cement shall be clean and practically free of oil, acid, alkali, chlorides, organic matter, and other deleterious substances.
 - 2. Water from city water supplies or other sources which are approved by a public health department may be accepted without being tested. Water from all other sources shall be tested and approved before use and shall impurities in excess of the following limits:

Acidity or alkalinity calculated in terms of calcium carbonate	0,05%
Total organic solids	0.05%
Total inorganic solids	0.08%
Total chlorides as sodium chloride	0.05%
- C. Cut-Back Asphalt, Grade RC-70: Rapid-curing cut-back asphalt shall conform with the requirements of AASHTO Designation M 81 except that penetration range shall be from 60-120 instead of 80-120.
- D. Emulsified Asphalt, Grade SS-1: Emulsified asphalt shall meet the requirements of AASHTO Designation M 140.
- E. Soil: The soil for the base course shall consist of the natural material in the roadway or selected soil placed in the roadbed, as shown on the Drawings, or a combination of these materials, proportioned as directed. The soil shall not contain gravel or stone retained on a 2-inch sieve or more than 45% retained on a No. 4 sieve.

PART 3 - EXECUTION

3.01 GENERAL

- A. Equipment: For performing the work specified in this Section the Contractor may use any machine, combination of machines, or equipment that are in good, safe working conditions and that will produce results meeting the requirements for cement

application, soil pulverization, mixing water application, compaction, finishing and curing, as required herein. Special attention is direct to the necessity for utilizing compaction equipment which will produce the required density in a particular soil-cement blend.

- B. Limits of Construction: The Contractor shall construct the base to the full width shown on the Drawings.

3.02 COMPOSITION AND PROPORTIONING

- A. Cement: Portland cement shall be applied at the rate determined by Owner for a particular soil used; therefore, no processing of the soil-cement mixture shall be started until all tests of the soil to be used to construct the base have been completed and the specified rate of application of Portland cement for the particular soil has been determined. In general, a period of approximately three weeks, subsequent the time that a particular section of the roadbed has been constructed substantially to grade, if required for such testing. The rate of application will be specified in terms of either pounds of Portland cement per square yards for the area to be mixed or pounds of cement per cubic yard of soil-cement mixture.
- B. Water: The quantity of water required will be the amount necessary to comply with Article 3.04 below.

3.03 PREPARATION

- A. Subgrade:
 - 1. Before base construction operations are begun, the subgrade shall have been completed. The subgrade shall be firm enough to support the equipment used in the soil-cement base operations without appreciable distortion or displacement. Any unsuitable material shall have been removed and replaced with suitable material.
 - 2. When the base is to be constructed of central plant-mix soil-cement, the subgrade shall be moist for a depth of at least one inch at the time the mixed base course material is placed thereon.
- B. Base Soil: The area over which base is to be constructed shall be graded and shaped to an elevation which will provide a base in conformance with the grades, lines, thicknesses, and typical cross section shown on the Drawings. All roots, sticks, and other deleterious matter shall be removed during processing.

3.04 PERFORMANCE

A. Mixing:

1. General:

- a. Mixing of the soil, cement and water shall be accomplished either by the mixed-in-place or the central plant-mix method.
- b. The percentage of moisture in the soil at the time of cement application shall not exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations. For clay soils it shall not exceed the optimum moisture content for the soil-cement mixture. For sandy soils the moisture content shall be within two percentage points above or below, the optimum moisture content. With certain type of soils, Owner may designate a moisture range other than those specified above.
- c. At completion of moist-mixing, the soil shall be so pulverized that 100 percent passes a one-inch sieve and a minimum of 80 percent passes a No. 4 sieve, exclusive of gravel and stone retained on the No. 4 sieve.
- d. The operation specified in this subparagraph and in subparagraphs 3.4B and C shall be continuous and shall be completed within a period of four hours starting from the time mixing commences.

2. Mix-In-Place

- a. Where feasible, the entire width of the base shall be processed as a single operation. The specified quantity of cement shall be spread uniformly on the soil at the required rate of application by means of an approved method. Spread cement that becomes displaced shall be replaced before mixing is started.
- b. After the cement has been applied, mixing shall begin within 60 minutes unless otherwise directed by Owner. The soil and cement shall be initially mixed until the cement has sufficiently blended with the soil to prevent formation of cement balls when additional water is applied; then water is added if necessary and the soil-cement mixture remixed.
- c. Processing may be to full depth in one course provided that satisfactory distribution of cement and water and the specified density can be obtained. If not, construction shall be in courses of such thickness that

satisfactory results are obtained. Provisions shall be made to achieve adequate bonding between courses.

- d. Immediately after mixing of the soil and cement, any additional water that is necessary shall then be added. If the moisture content exceeds that specified, the soil-cement mixture shall be manipulated by remixing or blading, as required to reduce the moisture content to within the specified range. Excessive concentrations of water shall be avoided. During the time of application of water and after all mixing water has been applied, mixing shall continue until a uniform and intimate mixture of soil, cement and water has been obtained.
- e. At the option of the Contractor, as an alternative to the above described procedure he may use an approved machine that will blend the cement and the soil and then add and mix-in any additional water that is necessary.

3. Central Plant-Mix:

- a. The soil, cement and water shall be mixed in a pugmill, of either batch or continuous flow type. The plant shall be equipped with feeding and metering devices which will accurately proportion the soil, cement, and water in the quantities specified. Soil and cement shall be mixed sufficiently to prevent cement balls from forming when additional water is added. Mixing shall continue until a uniform and intimate mixture of soil, cement and water is obtained. The materials shall be mixed a minimum of 30 seconds.
- b. The mixture shall be hauled to the roadway in trucks equipped with protective covers. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader. Not more than 30 minutes shall elapse between the placement of soil-cement in adjacent passes of the spreader at any location, except at longitudinal construction joints. The layer of soil-cement shall be uniform in thickness and surface contour, and in such quantity that the completed base will conform to the required grade and cross section. Dumping of mixture in piles or windrows upon the subgrade will not be permitted.

B. Compaction:

- 1. Compaction of the soil-cement mixture shall begin immediately after mixing is completed. In no case shall more than 60 minutes elapse between the last pass of moist-mixing and the start of compaction of the soil-cement mixture at a particular location.

2. At the start of the final compaction operation, the percentage of moisture in the mixture and in pulverized soil lumps, based on dry weights, shall not be more than two percentage points above or below the optimum moisture content.
3. The optimum moisture content and maximum density shall be determined in the field by the methods prescribed in AASHTO Designation T 134, on representative samples of the soil-cement mixture obtained from the area being processed.
4. The loose mixture shall be uniformly compacted to not less than 95 percent of the maximum density. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross section.

C. Finishing:

1. After compaction, the surface of the soil-cement shall be shaped to the required lines, grades, and cross section. In all cases where soil-cement mixture is added to any portion of the surfaces, the surface shall be lightly scarified with a spring tooth harrow, spike, drag, or other approved device, such that the surface is uniformly loosened prior to addition of material and prior to initial set of the soil-cement mixture. The resulting surface shall then be compacted to the specified density. Rolling shall continue until all rutting ceases and until the entire base conforms to the density requirements. With certain granular soils Owner may determine that minor tire marks are acceptable.
2. The moisture content of the surface material shall be maintained at not less than two percentage points below its specified optimum moisture content, during finishing operations. Surface compaction and finishing shall be done in such manner as to produce a smooth, dense surface, free of compacting planes, cracks, ridges, and loose materials.
3. If the time limits set forth herein are exceeded, the base shall be left undisturbed for a period of seven days, after which it will be examined by Owner to determine its suitability. If it is found suitable the Contractor shall be fully compensated providing the base meets all other requirements specified herein. If found unsuitable the base shall be removed and replaced by the Contractor without any additional compensation. The Contractor may, at his option, remove and replace the deficient base rather than wait the seven-day test cure.

- D. Construction Joints: At the end of each day's construction a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face. The construction joint shall be located such as to exclude all of that part of the base at the end of the run which does not meet the requirements of the

specifications and typical section.

E. Curing:

1. Surface Requirements: (Scalping and Hard planing): After compacting and finishing have been completed, and not later than the beginning of the next calendar day after the construction of any section of base, the surface shall be tested with a template cut to the required crown and with a 15-foot straightedge laid parallel to the center-line, and all irregularities greater than 1/4 inch shall be immediately corrected with a blade adjusted to the lightest cut which will ensure a surface that does not contain depressions greater than 1/4 inch under the template or straightedge. In the testing of the surface the measurements will not be taken in small holes caused by individual rocks having been pulled out by the blade. The material removed shall be wasted.
2. Protection Against Drying:
 - a. During the period when finishing and surface correction operations are being accomplished, the surface of the base shall be kept continuously moist by sprinkling as necessary. Subsequent to this period it shall be protected from drying for seven days, by application of either (1) cut-back asphalt, Grade RC-70, applied at a the rate of 0.15 to 0.20 gallon per square yard; or (2) a mixture containing equal parts of emulsified asphalt, Grade SS-1, and water, applied at the rate of 0.20 to 0.25 gallon of the diluted mixture per square yard. The actual rate of application shall be as directed and shall provide complete coverage without excessive runoff. At the time the bituminous material is applied, the soil-cement surface shall be dense and free of all loose and extraneous material, and shall contain sufficient moisture to prevent excessive penetration of the bituminous materials.
 - b. Should it be necessary to allow construction equipment or other traffic to use the completed base before the bituminous material has cured sufficiently to prevent pickup or displacement, the bituminous material shall be sanded, using approximately ten pounds of clean sand per square yard.
 - c. The curing material shall be maintained by the Contractor during the seven day protection period.

- F. Opening to Traffic: No traffic shall be permitted on the base subsequent to completion of the finishing operations specified in paragraph 3.4C article H for a period of seven days. As an exception to this requirement the equipment necessary for correction of surface irregularities, application of water and application of curing materials will be

allowed provided that the tire contact pressures of such equipment do not exceed 45 pounds per square inch. After the seven day curing period the base may be opened to traffic provided that it either is protected or has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic.

G. Maintenance: The Contractor shall maintain the base to a true and satisfactory surface until the wearing surface is constructed. Should any repairs or patching be necessary they shall extend to the full depth of the base and shall be made in a manner that will assure restoration of a uniform base course conforming to the requirements of these specifications. In no case shall repairs be made by adding a thin layer of soil-cement to the completed work. The Contractor may at his option, make full depth repairs to small or minor areas, such as at manholes, inlets, or the like, with Class C concrete.

H. Thickness;

1. During various stages of construction, test holes shall be dug in the mixture to determine the thickness. After the base is completed test holes shall be dug or drilled and the thickness of the base shall be determined from measurements made in these test holes.
2. Where the base is deficient in thickness by more than ½ inch, the area of deficient base shall be removed and replaced by base of the required thickness, at the Contractor's expense.
3. As an exception to the above, if the deficiency is considered to not be sufficient to seriously impair the required strength of the base, the deficient area may be left in place. No payment will be made for the base or the theoretical amount of cement used in areas left in place without correction.

END OF SECTION

SECTION 02240
STABILIZED SUBGRADE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation necessary to construct stabilized subgrade for areas as shown on Drawings.
 - 1. Contractor to stabilize parking areas to a minimum depth of 6-inches below the bottom grade of the base material and to a width of 6 inches outside each pavement or concrete curb edge.
 - 2. Stabilize roadways and streets to 12 inches unless otherwise indicated on the Drawings. .
 - 3. Where it fails to meet the specified Limerock Bearing Ratio (LBR) 40, stabilize the subgrade to the uniformity, density and bearing ratio specified as FDOT Type B.
- B. Definitions: Use FDOT Type B stabilization as described in Florida Department of Transportation Standard Specifications For Road and Bridge Construction, (FDOT Specifications), 2013 edition and as specified herein to obtain the required bearing ratio by the addition and mixing in of suitable stabilizing material.
- C. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 – Site Preparation and Earthwork

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Use either Commercial Materials or Local Materials as defined hereunder, at the Contractor's option.

- B. Commercial Materials: Limerock, overburden or crushed shell meeting the following requirements:
1. Limerock and Limerock Overburden: Material with at least 70 percent of carbonates of calcium and magnesium, plasticity index not exceeding 10 and 97 percent of passing a 1 1/2-inch sieve.
 2. Crushed Shell: Mollusk shell (i.e., oysters, mussels, clams, cemented coquina, etc.) meeting the following requirements.
 - a. At least 97 percent by weight of the total material passing a 1-inch screen and at least 50 percent by weight of the total material retained on the No. 4 sieve.
 - b. Not more than 7.5 percent by weight of the total material passing the No. 200 sieve as determined by washing the material over the sieve.
 - c. In the event that the shell meets the above requirements without crushing, crushing will not be required. The use of steamed shell will not be permitted.
- C. Local Material: High-bearing-value soils or sand-clay material with the portion passing the 40-mesh sieve having a liquid limit not greater than 30 and a plasticity index not greater than 10. Blending of materials to meet these requirements will not be permitted unless authorized by Owner. When permitted, test and obtain approval for the blended material before using.
- D. Stabilization:
1. Determine bearing value by the Limerock Bearing Ratio (LBR) Method.
 2. After grading operations are substantially complete, determine the quantity (if any) of selected stabilizing material to be added for compliance with the bearing value requirements.
 3. Ensure that the finished subgrade meets the bearing value requirements, regardless of the quantity of stabilizing materials necessary to be added.

PART 3 - EXECUTION

3.01 PREPARATION

A. General:

1. Prior to the beginning of stabilizing operations, complete the subgrade to the

lines, grades and cross section shown on Drawings.

2. Stabilize the subgrade in one course, unless the equipment and methods being used do not provide the required uniformity, particle size limitation, compaction and other desired results, in which case, perform the processing in more than one course as approved by Owner.

3.02 APPLICATION

- A. Stabilizing Material: Spread the stabilizing material uniformly over the area to be stabilized by means of mechanical material spreaders, except that where use of such equipment is not practicable other means of spreading may be used, but only upon written approval of Owner.
- B. Mixing: By means of rotary tillers, or other equipment meeting the approval of Owner, thoroughly mix the subgrade throughout the entire depth and width of the area to be stabilized.
- C. Maximum Particle size of Mixed Materials: At the completion of mixing, check that all particles of material within the limits of the area to be stabilized pass a 3 1/2-inch ring. Remove from the stabilized area any particles not meeting this requirement or break them down so as to meet this requirement.
- D. Compaction: After the mixing operations have been completed and requirements for bearing value, uniformity and particle size have been satisfied, compact the stabilized area to a density of not less than 98% of maximum density as determined by AASHTO T 180. Compact the materials at a moisture content permitting the specified compaction. If the moisture content of the material is improper for attaining the specified density, either add water or allow drying until the proper moisture content for the specified compaction is reached.
- E. Finish Grading: Grade and shape the completed stabilized subgrade to conform with the finished lines, grades and cross-section indicated in the Drawings.
- F. Quality Assurance:
 1. After the stabilizing and compaction operations have been completed, check that the subgrade is firm and substantially unyielding, to the extent that it will support construction equipment and will have the bearing value required.
 2. Remove and replace with suitable material all soft and yielding material, and any other portions of the sub-grade which will not compact readily, and bring the whole subgrade to line and grade, with proper allowance for subsequent compaction.
- G. Maintenance Of Completed Subgrade: upon completion, maintain the subgrade free

from ruts, depressions and any damage resulting from the hauling or handling of materials, equipment, tools, etc. Maintain the required density until the subsequent base or pavement is in place. Make any repairs, replacement of curb and gutter, sidewalk, etc., which might become necessary in order to re-compact the subgrade in the event of under-wash or other damage. Construct and maintain ditches and drains as necessary to protect the completed subgrade from damage by storm water.

3.03 FIELD QUALITY CONTROL

A. Bearing Value Requirements:

1. General: Bearing value samples will be obtained and tested by Owner at completion of satisfactory mixing of the stabilized area. For any area where the bearing value obtained is deficient from the value indicated in the Drawings, in excess of the tolerances established herein, spread and mix in additional stabilizing material as specified above for the full width of the roadway being stabilized and longitudinally for a distance of 50-feet beyond the limits of the area in which the bearing value is deficient. Pay for all retesting required until subgrade meets the specified requirements.
2. Tolerances In Bearing Value Requirements: A under tolerance of 5.0 from the specified bearing value of LBR 40 will be allowed as based on tests performed on samples obtained after mixing operations have been completed.

END OF SECTION

SECTION 02480
SODDING, SEEDING, AND MULCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation for the sodding of newly graded areas, seeding and mulching of new swales, pond areas and, reconditioning of existing grass areas, damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition sodded areas, landscaping areas and grass areas where settlement or washouts occur or where minor regrading is required.
- B. Related Sections: The following sections contain requirements that related to this section/
 - 1.. Section 02210 – Site Preparation and Earthwork
 - 2. Section 02220 -: Excavating, Backfilling, and Compacting

1.03 SUBMITTALS

- A. General: Submit each item of materials according to the general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
- C. Certification of each seed mixture for sod, identifying sod source, including name and telephone number of supplier.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications: Engage an experienced Contractor who has completed landscaping work similar in material, design, and extent to that indicated on Drawings for this Project and with a record of successful landscape establishment.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Sod: Harvest, deliver, store, and handle sod according to the requirements of the American Sod Producers Association's (ASPA) "Specifications for Turfgrass Sod Materials and Transplanting/Installing."
- B. Mulch: Mulch shall be shredded cypress grade "B" or equal. Mulch shall be clean, fresh and free of foreign materials.
- C. Fertilizer: Custom Blend Fertilizer formulation shall be as listed below: The blend shall be uniform in mix, dry and free flowing. This fertilizer blend has one third of its nitrogen in a readily available form and two thirds in a controlled release form. Salt index is low.

Formulation 8-1-8	
3% ammonium sulfate	
2% sulfur coated urea	
3% milorganite	
Fe as organically bound iron	2.1% from the milorganite
Mn as manganese <u>sulfate</u>	1.0%
Magnesium from sulphomag	1.5%
Zinc from zinc sulfate	0.06%
Copper from copper sulfate	0.01%
Boron from sodium borate	0.006%

The potassium is derived from sulphomag and potassium sulfate. The Phosphorus is derived from milorganite and TSP. This product is 94% fertilizer with only 145 lbs of filler per ton and is available through Harrell's Fertilizer Company, phone (800) 282-8007.

1.06 LAWN MAINTENANCE

- A. Begin maintain of lawns immediately after each area is planted and continue until acceptable lawn is establish, but for not less than the following periods:

1. Sodded Lawns: 30 days after date of Substantial Completion.
- B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth lawn.
- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm).
 1. Water lawn at the minimum rate of 1 inch (25 mm) per week.

PART 2 - PRODUCTS

2.01 GRASS MATERIALS

- A. Sod: Certified turfgrass sod complying with ASPA specifications for machine-cut thickness, size, strength, moisture content, and mowed height, and free of weeds and undesirable native grasses. Provide viable sod of uniform density, color, and texture of the following turfgrass species, strongly rooted, and capable of vigorous growth and development when planted.

2.02. FERTILIZER

- A. Fertilizer shall be delivered to the site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance of State laws. In lieu of containers, fertilizer may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 SOIL PREPARATION

- A. Limit subgrade preparation to areas that will be planted in the immediate future.
- B. Loosen subgrade to a minimum depth of 4 inches (100 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials.
- C. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
 - 1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
 - 2. Allow for sod thickness in areas to be sodded.
- D. Grade sodding areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches (38 mm) in any dimension, and other objects that may interfere with planting or maintenance operations.
 - 1. Moisten prepared sodding areas before laying sod when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
 - 2. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.03 APPLYING NEW SOD

- A. Lay sod within 24 hours of stripping. Do not lay seed if dormant or if ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
- C. Saturate sod with fine spray within 2 hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below the sod.

3.04 SEEDING

- A. Seeds shall be broadcasted evenly with a commercial spreader.
- B. As soon as the seeding process is complete, areas shall be irrigated by uniform application of one-half inch (1/2") of water. No more than sixty minutes should elapse from the time seed is placed until it has been irrigated.

3.05 CLEANUP AND PROTECTION

- A. During sodding, seeding and mulching operations, keep work areas in an orderly condition.
- B. Maintenance Period: The Contractor shall commence after each area is landscaped and the maintenance period shall continue after the Punch List items from the Substantial Completion inspection have been completed to the satisfaction of the Owner. The Contractor is responsible for mowing lawns during the maintenance period if needed.
- A. Protection Against Damage: The Contractor shall provide protection against mechanical damage and protection from vehicles, including posting of approved warning signs and barricades as might be necessary. He shall repair, restore or replace any planting areas that might become damaged as a result of any negligence by him in complying with these requirements.

3.06 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil unsuitable soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 02500
ASPHALT CONCRETE PAVING AND RESURFACING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation for the installation of asphalt concrete paving to the extent as shown on Drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02232 – Limerock Base
 - 2. Section 02234 – Soil Cement Base .

1.03 SUBMITTALS:

- A. Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with Florida Department of Transportation Standard Specifications for Road and Bridge Construction, 2013 edition, and with local governing regulations if more stringent than herein specified.

1.05 SITE CONDITIONS

- A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg. F (10 deg. C), and when temperature has not been below 35 deg. F (1 deg. C) for 12 hours immediately prior to application. Do not apply when base is wet or

contains an excess of moisture.

- B. Construct asphalt concrete surface course when atmospheric temperature is above 40 deg. F (4 deg. C), and when base is dry. Base course may be placed when air temperature is above 30 deg. F (-1 deg. C) and rising.
- C. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Use locally available materials and gradations which exhibit a satisfactory record of previous installations.
- B. Base Course Aggregate: Limerock or cemented coquina shell meeting Florida Department of Transportation Specification Sections 911 or 915, respectively. See Soils Report.
- C. Surface Course Aggregate: Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand.
- D. Sand prepared from stone, blast-furnace slag, or gravel, or combinations thereof may be used if required to suit local material availability.
- E. Asphalt Concrete: Shall comply with Florida Department of Transportation Specifications, Section 331, Type S-1 for parking areas. See Soils Report.
- F. Prime Coat: Shall comply with Florida Department of Transportation Standard Specifications, Section 300.
- G. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form.
- H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Allied Chemical Corp.
Achem Products, Inc.
Ciba-Geigy Corp.
Dow Chemical U.S.A.

E.I. DuPont De Nemours & Co., Inc.
FMC Corp.
Thompson-Hayward Chemical Co.
U.S. Borax and Chemical Corp.

- I. Lane Marking Paint: Chlorinated rubber-alkyd type, AASHTO M 248 (FS TT-P-115), Type III.
- J. Wheel Stops: Precast of 3,500 psi air-entrained concrete, approximately 6" high, 9" wide, and 7'0" long, with chamfered corners and drainage slots on underside.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

- A. Remove loose material from compacted subbase surface immediately before applying herbicide treatment or prime coat.
- B. Proof roll prepared subbase surface to check for unstable areas and areas requiring additional compaction.
- C. Notify Owner of unsatisfactory conditions. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
- D. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subbase prior to application of prime coat.
- E. Prime Coat: Apply at rate of 0.20 to 0.50 gal. per sq. yd., over compacted subgrade. Apply material to penetrate and seal, but not flood surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.
- F. Tack Coat: Apply to contact surfaces of previous constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface. Allow to dry until at proper condition to receive paving.
- G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

3.02 PLACING MIX

Holden Heights Community Center 02500-3
19th Street Improvements
CTHA Project No. 1204.00

ASPHALT CONCRETE PAVING
AND RESURFACING

- A. General: Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 deg. F (107 deg. C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.
- B. Paver Placing: Place in strips not less than 10' wide, unless otherwise acceptable to Owner. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- C. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining works. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

3.03 ROLLING

- A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling or joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.04 TRAFFIC AND LANES MARKINGS

- A. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- B. Striping: Use chlorinated-rubber base traffic lane-marking paint, factory-mixed, quick-drying, and non-bleeding. Apply paint with mechanical equipment to produce uniform straight edges. Apply in 2 coats at manufacturer's recommend rates.
- C. Color: Yellow.
- D. Do not apply traffic and lane marking paint until layout and placement has been verified with Owner.

3.05 WHEEL STOPS

- A. Secure wheel stops to asphalt concrete surface with not less than two 3/4" diameter galvanized steel dowels embedded in precast concrete at 1/3 points. Size length of dowel to penetrate at least 6" into asphalt concrete. Drill placement holes oversize and embed dowels in hot bituminous grout material.

3.06 FIELD QUALITY CONTROL

- A. General: Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Owner.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
 - 1. Surface Course: 1/4", plus or minus.
- C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness, using 10' straightedge applied parallel with, and at right angles to centerline of pave area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.
 - 1. Wearing Course Surface: 1/8".
 - 2. Check surface areas at intervals as directed by Owner.

END OF SECTION

SECTION 02700
CONCRETE GUTTER, CURB ELEMENTS,
AND TRAFFIC SEPARATOR

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section included furnishing all labor, material, equipment, transportation and performing all work necessary to construct Portland cement concrete curb and gutter, concrete traffic separator, valley gutter, special concrete gutter, and any other types of concrete curb as specified in and as shown on Drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 – Site Preparation and Earthwork
 - 2. Section 03100 - Concrete Formwork
 - 3. Section 03200 - Concrete Reinforcement
 - 4. Section 03250 - Concrete Accessories
 - 5. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

- A. Submit, in accordance with general conditions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, certificates by the producers or manufacturers that the furnished materials meet the specific requirements of the Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete: Use concrete meeting the requirements of FDOT Design Standards Section 347. .
- B. Reinforcement: For all steel reinforcement required by the plans, meet the requirements of FDOT Design Standards Section 415..
- C. Joint Materials: Meet FDOT Design Standards Section 932.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Excavate to the required depth, and compact the foundation material upon which concrete gutter, curb elements and traffic separator are to be placed as shown on Drawings.

3.02 FORMS

- A. Form Materials: Construct forms for this work of either wood or metal. Provide forms that are straight, free from warp or bends, and of sufficient strength, when staked, to resist the pressure of the concrete without deviation from line and grade. For all items constructed on a radius, use flexible forms.:
- B. Depth of Forms: Ensure that forms have a depth equal to the plan dimensions for the depth of concrete being deposited against them.
- C. Machine Placement: The Contractor may place forms by machine methods with the approval of Owner provided that the Contractor consistently produces an acceptable finished product, true to line, grade, and cross section.

3.03 PLACING CONCRETE

- A. Place the concrete in the forms, and tamp and spade it to prevent honeycombing, and until the top of the structure can be floated smooth and the edges rounded to the radius as shown on Drawings.

3.04 JOINTS

A. Contraction Joints:

1. Except for machine placed, the Contractor may form joints by using dummy joints (either formed or Sawed) or by using sheet metal templates.
2. If using sheet metal templates, ensure that they are of the dimensions, and are set to the lines, as shown on Drawings. Hold templates firmly while placing the concrete. Leave templates in place until the concrete has set sufficiently to hold its shape, but remove them while the forms are still in place.
3. Saw contraction joints, for machine placed items, unless Owner approves an alternate method. Saw the joints as soon as the concrete has hardened to the degree that excessive raveling will not occur and before uncontrolled shrinkage cracking begins.
4. Space contraction joints at interval of 10 feet except where closure requires a lesser interval, but do not allow any section to be less than 4 feet in length.

- #### B. Expansion Joints:
- Construct expansion joints at all inlets, at all radius points, and at other locations as shown on Drawings. Locate them at intervals of 500 feet between other expansion joints or ends of a rune. Ensure that the joint is ½ inch in width.

3.05 FINISHING

- #### A. Repair of Minor Defects:
- Remove the forms within 24 hours after placing the concrete, and then fill minor defects with mortar composed of one part portland cement and two parts fine aggregate. Plastering on the face of the curb is not allowed. Remove and replace any rejected curb, curb and gutter, or valley gutter without additional compensations.
- #### B. Final Finish:
- Finish all exposed surfaces while the concrete is still green. In general, Owner will only require a brush finish. For any surface areas, however, which are too rough or where other surface defects make additional finishing necessary, Owner may require the Contractor to rub the curb to a smooth surface with a soft brisk or wood block, using water liberally. Also, if necessary to provide a suitable surface, Owner may require the Contractor to rub further, using thin grout or mortar.

3.06 CURING

- A. General: Continuously cure the concrete for a period of at least 72 hours. Commence curing after completely finishing and as soon as the concrete has hardened sufficiently to permit application of the curing material without marring the surface. Immediately replaced any curing material removed or damaged during the 72 hour period. After removing the forms, cure the surfaces exposed by placing a berm of moist earth against them or by any of the methods described, for the remainder of the 72 hour curing period.
- B. Wet Burlap Method: Place burlap over the entire exposed surface of the concrete, with sufficient extension beyond each side to ensure complete coverage. Overlap adjacent strips a minimum of 6 inches. Hold the burlap securely in place such that it will be in continuous contact with the concrete at all times, and do not allow any earth between the burlap surfaces at laps or between the burlap and the concrete. Saturate the burlap with water before placing it, and keep it thoroughly wet throughout the curing period.
- C. Polyethylene Sheeting Method: Place polyethylene sheeting over the entire exposed surface of the concrete, with sufficient extension beyond each side to ensure complete coverage. Overlap adjacent strips a minimum, of 6 inches. Hold sheeting securely in place and in continuous contact with the concrete at all times.

3.07 BACKFILLING AND COMPACTION

- A. After the concrete has set sufficiently, but not later than three days after pouring, refill the spaces in front and back of the curb to the required elevation with suitable material. Place and thoroughly compact the material in layers not thicker than 6 inches.

3.08 SURFACE REQUIREMENTS

- A. Test the gutter section of curb and gutter with a 10 foot straightedge laid parallel to the centerline of the roadway and while the concrete is still plastic. Perform straightedging along the edge of the gutter adjacent to the pavement or along other lines on the gutter cross-section, as directed by Owner. Immediately correct irregularities in excess of ¼ inch.

END OF SECTION

SECTION 02710
CONCRETE SIDEWALK

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section included furnishing all labor, material, equipment, transportation and performing all work necessary for the construction of the sidewalks to the lines and grades as shown on Drawings.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210 – Site Preparation and Earthwork
 - 2. Section 03100 - Concrete Formwork
 - 3. Section 03200 - Concrete Reinforcement
 - 4. Section 03250 - Concrete Accessories
 - 5. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

- A. Submit, in accordance with general conditions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, certificates by the producers or manufacturers that the furnished materials meet the specific requirements of the Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

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19th Street Improvements
CTHA Project 1204.00

CONCRETE SIDEWALK

- A. Concrete: Class B (3000 psi) conforming to the requirements of Section 03300.
- B. Welded Wire Fabric: As specified in Section 03200.
- C. Preformed Joint Filler: Non-extruding and resilient bituminous type conforming to the requirements of ASTM D 1751.
- D. Membrane Curing Compound: Clear fugitive dye conforming to the requirements of AASHTO M 148. Type I-D, Class A.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Subgrade Condition:
- B. Maintain the finished subgrade in a smooth, compact condition and restore any areas which are disturbed prior to placing of the concrete. Uniformly apply water ahead of the pouring operations as directed by the Engineer to keep the subgrade moist at the time the concrete is placed. Remove large boulders and other obstructions to a minimum depth of 6 inches below the finished subgrade elevation, and backfill the space with sand, base course material or other suitable material thoroughly compacted by rolling or tamping.
- C. Trim the subgrade accurately to the required elevation with a 1/4- inch tolerance. Trim high areas to proper elevation. Fill low areas with suitable material and compact to the specified density, or fill with concrete integrally with the placing of the pavement.
- D. Setting Forms: Set the forms accurately to line and grade and so that they rest firmly throughout their length, upon the compacted subgrade surface. Join forms neatly and tightly and brace them to resist the pressure of the concrete and the finished operations. Obtain the Engineer's approval for the alignment and grade of all forms before and immediately prior to the placing of concrete.
- E. Slipforming: The slipforming method will be allowed, provided that an acceptable finished product, true to line, grade, and cross section is consistently produced.
- F. Mixing Concrete: Mix in accordance with the requirements of Section 03300.

3.02 INSTALLATION

A. Placing Concrete:

1. Distribute the concrete on the subgrade to such depth that when it is consolidated and finished, the thickness required by the Civil Engineering Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface. Deposit the concrete on the subgrade in a manner which will require as little rehandling as possible and is continuous between transverse joints, without the use of intermediate bulkheads.
2. Final Finish: As soon as the water sheen has disappeared and just before the concrete becomes non-plastic, finish all edges, including expansion joint edges, with an edging tool having a radius of ½-inch. Finally give the top a light broom finish perpendicular to the forms.

B. Joints:

1. Transverse Construction Joints: Construct at the end of all pours and at other locations where the pouring operation is stopped for as long as 30 minutes, but not within five feet of any other transverse joint or of either end of a section of walk. If sufficient concrete has not been placed to form a slab at least five feet long, remove the excess concrete, back to the last preceding joint. Form the joints by placing a wood or metal bulkhead accurately and securely in place, in a plane perpendicular to the profile and center line of the walk. Tool edges of construction joints with a ½ -inch radius.
2. Transverse Construction Joints: Form at five foot intervals as planes of weakness created by an edging tool. Cut the fresh concrete perpendicular to the surface of the walk, to a depth of 1-1/2 inches below the top surface and tool edges to ½ -inch radius.
3. Transverse Expansion Joints: Form by placing preformed joint filler, one-half inch thick around all structures and at intervals not exceeding 100 feet.

C. Curing:

1. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, cover the entire surface and the edges of the newly placed concrete and cure with membrane curing compound.
2. Apply curing compound uniformly to the surfaces to be cured, in a continuous film, at the rate of application and in the manner recommended by the manufacturer.

3. Do not apply the curing compound during periods of rainfall. Should the film become damaged from any cause within the required curing period, immediately repair the damaged portions with additional compound. Upon removal of side forms immediately coat the sides of the slabs exposed, providing a curing treatment equal to that provided for the surface.
- D. Form Removal: After the concrete has sufficiently set a minimum of 12 hours, remove the forms and backfill the space on each side. Compact and grade the earth in a satisfactory manner without damage to the concrete work. Fill honeycombs with sand cement mortar. Plastering will not be allowed on the face of the walk. Remove rejected walk and replace without additional compensation.

END OF SECTION

SECTION 02720
STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMAMRY

- A. This Section included furnishing all labor, material, equipment, transportation and performing all work necessary for the construction of the storm drainage system consisting of roadside ditches, drainage swales and other drainage structures as shown on Drawings and specified herein.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02210- Site Preparation and Earthwork
 - 2. Section 02220 – Excavation, Backfilling and Compacting
 - 3. Section 02480 – Sodding, Seeding and Mulching

1.03 REFERENCES

- A. FDOT Standard Specifications for Road and Bridge Construction, 2013 edition.

1.04 JOB CONDITIONS

- A. Existing Drainage System: Maintain operational, prevent siltation and flooding.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Contractor to assume responsibility for determining the suitability of excavated material for use on the project in accordance with the applicable Contract Documents.

PART 3 - EXECUTION

3.01 DITCHES AND SWALES

- A. Excavation consists of all excavation of ditches, channels and swales parallel to the roadway right-of-way as shown on Drawings.
- B. Dress ditches, channels and swales to conform to the lines, grades, and cross-sections as shown on Drawings.
- C. Carefully dress areas adjacent to pavement areas to avoid damage to such pavement. Shape the earthwork to match adjacent pavement, curb, sidewalk, structures, etc. Shape bottom of ditches, channels, swales so that they impound no water.
- D. Complete grassing of ditches, channels and swales.

END OF SECTION

Division 3 Concrete

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplemental Conditions and Division 1 Specifications Section, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transportation to provide formwork for cast-in-place concrete.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 03200 -: Concrete Reinforcement
 - 2. Section 03300: - Cast-in-Place Concrete
 - 3. Section 03600: - Grout

1.03 SUBMITTALS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division Specifications Sections apply to this Section.

1.04 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:
 - 1. Standard Building Code.
 - 2. ACI 347 Recommended Practice for Concrete Formwork.
 - 3. Responsibility: The Contractor shall be responsible for the design of the formwork and for safety in its construction, use and removal.
 - 4. Tolerances: Formwork shall be constructed to insure that finished concrete surfaces will be in accordance with the tolerances listed in ACI 347. Camber

shall be provided as necessary to compensate for anticipated deflection in formwork and concrete due to weight and pressure of fresh concrete and other construction loads.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Forms:

1. Forms shall be of wood, steel or other approved materials, and as specified in this Section. The sheeting for all exposed surfaces shall be 5-ply plywood, unless otherwise specifically authorized. Forms of like character shall be used for similarly exposed surfaces in order to produce a uniform appearance. Forming for exposed exterior concrete from 1-foot below finished exterior grade to top of structure shall be carefully fabricated so as to provide a smooth finish without defects.
2. The type, size, shape, quality and strength of all materials of which the forms are made shall be subject to the approval of Owner. If it is his opinion that the interior surfaces of the forms are too irregular to produce the specified finish, they shall be lined with smooth dense, moisture resistant hardboard or other material of which he approves.

B. Plywood: Unless otherwise indicated, forms shall be PLYFORM, Class 1, BB-Exterior type, mill oiled and edge sealed. Thickness shall be as required to support concrete at the rate place, but not less than 3/4-inch.

C. Form Accessories: Form accessories shall be of a commercially manufactured type.

1. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete.
2. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 1 1/2-inches from the formed face of the concrete. Use embedded rods with integral waterstops and cones.
3. Wire ties and wood spreader will not be permitted.

D. Chamfer Strips: Chamfer strips shall be polyvinyl strips or other approved material designed to be nailed in the forms to provide a 3/4-inch chamfer at exposed edges of concrete members.

E. Form Release Agent: form release agent shall be a paraffin base oil or mineral oil coating that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain the concrete surfaces, and will leave the concrete with a

paintable surface.

PART 3 - EXECUTION

3.01 INSTALLATION/ERECTION

A. Forms

1. Construction:

- a. Forms shall be built true to line and grade, and shall be mortartight and sufficiently rigid to prevent displacement or sagging between supports. Particular attention shall be given to adequacy of supports and shoring, which is the Contractor's responsibility. The surfaces of forms used for permanently exposed surfaces shall be smooth and free from irregularities, dents, sags or holes. Forms for surfaces to receive stucco finish shall be suitable for its application.
- b. All forms shall be so constructed that they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges at expansion joints or at any other corners that are to remain. Beams below grade shall have forms at both sides.
- c. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal is at least 1-1/2 inch from any concrete surface. Form ties shall be removed immediately after removal of forms, and holes shall be thoroughly plugged with grout within 24 hours after form removal and kept damp for 4 days to prevent shrinking.
- d. Wire ties will not be permitted.

2. Form facing Materials: The facing material shall produce a hard form texture on the concrete. Facing materials with raised grain, torn surfaces, worn edges, patches, dents or other defects shall not be used. The maximum deflection of facing materials as reflected in concrete surfaces shall not exceed 1/240 of the span between structural members.

3. Preparation of Form Surfaces: After each use and prior to placing reinforcing, forms shall be cleaned of mortar, grout and other foreign material and the form release agent shall be applied. Form releasing agent shall not be allowed to stand in puddles in the forms or allowed to come in contact with hardened concrete against which fresh concrete is to be placed.

4. Coating: Prior to the placing of steel reinforcement or concrete, forms for

exposed surfaces shall be coated with a non-staining paraffin base oil or mineral oil. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling, immediately before the placing of concrete.

- B. Adjustment: Positive means of adjustment of shores and struts shall be provided and all settlement shall be taken up during concrete placing.
- C. Temporary Openings: Temporary openings shall be provided in wall forms to limit the free fall of concrete to a maximum of 4 feet unless an elephant trunk is used. such openings shall be located to facilitate placing and consolidation and shall be spaced no more than 8 feet apart. Temporary openings shall also be provided in the bottom of wall and column forms and elsewhere as necessary to facilitate cleaning and observation immediately prior to placing.
- D. Construction Joints: At construction joints, the contact surfaces of the form sheathing shall overlap the hardened concrete by not less than 1 inch. Forms shall be held against the hardened concrete to prevent offsets or loss of mortar.
- E. Chamfers: All exposed concrete edges shall be chamfered 3/4-inch by 3/4-inch, unless otherwise indicated on the Drawings.
- F. Runways: Smooth and rigid runways shall be provided (if needed) for moving equipment and concrete. Runways shall be supported directly on formwork or on grade and in no case on reinforcing steel or bar supports.
- G. Footings, Grade Seams and Slab Edges: Exterior faces of footings, grade beams, walls and slab edges shall be formed with plywood.
- H. Embedded Item: Set anchor bolts and other embedded items accurately and hold securely in position in the forms until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check all nailing, blocks, plugs and strips necessary for the attachment of trim, finish and similar work prior to concreting.
- I. Pipes and Wall Spools Cast in Concrete:
 - 1. Install wall spools, wall flanges and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools to the reinforcing steel.
 - 2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will be possible during construction.
- J. Form Removal: Formwork shall not be removed from any concrete until it has obtained a minimum of 3,000 psi compressive strength to support itself and any live loads it may be subjected to, and then only with the approval of Owner.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing and transport of reinforcing steel and welded wire mesh for cast-in-place or precast concrete structures.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02710 – Sidewalks
 - 2. Section 02720 – Storm Drainage System

1.03 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall meet all requirements of the latest editions of the following standards:
 - 1. Southern Standard Building Code.
 - 2. ACI 318 Building Code Requirements for Reinforced Concrete.
 - 3. ACI 315 Details and Detailing of Concrete Reinforcement.
 - 4. CRSI Manual of Standard Practice, MSP-2.
 - 5. FDOT Standard Specifications for Road and Bridge Construction, 2013 ed.

1.04 SUBMITTALS

- A. Submit complete shop drawings including bar lists and placing drawings to Owner for review in accordance with general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification. Drawings shall show the type,

spacing and location of metal bar supports, the grade of the reinforcing and the name of the manufacturer. The type of coupler splice devices shall be designated.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel:

1. Reinforcing steel shall conform to the requirements of ASTM Designation A 615, Deformed Grade 60, except where otherwise indicated.
 - a. The name of the manufacturer of the reinforcing steel shall be called out in the shop drawings together with a sketch showing the pattern of the deformation, including the mill mark.
 - b. Bar reinforcement shall be accurately fabricated in accordance with the latest CRSI Manual of Standard Practice. The Contractor shall have prepared and shall submit to Owner six (6) copies of necessary shop drawings and bar lists. The Contractor shall be responsible for errors made in shop drawings even though approved by Owner.

B. Welded wire fabric for concrete reinforcement shall conform to the requirements of ASTM Designation A 185 and shall be formed with smooth cold-drawn wire.

C. Supports:

1. Metal Bar Supports:

- a. Bar supports for reinforcing steel shall conform to the requirements of CRSI Manual of Standard Practice, Chapter 3 and shall be of a height to furnish the concrete cover called for on Drawings. High chairs shall be furnished for bent or top bars in solid slabs. Bar supports to be in contact with exterior surfaces of concrete shall be Class C with plastic caps at least 1-inch in length on the leg tips, or Class E with stainless steel legs. Bar supports shall be spaced not more than 100 times the diameter of the bars to be supported, with not more than 1/4 spacing from the end of the supported bars to the first chair.
- b. Bar supports for slabs on grade shall be plain concrete blocks, 3-inches high by 4-inches square with the tie wires embedded in support. Concrete strength shall be at 3,000 psi at time of use.

2. Cold-drawn wire for spirals shall be plain and shall conform to the requirements

of ASTM Designation A 82 with a minimum yield strength of 70,000 psi.

2.02 FABRICATION

- A. Fabrication shall not begin until the approval of the shop drawings by Owner has been received. Fabrication shall meet all requirements of the specified standards. Unless otherwise indicated the following shall apply:
1. Hooks shall be standard hooks.
 2. Bottom bars shall extend a minimum of 6 inches into supporting members.
 3. Cover is to the outermost stirrup, tie or bar.
 4. Splices are permitted only where indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Reinforcing Steel: When placed in the forms, reinforcement shall be clean and free of all rust, scale, dust, dirt, paint, oil or other foreign material and shall be accurately and securely positioned in the forms as shown on the Drawings before the placing of concrete. Reinforcing steel shall be wired or otherwise fastened together at intersections and shall be supported by concrete or metal supports, spacers or hangers. Bar supports, where adjacent to the ground, shall be set on precast concrete pads compressed into the subgrade. The Contractor shall obtain Owner's approval before fastening reinforcing steel at intersections by welding methods.
1. Splicing of reinforcement shall be held to a minimum and shall be placed at points of minimum stress. Bars shall be lapped at splices a minimum of 24 bar diameters unless otherwise shown on the Drawings or directed by Owner, and shall be rigidly wired or clamped.
 2. Wire fabric shall be straitened before placing and shall overlap one full space of mesh at ends and edges and shall be securely fastened. Fabric shall be supported so as to occupy its proper location in the concrete as shown on the Drawings. Fabric shall not cross any expansion joints.
- B. Embedded Items: In addition to steel reinforcement, pipes, inserts and other metal objects as shown, specified or ordered shall be built into, set in or attached to the concrete. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before concrete is placed, care shall be taken

to determine that all embedded parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. No wood shall be embedded in concrete. The concrete shall be packed tightly around pipes and other metal work to prevent leakage and to secure perfect adhesion. Drains shall be adequately protect from intrusion of concrete.

- C. Supporting Reinforcing: Bar supports shall be provided as required by CRSI MSP-2 and ACI-315. Top and bottom bars in slabs formed on earth shall be supported on precast concrete block supports except where such bars are properly supported from formwork. Precast concrete block supports are not required in slabs formed on tremie concrete but may be used at the Contractor's option.
- D. Placing Reinforcing: Placing of reinforcing and welded wire fabric shall be as indicated on the Drawings and as recommended by CRSI MSP-2 and ACI 315. Reinforcing shall be securely tied and supported to prevent displacement during concrete placement.
- E. Welded Wire Fabric: Splices in welded wire fabric shall be such that the overlap between the outermost cross wires of each fabric sheet is not less than the spacing of the cross wires, plus 2 inches. Fabric shall not be extended through expansion joints or construction joints in slabs on grade, except as otherwise noted.
- F. Dowels: Dowels shall be wired in position prior to placing concrete.
- G. Field Bending: Heat shall not be used to bend bars. Bars shall not be bent after being embedded in concrete.
- H. Welding: Welding of reinforcing will not be permitted.
- I. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This section includes furnishing labor, materials, equipment and transport for the installation all the plain and reinforced concrete paving, concrete sitework and concrete structures as shown on the Drawings, or incidental to the proper execution of the work, or as herein specified.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02700 – Concrete Gutter, Curb Elements, and Traffic Separator
 - 2. Section 02710 – Sidewalk
 - 3. Section 03100: Concrete Formwork
 - 4. Section 03200: Concrete Reinforcement
 - 5. Section 03600 - Grout

1.03 SUBMITTALS

- A. Submit to Owner in accordance general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specifications the following items:
 - 1. Concrete design mix for Class A and Class B concrete
 - 2. Reinforcing details with bar list
 - 3. Product data on cement and all concrete additives
 - 4. Certification for reinforcing steel
 - 5. Lab reports on aggregate

6. Product data on curing compounds

PART 2 - PRODUCTS

2.01 GENERAL

- A. Composition: Concrete shall be composed of cement, fine aggregate, coarse aggregate, and water, so proportioned and mixed as to produce a plastic workable mixture in accordance with all requirements under this section suitable to the specific conditions of placement.

2.02 MATERIALS

A. Cement:

1. Cement: Cement for all concrete shall be domestic Portland cement that conforms to the requirements of ASTM Designation C 150, Type I, Type II or Type III. Type III cement for high early strength concrete shall be used only for special locations and only with the approval of the Owner. Type II cement shall be used in the construction of sanitary sewer manholes, wet wells and communitor pits.
2. Only one brand of cement shall be used in any individual structure unless approved by the Owner. Cement which has become damaged, partially set, lumpy or caked shall not be used and the entire contents of the sack or container which contains such cement will be rejected. No salvaged or reclaimed cement shall be used.
3. Fine Aggregate: Fine aggregate shall conform to the requirements of Section 902 of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", 1991 edition and supplements thereto.
4. Coarse Aggregate: Coarse aggregate shall conform to the requirements of Section 901 of the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction", 1991 edition and supplements thereto, except that slags shall not be used and the gradation shall be size 5 or size 9 as approved by the Owner.
5. Water: Water shall be taken from a portable water supply and shall be fresh, clean and free from injurious amounts of oil, acid, alkali or organic matter.

- E. Admixtures: No admixtures shall be used except by specific approval of the Owner.

- F. Membrane Curing Compound: Membrane curing compound shall conform to the requirement of AASHTO Designation M 148, Type 1-clear or Type 2-white pigmented.
- G. Expansion Joint Filler: Expansion Joint Filler shall conform to the requirements of Section 03250.
- H. Separation Board: Separation board shall be closed cell, non-extruding, PVC foam Grade #327 with a 20 psi maximum compressive strength to compress to 75 percent of thickness.
- I. Membrane: Membrane shall be a 6 mil polyethylene film.
- J. Non-shrink Grout: See Section 3600 – Grout

2.03 CLASSIFICATION AND STRENGTH OF CONCRETE

- A. Class and minimum strength requirements for concrete shall be as tabulated below. Unless otherwise specified, Class B concrete shall be used.
- B. Strength Requirements: Concrete class and strength shall meet the minimum compressive strength requirements at the age of 7 and 28 days as shown in the following table. The compressive strengths shall be as determined by standard laboratory cylinder tests in accordance with the procedure set forth in ASTM Designation C 31 and C 39.

Compressive Strength in Pounds Per Square Inch

Class	For Design Purposes	3 Consecutive Cylinder Average		Low Cylinder	
		7 Days	28 Days	7 Days	28 Days
A	4000	2950	4250	2600	3750
B	3000	2100	3200	1850	2800
C	2500	1800	2700	1550	3000

2.04 PROPERTIES AND DESIGN OF CONCRETE MIX

- A. Tests and Design Mix:
 - 1. The Contractor, 30 days before the beginning of concrete work, shall advise the Owner of the proposed sources of the materials, or ready-mixed concrete, which the Contractor intends to use in the work. A design mix which has been used by the proportions and strengths meet the requirements of this specification and is acceptable to the Owner.
 - 2. The source and manufacturer of material after once have been approved shall

not be changed by the Contractor, except as approved by the Owner's to prove conformance with specification requirements.

3. If during the progress of the work, tests indicate that concrete is not being produced in accordance with these Specifications, the Owner may order changes in the materials or their proportions so as to secure concrete as specified.
- B. Slump: Slumps shall be as low as possible consistent with proper placing. Low slump concrete shall be used for footing and slabs on grade. Medium slump concrete shall be used for walls, columns and suspended slabs. Concrete shall conform to the limits specified in the following schedule:

<u>Class of Concrete</u>	<u>Medium Slump</u>	<u>Low Slump</u>
A	4 to 5 in.	2 to 3 in.
B	4 to 5 in.	2 to 3 in.
C	5 to 6 in.	3 to 4 in.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Concrete Mixing:
1. Equipment: The concrete shall be ready-mixed and the equipment shall conform to the applicable requirements of ASTM Designation C 94.
 2. Measurement: Equipment necessary to positively determine and control the actual amounts of all materials entering the concrete shall be provided by the Contractor or the concrete manufacturer. All materials shall be measured by weight, except that water may be measured by volume. A bag of cement weighs 94 pounds.

3.02 INSTALLATION

- A. Concrete:
1. General: Reinforcement shall be secured in position, inspected and approved before placing concrete. Runways for transporting concrete shall not rest on reinforcing steel. Concrete not placed within 90 minutes from the time mixing is started will be rejected and shall be removed from the job by the Contractor.

Concrete shall be deposited as nearly as practicable in final position. Concrete shall not be allowed to drop freely more than five feet. All concrete shall be placed in daylight and (excepted seal concrete) shall be placed in the dry unless otherwise authorized by the Owner in writing.

2. Slabs Placed on Subgrade:

- a. Slab concrete placed on earth or fill subgrade shall be separated from direct contact with the subgrade by 6 mil polyethylene film or other approved material.
- b. Sidewalks and walkways will not require a separation sheet. Polyethylene film shall be lapped 4-inches on sides and 12-inches on ends.

3. Compaction: Concrete shall be compacted by internal vibrating equipment, supplemented by hand rodding and tamping as required. Vibrators shall in no case be used to move the concrete laterally inside the forms. Internal vibrators shall maintain a speed of at least 5000 impulses per minute when submerged in concrete. (At least one spare vibrator in working condition shall be maintained at the site during concrete placing operations.) Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation. Vibrator shall be moved constantly and placed in each specific spot only once.
4. Bonding: Before depositing new concrete on or against concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned so as to expose the coarse aggregate and be free of laitance, coatings, foreign matter and loose particles. Forms shall be retightened. The cleaned surfaces shall be dampened, but not saturated, and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2-inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained its initial set.
5. Protection: Rainwater shall not be allowed to increase the ratio of mixing water or to damage the surface finish. Concrete shall be protected from disfigurement, damage, vibration, internal fractures and construction overloads.

B. Curing:

1. All concrete, including gunite, shall be water cured by covering with a double thickness of clean burlap, cotton mats, or other approved material kept thoroughly saturated with water. The forms shall be kept wet until removed and upon removal, the curing specified herein shall be started immediately. Concrete shall be cured for a period of 7 days for normal Portland cement or 4 days for high early strength cement. Concrete poured in the dry shall not be submerged until it has attained sufficient strength to adequately sustain the stress involved

nor shall it be subjected to flowing water across its surface until it has cured 4 days. Curing of gunite shall be started as soon as possible without damaging surface and not later than 2 hours after placing.

2. In lieu of wet burlap or cotton mats as specified above, concrete slabs may be covered with wet sand and kept moist for the specified curing period. The initial curing period of not less than 24 hours shall consist of the wet burlap or cotton mat methods, then the wet sand method may be utilized until the end of the curing period.
3. Concrete surfaces which will not be coated, painted, plastered, stuccoed, covered with tile or floor covering or requiring a bonding surface may be cured by means of a membrane curing compound in lieu of the wet cure method. The curing compound shall be applied immediately after a satisfactory surface finish has been completed or forms have been removed. The rate of application of membrane curing compound shall be at least one gallon to every 200 square feet of exposed surface to be cured. The membrane curing compound and impervious covering shall be continuous and without defects and shall retain the required moisture in the concrete. Membrane curing compound that becomes damaged by rain, foot traffic or other conditions within 5 days of application shall be reapplied.

C. Finishes:

1. As soon as forms can safely be removed, all irregular projections shall be chipped off flush with the concrete surfaces. All voids produced by spacers or any honeycombing shall be pointed up with grout and troweled flush with the concrete surface immediately after removal of forms and water cured to prevent shrinkage. Honeycombing shall be cut out to expose a sound concrete surface prior to pointing. The use of mortar pointing or patching shall be confined to the repair of small defects in relatively green concrete. Where in the opinion of Owner substantial repairs are required, the defective concrete shall be cut out to sound concrete and repaired with gunite or the concrete shall be removed and reconstructed as directed.
2. Floor slabs shall be brought to a true and even finish by power or hand floating in a manner that will not bring excess fines to the surface. The consistency of the concrete shall be such that water does not accumulate at the surface. Unless otherwise shown on the Drawings, the surface shall be floated with a wood float and shall be steel troweled to a smooth finish. Troweling shall be the minimum to obtain a smooth, dense surface and shall not be done until the mortar has hardened sufficiently to prevent excess fine material from being worked to the surface. If so directed, the surface shall be brushed lightly with a push broom so as to produce a nonslip surface.
3. Concrete surfaces that are not exposed in the completed work will require no special finishes other than such pointing up and rubbing as is necessary to leave

them smooth and impervious.

4. Other surfaces which will be exposed in the completed work shall be finished by being rubbed smooth with a float and water or a carborundum brick. The final surface shall be smooth and dense, without pits, irregularities, blow hoes or bubbles.

D. Grout:

1. Grout for pointing and patching shall consist of cement and fine aggregate mixed in the proportions used in the concrete and a minimum amount of water to produce a workable grout.

END OF SECTION

SECTION 03600
GROUT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specifications, apply to this section.

1.02 SUMMARY

- A. The work included under this section consists of furnishing all materials, forms, transportation and equipment, and performing all necessary labor to do all the pointing and patching of reinforced concrete paving and concrete sitework as shown on Drawings, or incidental to the proper execution of the work, or as herein specified.
- B. Related Sections: The following sections contain requirements that related to this section.
 - 1. Section 02710 – Sidewalks
 - 2. Section 02720 – Storm Drainage System

1.03 SUBMITTALS

- A. Submit to the Owner in accordance with general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections.
 - 1. Grout design mix for Class A and Class B concrete

PART 2 - PRODUCTS

2.01 GENERAL

- A. Composition: Grout for pointing and patching shall consist of cement and fine aggregate mixed in the proportions used in the concrete and a minimum amount of water to produce a plastic workable grout mixture in accordance with all requirements under this section suitable to the specific conditions of placement.

- B. Non-shrink Grout: Non-shrink grout shall be nonmetallic, pre-mixed type and shall be Sauereisen F-100 Level Fill, Master Builders Masterflow 713, Burke Non-Ferrous, Non-Shrink Grout or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. Grout Mixing:

1. Grout shall be mixed by hand.
2. Measurement: All materials, cement and fine aggregate, shall be measured by weight, except that water may be measured by volume.

3.02 INSTALLATION

- A. The grout shall be as thick as possible on vertical surfaces and at least 1/2-inch thick on horizontal surfaces.
- B. All voids produced by spacers or any honeycombing shall be pointed up with grout and troweled flush with the concrete surface immediately after removal of forms and water cured to prevent shrinkage.
- C. The use of grout pointing or patching shall be confined to the repair of small defects in relatively green concrete.

END OF SECTION

TECHNICAL SPECIFICATIONS
FOR
BID PACKAGE C
HOLDEN HEIGHTS COMMUNITY CENTER
SANITARY SEWER



ORANGE COUNTY UTILITIES
ORANGE COUNTY, FLORIDA

Barnes, Ferland & Associates, Inc.

June 2013

Orange County Utilities
Holden Heights Community Center Sanitary Sewer Project

TECHNICAL SPECIFICATIONS

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SECTION 01001
GENERAL WORK REQUIREMENTS

PART 1 - GENERAL

1.01 NOTICE AND SERVICE

- A. In conformance with the requirements of Notice and Service of the General Conditions, all notices or other papers required to be delivered by the Contractor to the County shall be delivered to the office of the Engineering Division, Orange County Utilities Department, 9150 Curry Ford Road, Orlando, FL 32825.

1.02 WORK TO BE DONE

- A. The Contractor shall furnish all labor, materials, equipment, tools services and incidentals to complete all work required by these specifications and as shown on the Drawings, at a rate of progress which will ensure completion of the Work within the Contract Time stipulated.
- B. All materials, equipment, skills, tools and labor which is reasonably and properly inferable and necessary for the proper completion of the Work in a substantial manner and in compliance with the requirements stated or implied by these Specifications or Drawings shall be furnished and installed by the Contractor without additional compensation, whether specifically indicated in the Contract Documents or not.
- C. The Contractor shall perform the Work complete, in place, and ready for continuous service, and shall include repairs, testing, permits, clean up, replacements, and restoration required as a result of damages caused during this construction.
- D. The Contractor shall comply with all City, County, State, Federal, and other codes, which are applicable to the proposed construction Work.
- E. All newly constructed Work shall be carefully protected from injury in any way. No wheeling, walking, or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the Contractor at his own expense.
- F. Scope of Work: See Section 01010 "Summary of Work" and the Bid Schedule for details.

1.03 DRAWINGS AND PROJECT MANUAL

- A. The Work shall be performed in accordance with the Drawings and Specifications prepared by the County/Professional. All work and materials shall conform to the Orange County Utilities Standards and Construction Specifications Manual, latest edition or as indicated in these Specifications or Drawings.

- B. The Contractor shall verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, Schedules, Specifications or other data received from the County/Professional, and shall notify same, in writing, of all errors, omissions, conflicts and discrepancies found therein. Failure to discover or correct errors, conflicts or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory Work, faulty construction or improper operation resulting there from, nor from rectifying such conditions at his own expense.
- C. All schedules are given for the convenience of the County and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for the making of estimates of the size, kind, and quantity of materials and equipment included in the Work to be done under this Contract.
- D. Intent:
1. All Work called for in the Specifications applicable to this Contract, but not shown on the Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified either in the Drawings or in the Specifications, but involved in carrying out their intent or in the complete and proper execution of the Work, is required and shall be performed by the Contractor as though it were specifically delineated or described.
 2. Items of material, equipment, machinery, and the like may be specified on the Drawings and not in the Specifications. Such items shall be provided by the Contractor in accordance with the specification on the Drawings.
 3. The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, and interpretation of these Specifications shall be made upon that basis.
- E. When obtaining data and information from the Drawings, conflicts, errors, and discrepancies shall be resolved from the documents given the following order of precedence:
1. Agreement
 2. Change Orders
 3. Addenda
 4. Supplementary Conditions
 5. Instructions to Bidders
 6. General Conditions
 7. Specifications (Divisions. 1 through 16)
 8. Drawings
 9. Dimensions
When measurements are affected by conditions already established or where items are to be fitted into constructed conditions, it shall be the Contractor's responsibility to verify all such dimensions at the site and the actual job dimensions shall take precedence over scale and figure dimensions on the Drawings.
 10. Full-size Drawing
 11. Large-scale Drawing

12. Small-scale Drawing
13. Advertisement for Bids
14. Bid
15. Bonds
16. Insurance Certificates
17. Insurance Endorsements
18. Affidavits

1.04 PROTECTION AND RESTORATION

- A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every means of protection necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in other manner acceptable to the County/Professional.
- B. Protection of Trees and Shrubs
 1. Protect with boxes or other barricades.
 2. Do not place excavated material so as to injure trees or shrubs.
 3. Install pipelines in short tunnels between and under root systems.
 4. Support trees to prevent root disturbance during nearby excavation.
- C. Tree and Limb Removal
 1. Tree limbs, which interfere with equipment operation and are approved for pruning, shall be neatly trimmed and the tree cut coated with tree paint.
 2. The County may order the Contractor, for the convenience of the County, to remove trees along the line or trench excavation. The Contractor shall obtain any permits required for removal of trees. Ordered tree removal shall be paid for under the appropriate Contract Items.
- D. Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age, at the proper season and at the sole expense of the Contractor.
- E. Lawn Areas: All lawn areas disturbed by construction shall be replaced with like kind to a condition similar or equal to that existing before construction. Where sod is to be removed, it shall be carefully removed, and the same re-sodded, or the area where sod has been removed shall be restored with new sod in the manner described in the applicable section.
- F. Fences: Any fence, or part thereof, that is damaged or removed during the course of the Work shall be replaced or repaired by the Contractor, and shall be left in as good a condition as before the starting of the Work.

- G. Where fencing, walls, shrubbery, grass strips or area must be removed or destroyed incident to the construction operation, the Contractor shall, after completion of the Work, replace or restore to the original condition all such destroyed or damaged landscaping and improvements.
- H. The cost of all labor, materials, equipment, and work for restoration shall be deemed included in the appropriate Contract Item or items, or if no specific item is provided therefore, as part of the overhead cost of the Work, and no additional payment will be made therefore.

1.05 PUBLIC NUISANCE

- A. The Contractor shall not create a public nuisance including, but not limited to, encroachment on adjacent lands, flooding of adjacent lands, or excessive noise.
- B. Sound levels measured by the County/Professional shall not exceed 45 dBA from 8 p.m. to 8 a.m. or 55 dBA 8 a.m. to 8 p.m. This sound level shall be measured at the exterior of the nearest exterior wall of the nearest residence. Levels at the equipment shall not exceed 85 dBA at any time. Sound levels in excess of these values are sufficient cause to have the Work halted until equipment can be quieted to these levels. Work stoppage by the County/Professional for excessive noise shall not relieve the Contractor of the other portions of this specification including, but not limited to, completion dates and bid amounts.
- C. No extra charge may be made for time lost due to work stoppage resulting from the creation of a public nuisance.

1.06 CONTRACTOR'S PAYMENTS TO COUNTY FOR OVERTIME WORK

- A. County Inspector Work Hours: Normal work hours for the County's inspector(s) are defined as any 8-hour period between the hours of 7:00 a.m. and 7:00 p.m. on the weekdays of Monday through Friday. Any County Inspector(s) work beyond the aforementioned normal work hours shall be requested in writing 48-hours in advance. All overtime and weekend work compensation to the County's Inspector(s) for working beyond the normal working hours are considered overtime compensation and shall be paid for by the Contractor at the overtime pay rate of \$51.00 per hour. This overtime pay rate is subject to adjustment by the County. The Contractor agrees that the County shall deduct charges for work outside normal work hours and for overtime pay from payments due the Contractor.

1.07 MAINTENANCE OF SERVICE

- A. If this project includes the demolition, rehabilitation and replacement of facilities that transmit wastewater within a wastewater collection system; the collection and transmission of wastewater is a continuous operation and must remain in service at all times. Unless noted otherwise on the plans, the operation of the existing wastewater pumping facility on each of the respective locations shall remain in service until the transfer of service has been completed. See "Transfer of Service" for additional description of these requirements. In lieu of maintaining the existing pumping station, the Contractor may provide bypass pumping. Bypass pumping provided by the Contractor either as alternate to maintaining the existing pumping facility or as required when noted on the specific facility plan shall meet the requirements as noted in Section 01516 "Collection System Bypass."
- B. The Contractor shall, prior to interrupting any utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the County and make arrangements for the interruption which will be satisfactory to the County.
- C. Utility lines that are damaged during construction shall be repaired by the Contractor and service restored within 4-hours of the breakage. The County retains the option of repairing any damage to utility pipes in order to expedite service to the customers. The Contractor will remain responsible for all costs associated with the repair.

1.08 TRANSFER OF SERVICE

- A. The Contractor shall use temporary plugs in the existing and proposed sewer lines to control the routing of gravity flow to the active pumping facility during the transfer period. The proposed pumping facility shall be constructed while the existing or bypass facility is in operation. When the County has accepted the proposed facilities and placed the facility into operation, the transfer of service is complete. The Contractor may begin the work of removing the existing facility or bypass pumping equipment. The Contractor shall also install permanent plugs in the sewer pipes to allow abandonment or removal of the existing sewer system and pumping facilities as noted on the plans.

1.09 LABOR

- A. Supervision: The Contractor shall keep the Contract under his own control and it shall be his responsibility to see that the Work is properly supervised and carried on faithfully and efficiently. The Contractor shall supervise the Work personally or shall have a competent, English speaking superintendent or representative, who shall be on the site of the Project at all working hours, and who shall have full authority by the Contractor to direct the performance of the Work and make arrangements for all necessary materials, equipment, and labor without delay.

- B. Jurisdictional Disputes: It shall be the responsibility of the Contractor to pay all costs that may be required to perform any of the Work shown on the Drawings or specified herein to avoid any work stoppages due to jurisdictional disputes. The basis for subletting work in question, if any, shall conform to precedent agreements and decisions on record with the Building and Construction Trades Department, AFL-CIO, dated June, 1973, including any amendments thereto.
- C. Apprenticeship: The Contractor shall comply with all of the requirements of Section 446, Florida Statutes, for all contracts in excess of \$25,000 excluding roadway, highway or bridge contracts and the Contractor agrees to insert in any subcontract under this Contract the requirements of this Article.

1.10 MATERIALS AND EQUIPMENT

A. MANUFACTURER

1. All transactions with the manufacturers or Subcontractors shall be through the Contractor, unless the Contractor shall request and at the County/Professional's option, that the manufacturer or Subcontractor communicate directly with the County/Professional. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
2. All workmanship and materials shall be of the highest quality. The equipment shall be the product of manufacturers who are experienced and skilled in the field with an established record of research and development. No equipment will be considered unless the manufacturer has designed and manufactured equipment of comparable type and size and have demonstrated sufficient experience in such design and manufacture.
3. All materials and equipment furnished by the Contractor shall be subject to the inspection, review and acceptance of the County and meet the requirements as outlined in the Orange County Utilities Standards and Construction Specifications Manual. No material shall be delivered to the Work without prior approval of the County/Professional.
4. All apparatus, mechanisms, equipment, machinery, and manufactured articles for incorporation into the Project shall be the new (most current production at time of bid) and unused standard products of recognized reputable manufacturers.
5. Manufactured and fabricated products:
 - a. Design, fabricate and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
 - c. Any two or more pieces of material or equipment of the same kind, type or classification, and being used for identical types of service, shall be made by the same manufacturer.
 - d. Products shall be suitable for service conditions as specified and as stated by manufacturer.
 - e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

- f. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.11 MANUFACTURER'S SERVICE

- A. Where service by the manufacturer is specified to be furnished as part of the cost of the item of equipment, the Work shall be at the Contractor's expense.
- B. The services provided shall be by a qualified manufacturer's service representative to check and verify the completed installation, place the equipment in operation, and instruct the County's operators in the operation and maintenance procedures. Such services are to be for period of time and for the number of trips specified. A working day is defined as a normal 8-hour working day on the job and does not include travel time.
- C. The services shall further demonstrate to the County/Professional's complete satisfaction that the equipment will satisfactorily perform the functions for which it has been installed.

1.12 INSPECTION AND TESTING

A. General

- 1. If, in the testing of any material or equipment, it is ascertained by the County/Professional that the material or equipment does not comply with the Contract, the Contractor shall be notified thereof, and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the Work and replace it with acceptable material, without cost to the County.
- 2. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEE, except as may otherwise be stated herein.

B. Cost

- 1. County shall employ and pay for the services of an independent testing laboratory to perform testing specifically indicated on the Contract Documents or specified in the Specifications and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents.
- 2. The cost of field leakage and pressure tests and shop tests of materials and equipment specifically called for in the Contract Documents shall be borne by the Contractor, and such costs shall be deemed to be included in the Contract price.
- 3. Notify County employed laboratory a minimum of 48-hours, sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. When tests or inspections cannot be performed after such notice, reimburse County for laboratory personnel and travel expenses incurred.
- 4. The Contractor shall pay for all work required to uncover, remove, replace, retest, etc., any work not tested due to the Contractor's failure to provide the 48-hours advance notice or due to failed tests. The Contractor shall also provide compensation for the County/Professional's personnel for required re-testing due to failed or rescheduled testing.

C. Shop Testing

1. Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function or special requirements are specified shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents. No such equipment shall be shipped to the worksite until the County/Professional notifies the Contractor, in writing, that the results of such tests are acceptable.
2. Five (5) copies of the manufacturer's actual shop test data and interpreted results thereof, accompanied by a certificate of authenticity notarized and signed by a responsible official of the manufacturing company, shall be furnished to the County/Professional as a prerequisite for the acceptance of any equipment. The cost of shop tests (excluding cost of County's representative) and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor and shall be included in the Contract price.
3. The Contractor shall give notice in writing to the County sufficiently in advance of his intention to commence the manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. Such notice shall contain a request for inspection, the date of commencement and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, the County shall arrange to have a representative present at such times during the manufacture as may be necessary to inspect the materials; or he will notify the Contractor that the inspection will be made at a point other than the point of manufacture; or he will notify the Contractor that inspection will be waived.
4. When inspection is waived or when the County/Professional so requires, the Contractor shall furnish to him authoritative evidence in the form of Certificates of Manufacture that the materials to be used in the Work have been manufactured and tested in conformity with the Contract Documents. These certificates shall be notarized and shall include five (5) copies of the results of physical tests and chemical analysis, where necessary, that have been made directly on the product or on similar products of the manufacturer.
5. The Contractor must comply with these provisions before shipping any material. Such inspections by the County shall not release the Contractor from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

D. Field Testing:

1. The County shall employ and pay for services of an independent testing laboratory to perform testing specifically indicated in the Contract Documents. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract. The Contractor shall provide compensation for retesting of all failed tests.
2. The County may at any time during the progress of the Work, request additional testing beyond that which is specified in the Contract. This testing will be at the County's expense. The Contractor shall assist the testing laboratory personnel in all ways so as to facilitate access to the location of the material or equipment to be tested. Contractor shall:
 - a. Cooperate with laboratory personnel, provide access to the Project.
 - b. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

- c. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes, which require control by the testing laboratory.
3. The following schedule summarizes the responsibilities of various tests that may be required by the Contract Documents. Contractor shall notify the County in advance of work so that arrangements can be made with the testing laboratory.

TEST	NOTES	PAID FOR
Soil Compaction	A. Pipe Work: Every 300 ft. at each lift of compaction B. Structures: As a minimum one test per 2000 SF of fill area per lift, or at least 2 tests per structure, per lift. As specified in material specifications sections	County
Low Pressure Air Exfiltration	Each section of gravity sewer pipe between manholes or lift station	Contractor
Hydrostatic Pressure	All segments of pressure piping (24-hour test).	Contractor
Hydrostatic Leakage	All segments of pressure piping (2-hour test).	Contractor
Bacteriological	As required by local and state agencies	County
Asphaltic Concrete Paving	As required by County	County
LBR	Each 600 SY of pavement	County
Concrete	Slump test each delivery, cylinders every 20 CY	County
Asbestos	Environmental testing of materials	County
All Other Testing	As specified in various sections of the Project Manual	As Indicated

- E. Demonstration Tests: Upon completion of the Work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance or demonstration tests as specified or required to provide compliance with the Contract Documents. The Contractor shall furnish all labor, fuel, energy, water and all other equipment necessary for the demonstration tests at no additional cost to the County.
- F. Final Inspection: Prior to preparation of the final payment application, a final inspection will be performed by the County to determine if the Work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents. See also Section 01700 "Project Closeout."
- G. Inspection by existing utility owners: The Contractor shall pay for all inspections during the progress of the Work required and provided by the owner of all existing public utilities paralleling or crossing the Work, as shown on the Drawings. All such inspection fees shall be deemed included in the appropriate Contract Item or items, or if no specific item is provided therefore, as part of the overhead cost of the Work, and no additional payment will be made therefore.
- H. Inspection by Other Agencies: The Florida Department of Transportation, the Florida Department of Environmental Protection, and other authorized governmental agencies shall have free access to the site for inspecting materials and work, and the Contractor shall afford them all necessary facilities and assistance for doing so. Any instructions to the Contractor resulting from these inspections shall be given through the County. These rights of inspections shall not be construed to create any contractual relationship between the Contractor and these agencies.

1.13 PROJECT SITE AND ACCESS

A. RIGHT-OF-WAY AND EASEMENTS

1. The use of public streets and alleys shall be such as to provide a minimum of inconvenience to the public and to other traffic. Any earth or other excavated material spilled from trucks shall be removed by the Contractor and the streets cleaned to the satisfaction of the County.
2. The Contractor shall not enter or occupy private land outside of easements, except by written permission of the property owner.
3. At the time of the Pre-Construction meetings, the Contractor shall fully acquaint himself with the status of all easements required for the Work and the possibility of parcels remaining to be acquired, if any. Should easements not be acquired by the County in specific areas of the Work, the Contractor shall sequence and reschedule his work therein so as not to interfere with the progress of work in other areas of the Project. Such rescheduling of work shall be performed by the Contractor at no additional cost to the County. The County agrees that it will make every effort to acquire all remaining easements with all speed and diligence possible so as to allow the completion of the Work within the Contract time.

B. ACCESS

1. Neither the material excavated nor the materials or equipment used in the construction of the Work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.
2. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business access with the business Owner. Such prearranged access closing shall not exceed two (2) hours. Property drainage and grading shall be restored and all construction debris removed within 48-hours of backfilling trench.
3. Contractor agrees that representatives of the County and any governmental agents will have access to the Work wherever it is in preparation or progress and that the Contractor shall provide facilities for such access and inspection.

1.14 UTILITIES

A. UTILITY CONSTRUCTION

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, house service connections, vaults, manholes and all other appurtenances and facilities pertaining thereto, whether owned or controlled by governmental bodies or privately owned by individuals, firms or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage or water. Other public or private property, which may be affected by the Work, shall be deemed included hereunder.

2. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons, and damage to property. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Bridges provided for access to private property during construction shall be removed when no longer required.
3. The length of open trench will be controlled by the particular surrounding conditions, but shall always be confined to the limits described by the County. If any excavation becomes a hazard, or if it excessively restricts traffic at any point, the County may require special construction procedures. As a minimum, the Contractor shall conform to the following restoration procedures:
 - a. Interim Restoration: All excavations shall be backfilled and compacted as specified by the end of each working day. For excavations within existing paved areas; limerock base or soil cement base (match existing) shall be spread and compacted to provide a relatively smooth surface free of loose aggregate material. At the end of each workweek, the S-I asphaltic surface course shall be completed and opened to traffic. Contractor shall coordinate his construction activity including density tests and inspections to allow sufficient time to achieve this requirement. All driveway cuts shall be backfilled, compacted, and limerock base spread and compacted immediately after installation. Contractor shall coordinate with the individual property owners prior to removing the driveway section. Any utility crossing an existing roadway, parking lot or other paved area shall be patched by the end of the working day.
 - b. All pipe and fittings shall be neatly stored in a location, which will cause the least disturbance to the public. All debris shall be removed and properly disposed of by the end of each working day.
 - c. Final Restoration Overlay: After completing all installations, and after testing of the pipe (but no sooner than 30-days after applying the S-I asphaltic surface), final restoration shall be performed. In no event shall final restoration begin after substantial completion. Final restoration shall provide an S-III asphaltic overlay as specified in an uninterrupted continuous operation until completion. Any additional restoration required after testing shall be repaired in a timely manner at no additional cost to the County.
 - d. Maintenance of all restored facilities shall be the Contractor's responsibility. This maintenance shall be performed on an on-going basis during the course of construction. The Contractor's Progress Schedule shall reflect the above restoration requirements.
 - e. Additional Restoration for Work in Business or Commercial Districts: The Contractor shall restore all private property, damaged by construction, to its original condition. Access to businesses located adjacent to the project site must be maintained at all times. Contractor may prearrange the closing of business accesses with the business owner. Such prearranged access closing shall not exceed two (2) hours. Property drainage and grading shall be restored within 24-hours of backfilling trench.

B. EXISTING UTILITIES

1. The locations of all existing underground piping, structures and utilities have been taken from information received from the respective owner. The locations are shown without express or implied representation, assurance, or guarantee that they are complete or correct or that they represent a true picture of underground piping, conduit and cables to be encountered. It is the Contractor's responsibility to verify all depths of marked locates as well as underground structures.
2. The Contractor shall, at all times in performance of the Work, employ acceptable methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage or destruction of existing public utility installations and structures; and shall, at all times in the performance of the Work, avoid unnecessary interference with, or interruption of, public utility services; and shall cooperate fully with the owners thereof to that end.
3. Pipelines shall be located substantially as indicated on the Drawings, but the County reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. When the location of piping is dimensioned on the Drawings, it shall be installed in that location; when the location of piping is shown on a scaled drawing, without dimensions, the piping shall be installed in the scaled location unless the County approves an alternate location for the piping. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required. The County/Professional may require detailed pipe laying drawings and schedules for project control.
4. The Contractor shall exercise care in any excavation to locate all existing piping and utilities. All utilities, which do not interfere with the completed work, shall be carefully protected against damage. Any existing utilities damaged in any way by the Contractor shall be restored or replaced by the Contractor at his expense as directed by the County. Any existing facilities, which require operation to facilitate repairs, shall be operated only by the owner of the respective utility.
5. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the proximity of excavation, be temporarily stayed and/or shored in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the Contractor.

C. NOTICES

1. All governmental utility departments and other owners of public utilities, which may be affected by the Work, will be informed in writing by the Contractor two (2) weeks after the execution of the Contract or Contracts covering the Work. Such notice will be sent out in general, and directed to the attention of the governmental utility departments and other owners of public utilities for such installations and structures as may be affected by the Work.
2. The Contractor shall also comply with Florida Statute 553.851 regarding notification of existing gas and oil pipeline company owners. Evidence of such notice shall be furnished to the County within two (2) weeks after the execution of the Contract.

3. It shall be the Contractor's responsibility to contact utility companies at least 72-hours in advance of breaking ground in any area or on any unit of the Work so maintenance personnel can locate and protect facilities, if required by the utility company.
4. The Contractor shall give a minimum five (5) working day notice prior to utility personnel interrupting a utility service (water, sewer, etc.) for the purpose of making cut-ins to the existing lines or for any other purposes, contact the utility owner and make arrangements for the utility personnel to isolate the existing lines thus providing interruption which will be satisfactory to the utility owner.

D. EXPLORATORY EXCAVATIONS

1. Exploratory excavations shall be conducted by the Contractor for the purpose of locating underground pipelines or structures in advance of the construction. Test pits shall be excavated in areas of potential conflicts between existing and proposed facilities and at piping connections to existing facilities a minimum of 48-hours or 1,000-feet in advance of work. If there is a potential conflict, the Contractor is to notify the County/Professional immediately. Information on the obstruction to be furnished by the Contractor shall include: Location, Elevation, Utility Type, Material and Size. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the County.

E. UTILITY CROSSINGS

1. It is intended that wherever existing utilities must be crossed, deflection of the pipe within specified limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the County this procedure is not feasible, he may direct the use of fittings for a utility crossing or conflict transition as detailed on the Drawings.

F. RELOCATIONS

1. Relocations shown on the Drawings: Public utility installations or structures, including but not limited to light poles, signs, fences, piping, conduits and drains that interfere with the positioning of the Work which are shown on the Drawings to be removed, relocated, replaced or rebuilt by the Contractor shall be considered as part of the general cost of doing the Work and shall be included in the prices bid for the various contract items. No separate payment shall be made therefore.
2. Relocations not shown on the Drawings
 - a. Where public utility installations or structures are encountered during the course of the Work, and are not indicated on the Drawings or in the Specifications, and when, in the opinion of the County, removal, relocation, replacement or rebuilding is necessary to complete the Work under this contract, such work shall be accomplished by the utility having jurisdiction, or such work may be ordered, in writing by the County, for the Contractor to accomplish.
 - b. If such work is accomplished by the utility having jurisdiction, it will be carried out expeditiously and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement or rebuilding as required. If such work is accomplished by the Contractor, it will be paid for as a Change Order.

3. All existing castings, including valve boxes, junction boxes, manholes, hand holes, pull boxes, inlets and similar structures in the areas of construction that are to remain in service and in areas of trench restoration and pavement replacement, shall be adjusted by the Contractor to bring them flush with the surface of the finished work.
4. All existing utility systems which conflict with the construction of the Work herein, which can be temporarily removed and replaced, shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the Work may be done by the Contractor.

1.15 RELATED CONSTRUCTION REQUIREMENTS

A. TRAFFIC MAINTENANCE

1. Maintain public highway traffic within the limits of the Project for the duration of the construction period, including any temporary suspensions of Work. Work shall also include construction and maintenance of any necessary detour facilities; furnishing, installing and maintaining of traffic control and safety devices during construction, control of dust, or any other special requirements for safe and expeditious movement of vehicular and pedestrian traffic.
2. Traffic Control shall be provided at the Contractor's expense by the Contractor's personnel or off-duty uniformed police officer, depending on and as required by the applicable traffic control requirements jurisdictional to the construction or road.
3. The Contractor shall prepare and submit a Maintenance of Traffic plan (MOT) to the County/Professional and to the County Public Works Department for review and acceptance prior to commencing any Work on the site. The Traffic Control Plan shall detail procedures and protective measures proposed by the Contractor to provide for protection and control of traffic affected by the Work consistent with the following applicable standards:
 - a. Standard Specifications for Road and Bridge Construction, Latest Edition including all subsequent supplements issued by the Florida Department of Transportation, (FDOT Spec.).
 - b. Manual of Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations, FDOT.
 - c. Right-of-Way Utilization Regulations, Orange County, Florida, latest edition. All references to the respective agency in the above referenced standards shall be construed to also include the County for this Work.
 - d. The cost of any required road permits shall be borne by the Contractor.
 - e. The Contractor will notify the public one (1) week in advance of any scheduled work via the use of portable message boards. The message boards shall be located at each approach to the construction area.
4. Before closing any thoroughfare, the Contractor shall give written notice to, and if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction over the thoroughfare. Notice shall be given no less than 72-hours in advance of the time when it may be necessary in the process of construction to close such thoroughfare, or as may be otherwise provided in the acceptable Maintenance of Traffic plan (MOT).

5. The Contractor shall sequence and plan construction operations and shall generally conduct his work in such a manner as not to unduly or unnecessarily restrict or impede existing normal traffic through the streets of the local community.
6. Insofar as it is practicable, excavated material and spoil banks shall not be located in such a manner as to obstruct traffic. The traveled way of all streets, roads and alleys shall be kept clear and unobstructed insofar as is possible and shall not be used for the storage of construction materials, equipment, supplies, or excavated earth, except when and where necessary.
7. If required by duly constituted public authority, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such a manner as not to constitute an undue traffic hazard. Private driveways shall not be closed except when and where necessary, and then only upon due advance notice to the County and for the shortest practicable period of time consistent with efficient and expeditious construction. The Contractor shall be liable for any damages to persons or property resulting from his work.
8. The Contractor shall make provisions at all "open cut" street crossings to allow a minimum of one lane to be open for vehicular traffic at all times. Lane closing shall be as permitted by the local governing authority and shall be repaired to a smooth, safe driving surface immediately following the installation of pipe or conduit. Flagmen shall be required, in addition to barricades, signs and other protective devices at all lane closings.
9. The Contractor shall make provisions at cross streets for the free passage of vehicles and pedestrians, either by bridging or otherwise, and shall not obstruct the sidewalks, gutters, or streets, nor prevent in any manner the flow of water in the latter, but shall use all proper and necessary means to permit the free passage of surface water along the gutters.
10. The Contractor shall immediately cart away all offensive matter; exercising such precaution as may be directed by the County. All material excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences and adjacent property of all kinds.

B. BARRIER AND LIGHTS

1. The Contractor shall exercise extreme care in the conduct of the Work to protect health and safety of the workmen and the public. The Contractor shall provide all protective measures and devices necessary, in conformance with applicable local, state and federal regulations regarding their need and use. Protective measures shall include but are not limited to barricades, warning lights/flashers and safety ropes.
2. All equipment and vehicles operating within 10-feet of the roadway shall have flashing strobe lights attached.

C. DEWATERING AND FLOTATION

1. The Contractor, with his own equipment, shall do all pumping necessary to dewater any part of the Work area during construction operations to insure dry working conditions. The Contractor shall be completely responsible for any tanks, wetwells or similar structures that may become buoyant during the construction and modification operations due to the ground water or floods and before the structure is put into operation. The proposed final structures have been designed against buoyancy; however the Contractor may employ methods, means and techniques during the various stages of construction (or other conditions), which may affect the buoyancy of structures. Should there be any possibility of buoyancy of a structure; the Contractor shall take the necessary steps to prevent its buoyancy either by increasing the structure's weight, by filling it with approved material or other acceptable methods. Damage to any structures due to floating or flooding shall be repaired or the structures replaced at the Contractor's expense.
2. Contractor shall be responsible for any required permits for the discharge of ground water.

D. DUST AND EROSION CONTROL

1. The Contractor shall prevent dust nuisance from his operations or from traffic by the use of water and deliquescent salts.
2. Erosion and Sedimentation Control
 - a. Temporary erosion controls include, but are not limited to, grassing, mulching, netting, watering and reseeded on-site surfaces and soil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the County, FDEP and any other agency having jurisdiction.
 - b. Temporary sedimentation controls include, but are not limited to; silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the County, FDEP and any other agency having jurisdiction.
 - c. The construction of temporary erosion and sedimentation control facilities shall be in accordance with the technical provision of section 104-6.4 of the 1991 Edition, FDOT Standard Specifications for Road and Bridge Construction.
 - d. Contractor is responsible for providing effective temporary erosion and sediment control measures during construction or until final controls become effective.

E. LINES AND GRADES

1. All Work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings, or as given by the County/Professional. The full responsibility for keeping alignment and grade shall rest upon the Contractor.
2. The Contractor shall, at his own expense, establish all working or construction lines and grades as required from the project control points set by the County, and shall be solely responsible for the accuracy thereof.

3. Water main and forcemain shall have a minimum of 36-inches of cover over the top of the pipe. Cover shall vary to provide long uniform gradient or slope to pipe to minimize air pockets and air release valves. The stationing shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed. All locations must be acceptable by the County.
4. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:
 - a. Gravity lines; continuous control, using laser beam technology.
 - b. Pressure lines; control stakes set at 50-foot intervals using surveyors' level instrument.

F. CUTTING AND PATCHING

1. The Contractor shall do all cutting, fitting or patching of his portion of the Work that may be required to make the several parts thereof join and coordinate in a manner satisfactory to the County and in accordance with the Drawings and Specifications.
2. Preparation:
 - a. Inspect the existing conditions of the Project, including elements subject to damage and/or movement during cutting and patching.
 - b. Provide adequate temporary support to assure the structural integrity of all facilities during completion of the Work.
3. Performance:
 - a. Execute cutting and demolition by methods, which will prevent damage to other existing facilities and will provide proper surfaces to receive installation of equipment and repair.
 - b. Excavation and backfilling shall be performed in a manner, which will prevent settlement and/or damage to existing facilities.
 - c. All pipes, sleeves, ducts, conduits and other penetration through surfaces shall be made airtight.
 - d. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes.

G. TEMPORARY CONSTRUCTION

1. Temporary fences: If, during the course of the Work, it is necessary to remove or disturb any fencing, the Contractor shall at his own expense, provide a suitable temporary fence which shall be maintained until the permanent fence is replaced. The County/Professional will be solely responsible for the determination of the necessity for providing a temporary fence and the type of temporary fence to be used.
2. Responsibility for Temporary Structures: In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary structures or work and for any damage which may result from their failure or their improper construction, maintenance or operation and will indemnify and save harmless the County from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

H. DAILY REPORTS

1. The Contractor shall submit to the County's Representative daily reports of construction activities including non-work days. The reports shall be complete in detail and shall include the following information:
 - a. Days from Notice to Proceed; Days remaining to substantial and final completion.
 - b. Weather information
 - c. Work activities with reference to the Critical Path Method (CPM) schedule activity numbers (including manpower, equipment and daily production quantities for each individual activity).
 - d. Major deliveries
 - e. Visitors to site
 - f. Test records
 - g. New problems, and
 - h. Other pertinent information
2. A similar report shall be submitted for/by each Subcontractor.
3. The report(s) shall be submitted to the County Representative's Field Office within 2 days of the respective report date. Each report shall be signed by the Contractor's Superintendent or Project Manager. Pay request will not be processed unless daily reports are current.
4. If a report is incomplete, in error, or contains misinformation, a copy of the report shall be returned by the County Representative to the Contractor's Superintendent or Project Manager with corrections noted. When chronic errors or omissions occur, the Contractor shall correct the procedures by which the reports are produced.

I. CLEANING

1. During Construction
 - a. During construction of the Work, the Contractor shall, at all times, keep the site of the Work and adjacent premises as free from material, debris and rubbish as is practicable and shall remove the same from any portion of the site if, in the opinion of the County, such material, debris, or rubbish constitutes a nuisance or is objectionable.
 - b. Provide on-site containers for the collection of waste materials, debris and rubbish and remove such from the site periodically by disposal at a legal disposal area away from the site.
 - c. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces. Use only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.
 - d. The Contractor shall remove from the site all surplus materials and temporary structures when no longer necessary to the Work at the direction of the County.

2. Final Cleaning
 - a. At the conclusion of the Work, all equipment, tools, temporary structures and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances. Employ skilled workmen for final cleaning. Thoroughly clean all installed equipment and materials to a bright, clean, polished and new appearing condition. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
 - b. The Work shall be left in a condition as shown on the Drawings and the remainder of the site shall be restored to a condition equal or better than what existed before the Work.
 - c. Prior to final completion, or County occupancy, Contractor shall conduct an inspection of interior and exterior surfaces, and all work areas to verify that the entire Work is clean. The County will determine if the final cleaning is acceptable.

1.16 CONSTRUCTION NOT PERMITTED

A. USE OF EXPLOSIVES

1. No blasting shall be done except upon approval by the County and the governmental agency or political subdivision having jurisdiction. When the use of explosives is approved by the County as necessary for the execution of the Work, the Contractor shall use the utmost care so as not to endanger life or property, and assume responsibility for any such damage resulting from his blasting operations, and whenever directed, the number and size of the charges shall be reduced. All explosives shall be stored in a secure manner and all such storage places shall be marked clearly, "DANGEROUS EXPLOSIVES" and shall be in care of competent watchmen. All permits required for the use of explosives shall be obtained by the Contractor at his expense. All requirements of the governmental agency issuing permit shall be observed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. This Contract is for the Holden Heights Community Center Sanitary Sewer project as shown on the Drawings and specified herein. The Work consists of furnishing all labor, equipment, and materials for the construction of the facilities consisting of, but not limited to the expansion of or improvements to the equipment and structures associated with the following:

20th Street

1. Installation of approximately 1,181 linear feet of 8-inch gravity sewer main and four (4) sanitary manholes, including seventeen (17) 6-inch sanitary sewer laterals.
2. Sewer main connection to an existing manhole.
3. Approximately 3,110 square yards of asphalt roadway replacement associated with the sanitary sewer installation.
4. Restoration and site clean-up.

Community Center Parcel

1. Installation of approximately 325 linear feet of 8-inch gravity sewer and three (3) 6-inch sanitary sewer laterals.

19th Street

1. Installation of approximately 343 linear feet of 8-inch gravity sewer main and three (3) sanitary manholes, including eight (8) 6-inch sanitary sewer laterals.
2. Restoration and site clean-up.

- B. The Contractor shall furnish all labor, equipment, tools, services and incidentals to complete all Work required by these Specifications and as shown on the Drawings and shall have experience with wastewater pump station rehabilitation and sanitary sewer installation.
- C. The Contractor shall perform the Work complete, in place, and ready for continuous service, and shall include repairs, testing, permits, cleanup, replacements and restoration required as a result of disruption or damages caused during this Construction.
- D. All materials, equipment, skills, tools and labor which is reasonably and properly inferable and necessary for the proper completion of the Work in a substantial manner and in compliance with the requirements stated or implied by these Specification or Drawings shall be furnished and installed by the Contractor without additional compensation, whether specifically indicated in the Contract Documents or not.
- E. The Contractor shall comply with all Municipal, County, State, Federal, and other codes

which are applicable to this Project.

1.02 WORKING HOURS

- A. Working hours for the County Inspector are an 8-hour period between the hours of 7:00 a.m. and 4:00 p.m., Monday through Friday. Any work beyond the 8-hour period is to be requested in writing 48 hours prior and paid for by the Contractor. Any work required on Saturday, Sunday or Holidays shall be requested in writing 48 hours in advance. All requests must be submitted to the County and approved by the County in advance. Under emergency situations, a verbal request may be made with a follow-up written request.
- B. The Contractor shall pay the County for County Inspector time outside of normal Working Hours at a rate of \$51.00/hour. The Contractor agrees that the County shall deduct such charges from the Contract Amount by a deductive Change Order.

1.03 CONTRACTOR'S USE OF PREMISES

- A. The Contractor shall assume full responsibility for the protection and safekeeping of products and materials at the job site. If additional storage or work areas are required, they shall be obtained by the Contractor at no additional cost to the Owner.

1.04 SEQUENCE OF WORK

- A. The Contractor shall establish his work sequence based on the use of crews to facilitate completion of construction and testing within the specified Contract Time.

1.05 PUBLIC UTILITY INSTALLATIONS AND STRUCTURES

- A. The Contractor shall give written notice to all governmental utility departments and other owners of public utilities of the location of the proposed construction operations, at least seventy-two hours in advance of breaking ground in any area or on any unit of the Work.
- B. Some of the utility contacts are listed on the plans for the Contractor's convenience.
- C. The maintenance, repair, removal, relocation or rebuilding of the public utility installation and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the utility involved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01021
SOILS REPORT AND OTHER INFORMATION

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Identification of reports of existing conditions.

Bidder's/Contractor's responsibilities for investigating and working with existing conditions.

1.02 LAND IN-ADDITION TO THE SITE

- A. Contractor is responsible for obtaining any lands, areas, properties, facilities and easements, in addition to those furnished by the County, that the Contractor considers necessary for temporary facilities, storage, disposal of spoil or waste material or other purposes the Contractor determines necessary to complete the Work. Contractor shall provide written documentation from owner to use such land or facilities. The County/Professional and the Geotech do not assume any responsibility for existing conditions at such lands, areas, properties, facilities and /or easements obtained by the Contractor.

1.03 SUBSURFACE CONDITIONS AND OTHER PHYSICAL CONDITIONS

- A. This Section identifies reports of explorations and tests of subsurface conditions, and drawings of physical conditions of existing surface and subsurface structures that have been used in the preparation of the Contract Documents. Contractor may rely upon any technical information and data in those reports found in Appendix A, "Geotechnical Report (includes geotechnical investigation and dewatering ground water quality values per Chapter 62-621, paragraph 62-621.300(2), F.A.C.)." The Report(s) in Appendix A is designated as Authorized Technical Data, but those reports and drawings are not part of the Contract Documents.
- B. Any conclusions or interpretations made by the Contractor based on any Authorized Technical Data will be at the Contractor's own risk. Contractor's reliance on any non-technical information, data, interpretations or opinions also will also be at Contractor's own risk. The County/Professional assume no responsibility for any understanding reached or representation made about subsurface conditions and physical conditions of existing structures, except as otherwise expressly shown in or represented by the Authorized Technical Data provided.

- C. The only information or data contained in the geotechnical report and used in the preparation of the Contract Documents that may be properly considered authorized technical data concerning subsurface conditions is found in Appendix A "Geotechnical Report". Such technical data are made available to allow the Contractor to have access to the same information available to the County. The County/Professional do not warrant the accuracy or completeness of any such information or that the Contract Documents identify all the existing relevant reports and/or documents.

1.04 UNDERGROUND UTILITIES

- A. Information or data about physical conditions of Underground Utilities, which have been used in the preparation of the Contract Documents, is shown or indicated in the Drawings and technical specifications. Such information and data is based on information and data obtained from record documents or furnished to the County by the owners of those Underground Utilities or by others.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXISTING GROUND SURFACE AND UNDERGROUND CONDITIONS; GENERALLY

- A. Where existing ground conditions are shown on the plans hereto attached, the elevations are believed to be reasonably correct but are not guaranteed to be absolutely so, and, together with any schedule of quantities, are presented only as an approximation. The Contractor shall satisfy itself, however, by actual examination of the site of the Work, as to the existing elevations and the amount of work required under the Contract.
- B. Where test pits and borings have been dug, the results supplied to the County/Professional by the soils Engineer may be given on the plans or are on file in the County/Professional's office and available for review . The County does not guarantee the accuracy or correctness of this information. If the Contractor desires any additional information relating to the soils investigation, contact the County/Professional to obtain such information. County does not guarantee the accuracy or correctness of any such information supplied to the Contractor.

- C. If, upon notice of a differing subsurface or latent physical condition from the Contractor, the County determines there was no unforeseen condition and unnecessary tests and investigations were conducted solely at the Contractor's request, any unnecessary expenses may be deducted from the Final Payment for the Contract. No increase in Contract Amount or Contract Time will be made if the differing site conditions were known or could have been discovered by the types of examinations that the Contractor, as Bidder, was responsible for. Claims based on groundwater table conditions will not be considered unforeseen subsurface conditions and will not be allowed. Any information indicated in the Contract Documents as to the groundwater table conditions has been provided for general information purposes only and is not intended to represent that the same conditions will exist during the execution of the Work. Further, no increase in Contract Amount or Contract Time will be made for costs incurred prior to the Contractor's written notice as required by the Contract Documents. The County will be allowed at least 10-days to investigate any alleged differing site conditions and to take appropriate action, before the Contractor is entitled to any adjustment in Contract Amount or Contract Time for Delay.

3.02 UNDERGROUND UTILITIES:

- A. The Contractor will be responsible for the safety and protection of, and providing for the repair of any damage done to the Work and existing surface and subsurface structures. The Contractor will be responsible for any damages and injury resulting from the failure to excavate in a careful and prudent manner.
- B. Contractor shall have full responsibility for locating all underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, stormwater, other liquids or chemicals, or traffic or other control systems, shown or indicated in the Contract Documents, in advance of construction, coordinating the Work with the actual locations found and making note of the actual locations on the record Drawings. Contractor shall exercise extreme caution when locating underground facilities to minimize the risk of damage from Contractor's activities. The Contractor will immediately notify the County and the owner of any Underground Utilities that are inaccurately identified or located on the Drawings.
- C. The Contractor will be responsible for any delay and all costs relating to the obligations set forth in this Section, except as provided by allowances specific to Underground Utilities.
- D. The Contractor will promptly notify the County, in writing, whenever the Contractor discovers that actual physical conditions of Underground Utilities differ materially from those indicated by the Contract Documents or Authorized Technical Data provided with the Contract Documents. Further, the Contractor promptly will notify the County, in writing, whenever the Contractor encounters Underground Utilities not shown or indicated in/through the Contract Documents, and which could not reasonably have been foreseen.

- E. The County and Contractor will follow the provisions of the General Conditions with respect to any conclusions reached by the County after the County compares the actual underground utility conditions with those included in the information provided to the Contractor.

3.03 ENVIRONMENTAL PROCEDURES FOR HAZARDOUS MATERIALS

- A. The Contractor will not, at any time, cause or permit any Hazardous Materials to be brought upon, stored, manufactured, blended, handled, or used in, on, or about the Project or the Site for any purpose except as lawful and necessary and in accordance with the Contract Documents. The Contractor will not cause or permit Hazardous Materials to be brought on Site unless they have been specifically pre-identified by the Contractor, and approved in writing in advance by the County.
- B. The Contractor will defend, save, indemnify and hold harmless the County, their agents and employees from and against all liabilities, claims, damages, losses and expenses including attorneys' fees, which arise at any time during or after completion of the Work as a result of or in connection with:
 - 1. The Contractor's breach of any prohibition or requirement set forth in this Section or,
 - 2. Any Hazardous Materials discharged, released, deposited or introduced in the soil or surface or groundwater in, on, under, or about the Work, the Site or other properties as a result of the activities of the Contractor, the Subcontractors and their respective agents and employees in connection with the Work.
- C. This Contractor's indemnity obligation includes without limitation, costs incurred in connection with any investigation of site conditions or any cleanup, remediation, removal, or restoration required by the County or any federal, State, or local Public Agency because of:
 - 1. The occurrence of any Hazardous Materials present in the soil or surface or groundwater in, on, under, or about the Work or the Site;
 - 2. The diminution in value of the Work or the Site;
 - 3. Damages for the loss or restriction on use of the Work or of any amenity of the Work or the Property; and/or
 - 4. Amounts paid in settlement of claims, penalties, attorneys' fees, court costs, consultant and laboratory fees and experts' fees.
- D. The Contractor will immediately notify the County in writing of any significant release of Hazardous Materials at the Project or the Site, specifying the nature and quantity of the release, the location of the release, and the measures taken to contain and clean up the release and ensure that future releases do not occur.
- E. The Contractor agrees that insulation and any other construction materials containing asbestos or urea formaldehyde will not be used on the Work, and that all Sub-agreements will prohibit the use of construction materials (including, but not limited to, insulation) containing asbestos or urea formaldehyde.

3.04 DIFFERING HAZARDOUS MATERIAL CONDITIONS:

- A. If the Contractor unexpectedly encounters material reasonably believed to be Hazardous Material, the Contractor will immediately stop all affected Work, give written notice to the County and take appropriate health and safety precautions. Unless the Contract Documents require otherwise, the Contractor will conduct an investigation. If upon due investigation, the Contractor determines the material a Hazardous Material that may present a danger to persons or the surroundings, the Contractor will recommend a solution to the County. In any such case, the affected Work will be considered to have been under a suspension of Work.
- B. If the Hazardous Material is not required Work under the Drawings and/or Specifications, the County will proceed to have the Hazardous Material removed or rendered harmless through a Change Order or by means of another contract or as the County otherwise deems expedient. Alternatively, the County will terminate the affected Work or Contract for the County's convenience.
- C. If the County did not elect termination, once the Hazardous Material has been removed or rendered harmless, the affected Work will be resumed as directed in writing by the County. Any determination by the Florida Department of Community Health or the Department of Environmental Quality that the Hazardous Material has been removed or rendered harmless will be binding upon the County and Contractor for the purposes of resuming the affected Work.
- D. If the Contractor is responsible for the Hazardous Material, the Contractor will bear its proportionate share of the delay and costs involved in cleaning up the Site and removing and rendering it harmless to the satisfaction of the County and all Political Subdivisions with jurisdiction. The Contractor will be solely responsible if the Hazardous Material was brought to the Site by the Contractor, or results in whole or in part from any violation by the Contractor of any applicable Laws.
- E. If the Contractor is responsible, but fails to take appropriate action, and the County acts accordingly, the Contractor will defend, save, indemnify and hold harmless the County from and against all claims arising from the County's exercise of appropriate action.
- F. If the Contractor is not responsible, the County will issue a Change Order with the necessary changes. The Change Order will adjust Contract Amount and/or Contract Time as made necessary by the changes and resulting unreasonable delay under the circumstances attributable to the County /Professional.

3.05 INCIDENTS WITH ARCHAEOLOGICAL FEATURES:

- A. The Contractor will immediately notify in writing, the County and all Federal, State and local agencies with jurisdiction of any Archaeological Feature deposits encountered or unearthed. The Contractor will protect such Archaeological Features in a proper and satisfactory manner. No further disturbance of the Archaeological Features will take place until work is allowed to resume in the affected areas.

- B. If the County concludes that the Contract Documents require changes because of Archaeological Feature deposits encountered, the County will issue a Change Order with the necessary changes in the Work. The Change Order also will adjust Contract Amount and/or Contract Time as made necessary by those changes and by any resulting unreasonable delay under the circumstances attributable to the County/Professional.

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. This Section specifies administrative and procedural requirements to define pay items and determine payable amounts, and includes but is not limited to:
 - 1. General Provisions
 - 2. Cash Allowances
 - 3. Work Not Paid for Separately
 - 4. Measurement for Payment
 - 5. Partial Payment for Stored Materials and Equipment

1.02 GENERAL PROVISIONS

- A. This specification includes standard descriptions for all bid items. This Contract's specific bid items are listed in the Bid Schedule.
- B. The total Contract Amount shall cover the Work required by the Contract Documents. All costs in connection with the successful completion of the Work, including furnishing all materials, equipment, supplies, and appurtenances; providing all construction, equipment, and tools; and performing all necessary labor and supervision to fully complete the Work, shall be included in the unit and lump sum prices bid. All Work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the prices bid.
- C. If used, all estimated quantities stipulated in the Bid Schedule or other Contract Documents are approximate and are to be used only (a) for the purpose of comparing the bids submitted for the Work, and (b) as a basis for determining an initial Contract Amount. The actual amounts of Work completed and materials furnished under unit price items may differ from the estimated quantities. The County does not expressly or by implication represent that the actual quantities involved will correspond exactly to the quantities stated in the Bid Schedule; nor shall the Contractor plead misunderstanding or deception because of such estimate or quantities or of the character, location or other conditions pertaining to the Work. Payment to the Contractor will be made only for the actual quantities of work performed or material furnished in accordance with the Drawings and other Contract Documents, and it is understood that the quantities may be increased or decreased as provided in the General Conditions.

- D. If used, the unit prices listed in the Bid Schedule shall include all services, obligations, responsibilities, labor, materials, devices, equipment, royalties and license fees, supervision, temporary facilities, construction equipment, bonds, insurance, taxes, clean up, traffic control, control surveys, field offices, close out, overhead and profit and all connections, appurtenances and any other incidental items of any kind or nature, as are necessary to complete the Work in accordance with the Contract Documents.
- E. Except for mobilization/demobilization and project record documents, payment for Work will be based on the percent of completed work of each item in the Schedule of Values, including stored materials, as determined by the County. Progress of work in each item of the Schedule of Values will be determined separately by the County. However, the County will issue a single payment certificate for progress on the Contract.
- F. The Contractor agrees that it will make no claim for damages, anticipated profits, or otherwise because of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts therefore.
- G. Where payment by scale weight is specified under certain items, the Contractor shall provide suitable weighing equipment which shall be kept in accurate adjustment at all times and certified. The weighing of all material shall be performed by the Contractor in the presence and under the supervision of the County.
- H. All schedules included in the Contract Documents are given for convenience and are not guaranteed to be complete. The Contractor shall assume all responsibility for the making of estimates of the size, kind, and quantity of materials and equipment included in work to be done under this Contract.
- I. Where pipe fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve the Contractor from laying and jointing different or additional items where required.

1.03 CASH ALLOWANCES

- A. The Contractor shall include in the Total Bid Amount, all cash allowances stated in the Contract Documents. Items covered by these allowances shall be supplied for such amounts and by such persons as the County may direct.
- B. The Contractor will obtain the County's written acceptance before providing equipment, materials or other Work under a cash allowance. Payments under a cash allowance will be made based on actual costs, excluding costs of general conditions, handling, unloading, storage, installation, testing, etc, which will be considered to be included within the Contract Price. Payments within the limits of any Allowance will exclude overhead and profit and bond and insurance premiums, since those costs will be considered to be included within the Contract Amount. The Contractor shall submit appropriate documentation to validate the actual cost of the item.
- C. The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by the Contractor.

1.04 WORK NOT PAID FOR SEPARATELY

- A. Delivery: Payment for equipment delivery, storage or freight shall be included in the pay items including their installation and no other separate payment will be made therefore.
- B. Bonds: Payment for bonds required by the Contract shall be included in the pay items for the Work covered by the required bonds and no separate payment will be made.
- C. Preparation of Site: Payment for preparation of site shall be included in pay items proposed for the various items of Work and no separate payment will be made therefore. Preparation of site includes setting up construction plant, offices, shops, storage areas, sanitary and other facilities required by the specifications or state law or regulations; providing access to the site; obtaining necessary permits and licenses; payments of fees; general protection, temporary heat and utilities including electrical power; providing shop and working drawings, certificates and schedules; providing required insurance; cleaning up; and all other work regardless of its nature which may not be specifically referred to in a Bid Item but is necessary for the complete construction of the project set forth by the Contract.
- D. Permitting & Permit Fees.
- E. The County reserves the right to delete any item included in the Schedule of Values and decrease the Contract Price by the scheduled amount for the item deleted.

1.05 MEASUREMENT FOR PAYMENT

A. Methods of Measurement - Generally:

- 1. Units of measurement shall be defined in general terms as follows:
 - a. Linear Feet (LF)
 - b. Square Feet (SF)
 - c. Square Yards (SY)
 - d. Cubic Yards (CY)
 - e. Each (EA)
 - f. Sacks (SK)
 - g. Lump Sum (LS)
- 2. Unit Price Contracts/Items:
 - a. Linear Feet (LF) shall be measured along the horizontal length of the centerline of the installed material, unless otherwise specified. Pipe shall be measured along the length of the completed pipeline, regardless of the type of joint required, without deduction for the length of valves or fittings. Pipe included within the limits of lump sum items will not be measured.
 - b. Square Feet (SF), Square Yards (SY), Cubic Yards (CY), Each (EA) and Sacks (SK) shall be measured as the amount of the unit of measure installed and compacted within the limits specified and shown in the Specifications and Drawings. Slope angles and elevations shall be measured using land-surveying equipment. Contractor shall provide supporting documentation (i.e. drawings, delivery tickets, invoices, survey calculations, etc.) to verify actual installed quantities.

B. Lump Sum Contracts/Items - Generally:

- 1. Quantities provided in the Schedule of Values are for the purpose of estimating the completion status for progress payments. Payment will be made for each individual

- item on a percentage of completion basis as estimated by the Contractor and approved by the County.
2. Adjustments to costs provided in the accepted Schedule of Values may be made only by Change Order.
 3. The County reserves the right to delete any item included in the Schedule of Values and decrease the Contract Price by the scheduled amount for the item deleted.

1.06 MEASUREMENT AND PAYMENT ITEMS

- A. ***Only those bid items included in the Bid Schedule are applicable for this Contract.*** The County has standardized the measurement and payment items. Currently, there are approximately 100 measurement and payment items describing approximately 300 bid items. The sections and subsections are listed below.

10. General Requirements
 - 10.1 General
11. Site Work
 - 11.1 Miscellaneous
 - 11.2 Road Work
 - 11.3 Install/Replace Fence or Wall
 - 11.4 Bypass Pumping
 - 11.5 Abandon or Remove Pipe/Structure
12. Pressure Pipes
 - 12.1 Pressure Pipe and Fittings and Restrained Joints
 - 12.2 Valves
 - 12.3 Tapping Sleeve and Valve Assembly
 - 12.4 Cut-in Connections to Existing Main
 - 12.5 Piping Appurtenances
 - 12.6 Directional Drill
 - 12.7 Pipe Bursting
13. Wastewater Collection System
 - 13.1 Cleaning Sanitary Sewers
 - 13.2 CCTV Sanitary Sewers
 - 13.3 Install/Replace Sanitary Sewer
 - 13.4 Install/Replace Sanitary Manholes
 - 13.5 Sanitary Manhole Rehabilitation
 - 13.6 Sanitary Service Laterals and Cleanouts
 - 13.7 Cured-in-Place Pipe (CIPP) Liner
 - 13.8 Sanitary Sewer Pipe Bursting
14. Pump Stations
 - 14.1 Wastewater Duplex Pump Station
 - 14.2 Wastewater Triplex Pump Station

Table A

BID ITEM	Orange County Utilities MEASUREMENT AND PAYMENT ITEMS <small>Pg 1</small>
	10 GENERAL REQUIREMENTS
	10.1 - General
1	Bid Item 10.110.110 Mobilization, Demobilization, Bonds, and Permits (not to exceed 5% of the total of all bid items except bid items under section 10.1 General)
	a. Measurement: Measurement of various items for Mobilization and Demobilization shall not be made for payment and all items shall be included in the lump sum price. <u>This lump sum price shall not exceed 5% of the total of all bid items except bid items under section 10.1 General.</u>
	b. Payment: Payment of 75 percent of the applicable lump sum price for the item shall be full compensation for the Work consisting of the preparatory Work and operations in mobilizing for beginning Work on the Contract, including, but not limited to, movement of those personnel, equipment, supplies and incidentals to the project site, preparation of submittals, and for the establishment of temporary offices and buildings, safety equipment and first aid supplies, project signs, field surveys, sanitary and other facilities required by these specifications, and State and local laws and regulations. The costs of General Requirements (Section 01001), bonds, permits, and any required insurance, project signs, and any other preconstruction expense necessary for the start of the work, excluding the cost of construction materials, shall also be included. This Work also consist of the general project management of the Work including, but not limited to, field supervision and office management, as well as other incidental cost for management of the Work during the duration of the Contract. This Work also includes maintenance of the field offices for the duration of the Contract.
	Payment of the remaining 25 percent of the applicable lump sum price for this item also consists of demobilization or the operations normally involved in ending Work on the project including, but not limited to, termination and removal of temporary utility service and field offices; demolition and removal of temporary structures and facilities; restoration of Contractor storage areas; disposal of trash and rubbish, and any other post-construction work necessary for the proper conclusion of the Work.
2	Bid Item 10.120.110 Preconstruction Audio-Video Documentation
	a. Measurement: Measurement shall be based on the satisfactory submittal of a comprehensive pre-construction video in accordance with the County requirements and specifications (Section 01101).
	b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, and equipment necessary to create a comprehensive pre-construction video in accordance with the County requirements and specification.
3	Bid Item 10.130.110 Indemnification
	a. Payment: In consideration of the Contractor's Indemnity Agreement as set out in the Contract Documents, the County specifically agrees to give the Contractor a maximum of \$100.00 and other good and valuable consideration, receipt of which is acknowledged upon signing of the Agreement.

BID ITEM	Orange County Utilities MEASUREMENT AND PAYMENT ITEMS Pg 2
4	Bid Item 10.140.110 Project Record Documents (a minimum of 1% of the total of all bid items except bid items under section 10.1 General)
	<p>a. Measurement: Measurement for this item shall be based on satisfactory progress of the Contractor to provide Project Record Documents in accordance with the County requirements and specifications (Section 01720). Various items for Project Record Documents shall not be made for individual payment and all items shall be included in the lump sum price. <u>This lump sum price shall be a minimum of 1% of the total of all bid items except bid items under section 10.1 General).</u></p>
	<p>b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, and equipment necessary to create the Project Record Drawings, including the certified as-built survey, in accordance with the County requirements and specifications. Payment will be made at the lump sum price divided into equal monthly payments based on the Contract Time and acceptance by County of the progressive as-builts drawings and tables.</p>
5	Bid Item 10.150.110 Maintenance of Traffic
	<p>a. Measurement: Measurement shall be based on satisfactory Maintenance of Traffic (MOT) in accordance with County requirements and Florida Department of Transportation (FDOT) standards.</p>
	<p>b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, and equipment necessary to maintain public roadway and pedestrian traffic including flag men, uniformed police officers, barricades, warning lights/flashers, and safety ropes. Also included is furnishing, installing and maintaining a Traffic Control Plan, control and safety devices, control of dust, temporary crossing structures over trenches, any necessary detour facilities, and other special requirements for the safe and expeditious movements of traffic.</p>
6	Bid Item 10.160.110 Public Information Officer
	<p>a. Measurement: Measurement shall be based on satisfactory Public Information/Relations in accordance with County requirements.</p>
	<p>b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, and equipment necessary to provide and maintain communication with those individuals having a residence, business, or property adjacent to or within 1,000-feet of the construction area. Payment shall include the rental of venues, preparation of and conducting all meetings, and preparation of and disbursement of printed materials.</p>
	11.1 - Miscellaneous
7	Bid Item 11.110.110 Erosion and Sediment Control
	<p>a. Measurement: Measurement shall be based on satisfactory Erosion and Sediment Control in accordance with the County requirements and specifications (Section 01560).</p>
	<p>b. Payment: Payment of the applicable Contract lump sum price as stated in the proposal will be full compensation for furnishing all labor, materials, and equipment to control and prevent sediment transportation from the Work area to adjacent properties, including installation, maintenance, and removal of temporary erosion and sediment controls.</p>

BID ITEM	Orange County Utilities MEASUREMENT AND PAYMENT ITEMS Pg 3
8	Bid Item 11.241.110 Asphalt Roadway Replacement (1"-2" thick w/base)
	a. Measurement: Asphalt Roadway Repair shall be measured in actual square yards of existing asphalt paving and subgrade removal and replacement, milling and subsequent resurfacing is completed and accepted at the thickness as indicated in the Drawings and furnished and installed in accordance with the County requirements and specifications. The width measured for payment of asphalt surface repair, as measured perpendicular to the centerline of the pipe, shall be limited to the width shown on the Drawings. The length shall be as measured along the centerline of the pipe.
	b. Payment: Payment will be made at the contract unit price bid per square yard as stated in the proposal for Asphalt Roadway Replacement and shall include all labor, materials, and equipment necessary to provide a safe, smooth driving surface. The Work shall include saw cutting; pavement removal and proper disposal of exiting pavement, installing prime coat, tack coat, and asphalt, compaction, mill surface; dispose of milled materials; and apply Type S-III asphalt surface overlay, traffic signalization repair, and temporary striping and markings in accordance with the County requirements and specifications. Payment will be made once and shall include both temporary and permanent Asphalt Roadway Replacement.

	13.3 - Install / Replace Sanitary Sewer Main
9	Bid Item 13.310.110 Sanitary Sewer Main 8-inch Diameter (0-6' depth)
10	Bid Item 13.310.111 Sanitary Sewer Main 8-inch Diameter (8'-10' depth)
11	Bid Item 13.310.112 Sanitary Sewer Main 8-inch Diameter (8'-10' depth)
12	Bid Item 13.310.113 Sanitary Sewer Main 8-inch Diameter (10'-12' depth)
	a. Measurement: The installation of Sanitary Sewer Main shall be measured in actual linear feet satisfactorily furnished and laid, as measured along the length of the centerline of the completed pipeline without deduction for the length of manholes. The depth shall be calculated from the invert to the top of the surface. Pipe included within the limits of lump sum pay items will not be measured for payment under this item.
	b. Payment: Payment will be made at the contract unit price bid per linear feet as stated in the proposal for Sanitary Sewer Main and shall include all labor, materials, and equipment to construct the respective pipeline including coordination with existing utilities, protection of existing utilities including service connections, tree protection, excavation, sheeting, shoring and bracing, dewatering, backfill, compaction, and grading, all testing; restoration and clean-up. This item also includes the removal and replacement of fences and gates, concrete or asphalt driveways, curb and gutter, asphalt mailboxes, trees, shrubs, irrigation sprinklers, sod and other obstructions.
13	Bid Item 13.350.110 Sanitary Sewer Main Connection to Existing Manhole
	a. Measurement: Measurement for Sewer Main Connection to Existing Manhole shall be made per actual number of core bores and connections to existing manholes satisfactorily furnished and installed.
	b. Payment: Payment for Sewer Main Connection to Existing Manhole shall be made based on the authorized quantity at the unit price indicated in the Bid. Payment of the applicable Contract unit price shall be full compensation for furnishing all labor, materials and equipment necessary for a complete connection to an existing manhole including protection of existing utilities, excavation, sheeting, shoring and bracing, dewatering, backfill, compaction, and grading, wall seal, core drilling, and bench adjustment.

BID ITEM	Orange County Utilities MEASUREMENT AND PAYMENT ITEMS Pg 5
	13.4 – Install/Replace Sanitary Manholes
14	Bid Item 13.410.110 Sanitary Manhole 4-foot Diameter (0-6’ depth)
15	Bid Item 13.410.111 Sanitary Manhole 4-foot Diameter (6’-8’ depth)
16	Bid Item 13.410.112 Sanitary Manhole 4-foot Diameter (8’-10’ depth)
	a. Measurement: Measurement for Sanitary Manhole shall be made per actual number of sanitary manholes of each type and depth satisfactorily furnished and installed. Depth shall be measured from the center of the invert to the top of the lid.
	b. Payment: Payment for Sanitary Manhole shall be made based on the authorized quantity at the unit price indicated in the Bid. Payment of the applicable Contract unit price shall be full compensation for furnishing all labor, materials and equipment necessary for a complete sanitary manhole installation including excavation, sheeting, shoring and bracing, dewatering, backfill, compaction, and final grading, crushed rock base, connection of new or existing sanitary sewer, polyolefin sheeting for exterior joint sealing, adjustment of the manhole rim, interior and exterior surface coatings to provide a complete and operable sanitary manhole.
17	Bid Item 13.610.110 Install 6-inch Diameter Sanitary Sewer Lateral (0 to 5’ depth @ main)
18	Bid Item 13.610.111 Install 6-inch Diameter Sanitary Sewer Lateral (6’ to 10’ depth @ main)
19	Bid Item 13.610.112 Install 6-inch Diameter Sanitary Sewer Lateral (10’ to 15’ depth @ main)
20	Bid Item 13.620.110 Install 6-inch Diameter Double Sanitary Sewer Lateral (0 to 5’ depth @ main)
21	Bid Item 13.620.111 Install 6-inch Diameter Double Sanitary Sewer Lateral (6’ to 10’ depth @ main)
22	Bid Item 13.620.112 Install 6-inch Diameter Double Sanitary Sewer Lateral (10’ to 15’ depth @ main)
	a. Measurement: Install Sanitary Sewer Lateral shall be made per actual number of sanitary sewer laterals satisfactorily installed, depending upon sewer lateral depth.
	b. Payment: Payment will be made based on the authorized quantity at the unit price indicated in the Bid Schedule and shall include all labor, materials, and equipment necessary to install the existing sanitary sewer lateral connection including excavation, sheeting, shoring and bracing, dewatering, backfill, compaction, and grading, all incidentals, all pipe, wyes, bends and plugs necessary to provide a watertight service connection, leakage testing, protection of existing utilities, structures, and property, restoration and clean-up. This item also includes the removal and replacement of fences and gates, concrete or asphalt driveways, curb and gutter, mailboxes, trees, shrubs, irrigation sprinklers, sod and other obstructions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01027
APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.01 REQUIREMENT

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
- B. Prior to submitting a monthly payment application, the Contractor's progressive As-Built Drawings and As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection Tables shall be accepted by the County.
- C. Progressive As-Built Drawings shall indicate the horizontal and vertical locations of all current constructed improvements with sufficient information and notes to easily determine if the improvements were constructed in conformance with the Contract Documents. The progressive As-Built Asset Attribute Data, Gravity Main, and Pipe Deflection Tables shall include a Surveyor's certified statement regarding the constructed improvements being within the specified accuracies or if not, indicating the variances as described in specification Section 01050 "Surveying and Field Engineering", Table 01050-1 Minimum Survey Accuracies.

1.02 FORMAT

- A. Format and Content: Use the accepted Schedule of Values.
 - 1. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:
 - a. Generic name
 - b. Related Specification Section
 - c. Name of Subcontractor
 - d. Name of manufacturer or fabricator
 - e. Name of supplier
 - f. Dollar value
 - 2. Round amounts off to the nearest whole dollar. The total shall equal the Contract Amount.

1.03 PREPARATION OF APPLICATION

- A. Each Application for Payment shall be consistent with previous applications and payments as certified and paid for by the County.
 - 1. The initial Application for Payment: The Application for Payment at time of Substantial Completion and the final Application for Payment involve additional requirements.

- B. Payment Application Times: As stated in the General Conditions, Payment applications are to be submitted monthly on a day of the month to be established by the County at the Pre-Construction conference.
- C. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Contractor. Incomplete applications will be returned without action.
1. Submit applications typed on forms provided by the County.
 2. Use data on Bid Form and approved Schedule of Values. Provide dollar value in each column for each line item for portion of Work performed and for stored products.
 3. List each authorized Change Order and an extension or continuation sheet, listing Change Order number and dollar amount as for an original item of work.
 4. Each item shall have an assigned dollar value for the current pay period and a cumulative value for the project to-date.
 5. Submit stored material log, partial waivers of claims and mechanic liens, and consent of surety with each application, as further explained below.
- D. Submit a stored material log with each application for payment which identifies the type, quantity and value of all stored material, and that tracks when the stored materials are installed and deducts them from stored quantity at that time. Include original invoices for all stored materials that payment is requested.
- E. Waivers of Claims and Mechanics Lien: With each Application for Payment submit waivers of claims and mechanics liens from Subcontractors or Sub-subcontractors and suppliers for the construction period covered by the previous applications.
1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. The County reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of work covered by the application that could lawfully be entitled to a payment claim or lien.
 5. Waiver Forms: Submit waivers of claims and lien on forms and executed in a manner acceptable to the County.
- F. Transmittal: Submit four (4) executed copies of each Application for Payment to the County by means ensuring receipt within 24-hours. One (1) copy shall be complete, including waivers of lien and similar attachments when required.
1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the County.
 2. The Contractor shall include a certification with each application stating that all previous payments received from the County under the Contract have been applied by the Contractor to discharge in full all obligations of the Contractor in connection with the Work by prior applications for payment, and all materials and equipment incorporated into the Work are free and clear of all liens, claims, security interest and encumbrances.

- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:
1. List of Subcontractors
 2. List of principal suppliers and fabricators
 3. Schedule of Values
 4. Contractor's Construction Progress Schedule (accepted)
 5. List of Contractor's staff assignments
 6. Copies of building permits
 7. Copies of authorizations and licenses from governing authorities for performance of the Work
 8. Certificates of insurance and insurance policies
 9. Performance and Payment bonds (if required)
 10. Data needed to acquire County's insurance
- H. Monthly Application for Partial Payment: Administrative actions and submittals that must precede or coincide with submittal of Monthly Partial Payments include the following:
1. Relevant tests
 2. Progressive As-builts (one (1) paper copy and electronic copy)
 3. Table 01050-2 Asset Attribute Data Form Examples (one (1) paper copy and electronic copy)
 4. Table 01050-3 Pipe Deflection Table Example (one (1) paper copy and electronic copy)
 5. Table 01050-4 Gravity Main Table (one (1) paper copy and electronic copy)
 6. An electronic copy of all survey field notes
 7. Partial Release of lien
 8. Partial consent of surety
 9. Site photographs
 10. Updated Progress Schedule: submit one (1) electronic copy and five (5) copies
 11. Summary of Values
 12. Pay Request
 13. On-Site Storage
- I. Substantial Completion Application for Payment: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment. This application shall reflect any Certificates of Partial Substantial Completion issued previously for County occupancy of designated portions of the Work.
1. Administrative actions and submittals that shall precede or coincide with this application include:
 - a. Occupancy permits and similar approvals
 - b. Warranties (guarantees) and maintenance agreements
 - c. Test/adjust/balance records
 - d. Maintenance instructions
 - e. Meter readings
 - f. Start-up performance reports
 - g. Change-over information related to the County's occupancy, use, operation and maintenance

- h. Final Cleaning
 - i. Application for reduction of retainage and consent of surety
 - j. Advice on shifting insurance coverage
 - k. List of incomplete Work, recognized as exceptions to County's Certificate of Substantial Completion
- J. Final Completion Application for Payment: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:
- 1. Prior to submitting a request for final payment or the County issuing a Certificate of Completion for the Work, the Contractor shall submit the final Record Documents to the County for approval. Retainage funds will be withheld at the County's discretion based on the quality and accuracy of the final Record Documents.
 - 2. Completion of project close-out requirements
 - 3. Completion of items specified for completion after Substantial Completion
 - 4. Assurance that unsettled claims are settled
 - 5. Assurance that work not complete and accepted is now completed
 - 6. Transmittal of required project construction records to the County
 - 7. Proof those taxes, fees and similar obligations have been paid
 - 8. Removal of temporary facilities and services has been completed.
 - 9. Removal of surplus materials, rubbish and similar elements
 - 10. Change of door locks to County's access
 - 11. Execute certification by signature of authorized officer.
 - 12. Prepare Application for Final Payment as required in General Conditions.

1.04 SUBMITTAL PROCEDURES

- A. Submit four (4) copies of each Application for Payment at time stipulated in Agreement.
- B. Submit under transmittal letter.

1.05 SUBSTANTIATING DATA

- A. When the County requires substantiating information, submit data justifying line item amounts in question.
- B. Provide one (1) copy of data with cover letter for each copy of submittal. Show Application number and date, and line item by number and description.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01050
SURVEYING AND FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Professional Surveyor: Provide professional surveying and mapping work required for the execution of the contract, including verification of existing survey data, construction layout, and production of the As-Built Drawings. This Work shall be performed by a Surveyor that is licensed by the State of Florida as a Professional Surveyor and Mapper pursuant to Chapter 472, F.S.
- B. Professional Engineer: The Contractor shall provide the services of a Registered Professional Engineer currently licensed in the State of Florida for the following specific services as applicable to the Work.

1.02 REQUIREMENTS

A. Survey Services

- 1. The Contractor shall retain the services of a registered Surveyor and Mapper licensed in the State of Florida to provide professional surveying and mapping services, and maintain both a control survey and an as-built survey during construction. The Surveyor will identify control points (monuments and benchmarks noted on the Drawings). The construction layout survey shall be established from the control points shown on the Construction Drawings and confirmed. The method of field staking for the construction of the Work shall be at the option of Contractor. The accuracy of any method of staking shall be the responsibility of Surveyor. All staking shall be done to provide for easy verification of the Work by the County. The Contractor shall provide all surveys necessary for the construction of the Work.

B. Engineering Services

- 1. The Engineer shall be responsible for duties during Construction to include, but not limited to:
 - a. Inspections, testing, witnessing requiring a licensed Professional Engineer.
 - b. Design of temporary shoring, bridging, scaffolding or other temporary construction, formwork and protection of existing structures.
 - c. Other requirements as specified herein.
- 2. Engineering related designs, tests and inspections shall be signed by the licensed Professional Engineer as required by the County.

1.03 QUALIFICATIONS OF THE SURVEYOR

- A. The Surveyor, who is proposed by the Contractor to provide services for the Project, is subject to the approval of the County. Prior to any services being performed, the Contractor shall submit the name and address of any proposed Surveyor and a written acknowledgement from the Surveyor stating that he has the hardware, software and adequate scope of services in his agreement with the Contractor to fully comply with the requirements of this specification. These submittals shall be provided to the County prior to Notice to Proceed. It is recommended that the Surveyor attend the Pre-Construction meeting. Any Surveyor, who has not previously performed work for the County shall attend the Pre-Construction meeting.

1.04 SUBMITTALS

- A. Provide qualifications of the Surveyor or Engineer.
 - 1. A Florida Registered Professional Engineer or Registered Surveyor and Mapper, who is proposed by the Contractor to provide services for the Work, shall be acceptable to the County prior to field services being performed.
 - 2. A Professional Engineer shall be of the discipline required for the specific service for the Work.
 - 3. Submit name, address and telephone number of the Surveyor and/or Engineer, as appropriate to the County for acceptance before starting survey or engineering work.
- B. On request, submit documentation verifying accuracy of survey work.
- C. Surveyor shall certify all elevations and locations included in Table 01050- 2, 3, and 4.

PART 2 - PRODUCTS

2.01 SURVEY DOCUMENTS

- A. Survey documents shall comply with the Minimum Technical Standards of Chapter 5J-17 of the Florida Administrative Code (FAC) and Table 01050-1 Minimum Survey Accuracies, whichever are more stringent. All coordinates shall be geographically registered in the Florida State Plan Coordinate System using the contract Drawings control points for horizontal and vertical controls.
- B. The Surveyor shall not copyright any of their Work related to this project.

**Table 01050-1
Minimum Survey Accuracies**

Asset	Horizontal Accuracy (feet)	Elevation Accuracy (feet)	Location: Horizontal Center and Vertical Top, unless otherwise specified
Bench Marks	0.01	0.01	Point
Baseline Control Locational Accuracy	0.01	N/A	Point
Tract and Easement Corners	*	N/A	Survey Monuments
Mains at 100-foot maximum intervals	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
PVC pipe >16-inch at every pipe joint	0.1	0.1	Pipe, Pipe at Valves, Pipe at Bore & Jack Casing
Fittings, Sleeve, Tapping Saddle, and end of the pipe if Plugged or Capped.	0.1	0.1	Fitting
Restrained Pipe	0.1	N/A	Restrained Joint Limits
Connections	0.1	0.1	Pipe
Bore & Jack Casing	0.1	0.1	Top of Casing at the Casing Limits
Directional Drill	0.1	0.1	10-foot intervals during the directional drill operation
Hydrants	0.1	N/A	Operating Nut of Hydrant
Valves	0.1	0.1	Operating Nut
Air Release, Blow off, and Backflow Valves	0.1	N/A	Valve Enclosure
Master Meters, Deduct Meters & Wastewater Meters	0.1	N/A	Register
Meter Box	0.1	N/A	Meter Box
Clean out	0.1	N/A	Clean out
Manhole Rim	0.1	0.1	Manhole
Manhole Inverts	N/A	0.01	Pipe Inverts
Pump Station (Public & Private)	0.1	0.01	Wetwell and Pipe Inverts
Production Well or Monitoring Well	0.1	0.1	Well
Grease Interceptor	0.1	0.1	
Oil / Water Separators	0.1	0.1	
Demolished Pipe (abandoned in place or removed)	0.1	0.1	Limits of Abandoned or Removed Pipe
Existing Utilities water, wastewater, reclaimed water, and appurtenant structures **	0.1	0.1	Pipe or Structure
* Shall conform to the requirements of the "Chapter 5J-17, 'Minimum Technical Standards', FAC", certified by a SURVEYOR.			
** Existing utilities including but not limited to water, wastewater, reclaimed water, stormwater, fiber optic cable, electric, gas and structures within the limits of construction.			

**TABLE 01050-2
Asset Attribute Data Form Examples**

Hydrants Worksheet

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Manufacturer	Model #	Comments
2	FH-1	C-7	518456.40	1483743.63	49.53	Brand B	XJ7-B	
3	FH-2	C-9	518477.68	1483758.95	54.23	Brand B	XJ7-B	

Valves Worksheet

	A	C	D	E	F	G	H	I	J
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Valve Type	Main Type	Valve Size	Valve Manufacture
2	ARV-1	C301	518060.09	1483231.33	81.72	ARV - Combination	Water Main	2	Brand H
3	ARV-1	C303	518083.55	1483280.50	81.15	ARV - Vacuum	Force Main	4	Brand G
4	BFP-1	C303	518086.00	1483282.88	78.21	Backflow Preventer	Reclaimed Water Main	8	Brand F
5	BO-9	C405	518088.83	1483289.43	78.20	Blowoff	Water Main	2	Brand E
6	BFV-1	C405	518088.11	1483295.00	81.95	Butterfly	Water Main	30	Brand D
7	GV-3	C405	518132.54	1483372.75	81.23	Gate	Water Main	16	Brand C
8	LS-W1	C405	576779.36	1539706.97	64.30	Line Stop	Water Main	16	Brand B
9	PV-22	C405	576880.60	1539718.32	64.52	Plug	Force Main	12	Brand A

	J	K	L	M	N	O	P	Q
1	Valve Manufacturer	Valve Model #	# of Turns to Close	Gear Actuator	Gear Ratio	Side Actuator	uator Manufact	Comments
2	Brand H	100XT						
3	Brand G	1000						
4	Brand F	2000 fgs						
5	Brand E	14 turbo						
6	Brand D	230 xls	200	Yes	3 to 1	Yes	Brand C	
7	Brand C	2225846	300	Yes	3 to 1	NO		
8	Brand B	7n6r44						
9	Brand A	Z100	200	Yes	3 to 1	Yes	Brand A	

Manhole Worksheet

	A	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ID Number	Plan Sheet #	Easting	Northing	Rim Elevation	Invert Elv II	Invert Elv IE	Invert Elv E	Invert Elv SE	Invert Elv S	Invert Elv SW	Invert Elv W	Invert Elv IW	Manufacturer
2	MH-1	C-20	517999.15	1483092.24	82.96	76.96		76.96						Brand X
3	MH-2	C-20	517999.15	1483492.24	83.54	75.63				75.58				Brand X

Meter Worksheet

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Comments
2	MM-1	C-6	576533.64	1539520.08	58.01	Water Main	
3	RWMM-1	C-6	576937.42	1539598.78	64.84	Reclaimed Water Main	

Fitting Worksheet

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Fitting Type	Comments
2	FM-1	C-3	572399.28	1539339.13	46.27	Force Main	Bend 11 1/4°	
3	FM-2	C-3	574840.74	1539856.91	51.73	Force Main	Bend 22-1/2°	
4	FM-3	C-3	574844.01	1539856.71	52.48	Force Main	Bend 45°	
5	FM-4	C-3	574845.72	1539856.61	52.33	Water Main	Bend 90°	
6	FM-5	C-3	574845.85	1539858.77	51.98	Water Main	Cap	
7	RW-1	C-4	574884.06	1539849.64	51.75	Reclaimed Water Main	Cross	
8	RW-2	C-4	574887.22	1539849.56	48.98	Reclaimed Water Main	Reducer	
9	RW-3	C-4	574904.30	1539849.10	49.39	Reclaimed Water Main	Plug	
10	RW-4	C-4	574907.42	1539849.01	52.32	Reclaimed Water Main	Sleeve	
11	WM-1	C-5	574938.65	1539848.16	54.42	Water Main	Tapping Saddle	
12	WM-2	C-5	572532.38	1539337.10	45.27	Water Main	Tee	
13	WM-3	C-5	572631.00	1539338.00	44.13	Water Main	Wye	
14	WM-4	C-5	572731.00	1539334.00	43.77	Water Main	Tapping Sleeve	

Cleanout Worksheet

	A	C	D	E	F	G
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Comments
2	CO-1	C-6	576533.64	1539520.08	58.01	
3	CO-2	C-6	576937.42	1539598.78	64.84	

Pipes Worksheet

	A	C	D	E	F	G	H	I	J	K	L
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Main Type	Type of Shot	Instruction	Material	Pressure Class	Manufacturer
2	CSNG-1	C-4	517827.57	1482195.46	78.83	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A
3	CSNG-2	C-4	517848.20	1482195.31	78.38	Force Main	Bore & Jack (Casing)		PVC	DR18	Brand A
4	RW-1	C-7	517731.98	1482237.24	80.42	Reclaimed Water Main	Restraint Joint Limit	Open Cut	DIP	Class 250	Brand B
5	RW-2	C-7	517732.848	1482338.1	80.943	Reclaimed Water Main	Restraint Joint Limit	Open Cut	DIP	Class 250	Brand B
6	WM-1	C-9	573309.068	1539372.9	56.10	Water main	Shot on Pipe	Open Cut	PVC	DR18	Brand C
7	WM-2	C-9	573308.752	1539375	54.66	Water main	Shot on Pipe	Open Cut	PVC	DR18	Brand C
8	FMDD-1	C-4	504345.94	1488969.2	114.14	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X
9	FMDD-2	C-4	504360.86	1488970.5	112.74	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X
10	FMDD-3	C-4	504377.19	1488971.2	106.14	Force Main	Shot on Pipe	Directional Drill	HDPE	DR17	Brand X
11	FM-9	C-4	504480.47	1488982.9	105.24	Force Main	Shot on Pipe	Open Cut	PVC	DR18	Brand C

Well Worksheet

	A	C	D	E	F	G
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Comments
2	PS-1	C-40	517914.346	1482906.562	83.912	

Easements Worksheet

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Boundary Corner Type	Comments
2	Corner-1	C-8	463484.59	1511029.72		Pump Station Tract	N.W. CORNER
3	Corner-2	C-8	463523.24	1511040.01		Pump Station Tract	N.E. CORNER
4	Corner-3	C-8	463480.45	1511015.23		Pump Station Tract	S.W. CORNER
5	Corner-4	C-8	463526.97	1511025.49		Pump Station Tract	S.E. CORNER
6						Easement	
7						Property	

Existing OC Utility Crossing

	A	C	D	E	F	G	H	I
1	ID Number	Plan Sheet #	Easting	Northing	Existing Pipe Elevation	Proposed Crossing Elevation	Existing Main Type	Comments
3	Conf-1	C-750	463464.47	1511013.75	100.54	104.88	Water main	
4	Conf-2	C-750	463163.91	1510693.49	98.32	103.57	Storm Main	

Grease Interceptor

	A	C	D	E	F	G	H
1	ID Number	Plan Sheet #	Easting	Northing	Elevation	Volume (Gallons)	Comments
2	GI-1	C-400	508387.3	1487203.18	89.70	1000.00	

For ease of calculating pipe deflections in Table 01050-3, begin by providing a unique asset ID (top of pipe shots and fittings) for each utility and type, numbered sequentially along the pipe run (including changes in direction) from start to finish of the pipe in the Table 01050-2. Then branches and services of the same utility type can be numbered. It is recommended that each utility (water, wastewater or reclaimed water) numbering format be distinguishable from the other. This will allow organization and convenient sorting after the individual asset table worksheet tabs are combined in the spreadsheet program prior to copying and pasting to the deflection table spreadsheet.

**TABLE 01050-3
PIPE DEFLECTION TABLE EXAMPLE**

Project: Contractor: Progress Mtg Date: Contract # Dwg Sheet # Utility Type Pipe Manufacturer Pipe size & material PVC Manufacturer Deflection County Allowable Deflection 75% Allowable Angle of Offset Allowable Radius of Curvature Laying Length of Pipe	FM National Pipe 16" PVC C905 6 inches 4.5 inches 1.5 degrees 764 feet 20 feet	
---	---	--

ID	Size and Type	Northing	Easting	Elev.	Calculations Including Elevation (XYZ)							
					Distance between points AB	Distance between points BC	Distance between points AC	Total Deflection Ø ^a	Radius of Curve ^a	Average Offset Angle ^{***}	Average Offset ^{****}	
					Length AB ft	Length BC ft	Length AC ft	XYZ (w elevation) degrees	XYZ (w elevation) ft	per laying length degrees	per laying length inches	
14041	16" FM	1505131.50	468948.53	107.68	-	-	-	-	-	-	-	-
7000	16" FM	1505059.60	468932.08	108.15	73.76	38.93	112.66	5.48	1,178.35	0.97	4.07	
2128	16" FM	1505022.11	468921.60	108.55	38.93	39.61	78.54	2.29	1,961.65	0.58	2.45	
2127	16" FM	1504983.85	468911.35	108.29	39.61	38.35	77.96	1.78	2,505.50	0.46	1.92	
2126	16" FM	1504946.67	468901.96	107.81	38.35	39.13	77.42	8.79	505.16	2.27	9.51	
2125	16" FM	1504908.11	468895.31	107.48								

Data that has been inputted
 Values in yellow are over spec

^aUses law of cosines to determine angle ABC and Ø.
 angle ABC = arccos((AB²+BC²-AC²)/(2*AB*BC))
 180-Ø/2 = angle ABC
 Calculate the total deflection Ø.
 to the outer point (A or C) is equal in angle to
 the approach from the next point along the

^{**} Uses law of sines, using the chord length AC and radius R.
 Since sin((Ø/2)*(PI/180))=(Chord/2)/R and length AC=Chord
 R=AC/(2*sin(Ø*PI/360))
 This calculation assumes an average radius over the bend between three points.

^{***} Adds the lengths of AB + BC / 20ft to get an approximate number of bends over the span.
 This value is divided by the total deflection
 angle to calculate the average bend angle of
 This assumes that the bend angle consistent across the entire length.

^{****} Uses average offset angle and laying length of pipe.

PART 3 - EXECUTION

3.01 SURVEY FIELD WORK

- A. Locate, reference, and preserve existing horizontal and vertical control points and property corners shown on the Drawings prior to starting any construction work. If the Surveyor performing the Work discovers any discrepancies that will affect the Project, the Contractor must immediately report these findings to the County. All survey work shall meet the requirements as defined in Florida Administrative Code 5J-17. Reference and preserve all survey points during Construction. If survey points are disturbed, it is the responsibility of the Contractor's Surveyor to reset the points at the Contractor's expense. Copies of the Surveyor's field notes and/or electronic files for point replacement shall be provided to the County.
 - 1. The Surveyor shall locate all improvements for the project As-Built Asset Attribute Data using State Plane Coordinates as the horizontal datum and the benchmark referenced on the Drawings as the vertical datum. The County will provide electronic files of the Drawings to be used by the Surveyor in complying with these specifications.
 - 2. The construction layout shall be established from the reference points shown or listed on the Drawings. The accuracy of any method of staking shall be the responsibility of the Contractor. All construction layout staking shall be done such as to provide for easy verification of the Work by the County.

- B. Only a Surveyor licensed in the State of Florida shall be employed for this Work. All control points shall be protected by the Contractor from disturbance. If the monuments are disturbed, any Work that is governed by these monuments shall be held in abeyance until the monuments are reestablished by the Contractor and approved by the County. The accuracy of all the Contractor's stakes, alignments and grades is the responsibility of the Contractor. However, the County has the discretionary right to check the Contractor's stakes, alignments, and grades at any time.

- C. Use survey control points to layout such work tasks including but not limited to:
 - 1. Clearing, grubbing, work limits, right-of-way lines and easements
 - 2. Locations for pipelines and all associated structures and appurtenances

- D. The Surveyor shall reference and replace any project control points, boundary corners, benchmarks, section corners, and right-of-way monuments that may be lost or destroyed, at no additional cost to the County. Establish replacement points based on the original survey control. Copies of all reference field notes and/or electronic files for point replacement shall be submitted to the County.

3.02 SURVEYING

- A. Locate and protect existing horizontal and vertical control points shown on the construction Drawings prior to starting any work. If the Surveyor performing the Work finds differences that will effect the Work, the Contractor must immediately report the findings to the County. Establish control points, lines and levels by instrumentation and similar appropriate means. The location of these points should minimize the number of sightings necessary to control the Work and the likelihood of the points being disturbed. Preserve and reference all permanent reference points during Construction. If permanent reference points are disturbed, it is the responsibility of the Contractor's Surveyor to reset the points at the Contractor's expense. Copies of the Surveyor's field notes shall be provided to the County.
 - 1. Record locations, with horizontal and vertical data, on project As-Built survey.
 - 2. Make no changes or relocations without prior written notice to the County or without receipt of written approval from the County.
 - 3. Report to the County when any control point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
- B. Cover for water, reclaimed water and force mains shall vary to provide long uniform gradient or slope to pipe to minimize air pockets and air release valves. The locations shown on the Drawings for air and vacuum release valve assemblies are approximate and the Contractor shall field adjust these locations to locate these valves at the highest point in the pipeline installed.
- C. To insure a uniform gradient for gravity pipe and pressure pipe, all lines shall be installed using the following control techniques as a minimum:
 - 1. Gravity lines: Continuous control, using laser beam technology,
 - 2. Pressure lines: Control stakes set at 50 ft. intervals using Surveyor's level instrument.

3.03 SURVEY DOCUMENTS

- A. The Tables 01050-2 Asset Attribute Data, 01050-3 Pipe Deflection Table, and 01050-4 Gravity Main Table shall be signed, sealed and dated by the Surveyor with each pay request as specified in Section 01027 "Application for Payment" and the requirements of Section 01720 "Project Record Documents."

END OF SECTION

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SECTION 01065
PERMITS AND FEES

PART 1 - GENERAL

1.01 REQUIREMENTS

A. General

1. Upon Notice of Award, obtain and pay for all appropriate and applicable permits and licenses as provided for in the General Conditions, except as otherwise provided herein.
2. Schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.
3. Strictly adhere to the specific requirements of the governmental unit(s) or agency(cies) having jurisdiction over the Work. Whenever there is a difference in the requirements of a jurisdictional body and the Contract Documents, the more stringent shall apply.
4. A copy of the permits obtained by the County are furnished in Appendix C "Permits Obtained by County" of these specifications.
5. Unless otherwise specified, the cost of work specified in the various sections of Division 1, will not be paid for separately but the cost therefore shall be considered incidental to and included in the bid prices of the various Contract items.

B. Building Permit (Orange County)

1. The County will pay the general building permit fee and any related impact fees or assessments to be paid to Orange County for the issuance of that permit only.
2. The Contractor shall pay all fees associated with obtaining Orange County trade permits and any and all inspection fees for the Orange County Building Department providing inspections for this project. The Contractor shall apply for and obtain the building permits from Orange County and schedule and obtain final approval from the building inspectors.
3. Information on Orange County Building Department fees is included in the Instructions to Bidders in Division 0.
4. The Contractor shall be responsible for scheduling all permit inspections and obtaining inspection approval from Orange County, as required by the building and sub-discipline construction permits.

C. Construction Dewatering Permit

The Contractor shall apply and pay for all fees associated with obtaining Florida Department of Environmental Protection District Office construction dewatering permits, if required. The Contractor shall provide all materials and equipment to comply with the permit requirements at no additional cost to the County.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01070
ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Reference to the following standards of any technical society, organization or body shall be construed to mean the latest standard, code or specification or tentative specification adopted and published at the date of advertisement for bids, even though reference has been made to an earlier standard. Such reference is hereby made a part of the Contract the same as if herein repeated in full and in the event of any conflict between any of these specifications, standard codes or tentative specifications and the Contract Documents, the most stringent shall govern.

AA	Aluminum Association
AASHTO	American Association of State Highway and Transportation Officials
ABPA	Acoustical and Board Products Association
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	American Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASA	American Standards Association (now ANSI)
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSCBC	American Standard Safety Code for Building Construction
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWBP	American Wood Preservers Board
AWS	American Welding Society
AWWA	American Water Works Association

CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard
DOT Spec	Standard Specification for Road and Bridge Construction –
FDOT	Florida Department of Transportation
FAC	Florida Administrative Code
FS	Federal Standard
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NACE	National Association of Corrosion Engineers
NASSCO	National Association of Sewer Service Companies
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NEC	National Electrical Code
NECA	National Electrical Contractor's Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NPT	National Pipe Threads
NSF	National Science Foundation
OSHA	U.S. Department of Labor, Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	United States Products Standards
SAE	Society of Automotive Engineers
SDI	Steel Decks Institute
SJI	Steel Joists Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Structural Steel Painting Council
UL	Underwriter's Laboratories, Inc.
USASI	United States of American Standards Institute (Now ANSI)

B. UNITS OF MEASUREMENT

CU FT	cubic feet
CU IN	cubic inch(es)
CY	cubic yard(s)
DegC	degree(s) Centigrade
DegF	degree(s) Fahrenheit
F	Fahrenheit
FT	feet, foot
G	gram(s)
GA	gage
GAL	gallon(s)
GPH	gallon(s) per hour
GPM	gallon(s) per minute

GPS	gallon(s) per second
HR	hour(s)
IN	inch(es)
IPS	iron pipe size
KG	kilogram(s)
L	liter(s)
LB	pound(s)
LBF-IN	pound (force) inch
LF	linear foot, linear feet
MIN. min.	minute(s), minimum
ml	milliliter
MO	month(s)
OZ	ounce(s)
QT	quart
RH	relative humidity
SF	square foot, square feet
SQ IN	square inch(es)
YD	yard(s)
YR	year(s)

C. TERMINOLOGY

@	at
AB	anchor bolt
ADJ	adjust, adjustable
ADMIN	administration
AFG	above finished grade
AGGR	aggregate
AL	aluminum
ALT	alternate
APPX	appendix
APX	approximate
ART	article
ASPH	asphalt
ASSY	assembly
AUTO	automatic
AUX	auxiliary
AVE	avenue
AVG	average
AWG	American Wire Gauge
BAR	barrier
BCCMP	bituminous coated corrugated metal pipe
BL	base line
BLDG	building
BLKG	blocking
BM	beam

C to C	center to center
CCB	concrete block, masonry
CEM	cement
CIP	cast iron pipe, cast in place
CJ	construction joint
CL	center line, clearance
CM	Construction Manager
CMP	corrugated metal pipe
CO	cleanout
CONC	concrete
CONN	connection
CONST	construction
CONT	continuous
CONTR	contractor
CU, COP	copper
ORR	corridor
CRIT	critical
CTD	coated
CTR	center
CULV	culvert
d	delta
DBL	double
DEM	demolition, demolish
DEPT	department
DET	detail
DIA, D	diameter
DIAG	diagonal
DIM	dimension
DWG	drawing
FEM	female
FUT	future
FV	field verify
FM	force main
FH, HYD	fire hydrant
ID	inside diameter
MAS	masonry
MATL	material
MAX	maximum
MFD	manufactured
MFG	manufacturing
MFR	manufacturer
MH	manhole, metal hallide
MIN	minimum
MISC	miscellaneous
MTL	material

NAT	natural
NATL	national
NOM	nominal
NTS	not to scale
OD	outside diameter
PP	power pole
R	radius
Rd	road
REIN	reinforce
REL A	relief air
REQD	required
REV	revision
RR	railroad
R/W	right-of-way
RWM	reclaimed water main
RY	railway
SAN	sanitary
SCH	schedule
SECT	section
SLV	sleeve
SQ	square
SST	stainless steel
ST	street
STA	station
STD	standard
SURF	surface
SUSP	suspend(ed)
SYM	Symbol, symmetrical
SYS	system
TEMP	Temperature, temporary
TYP	typical
UTIL	utility
W	West
WLD	welded
WM	water main
W/O	without
WT	weight
YD	yard
YR	year
Y W	wye

END OF SECTION

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SECTION 01091
REFERENCE SPECIFICATIONS

PART 1 - GENERAL

1.01 GENERAL

- A. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of or omission from said standards or requirements.

- B. Assignment of Specialists: In certain instances, specification test requires (or implies) that specific work is to be assigned to specialist or expert entities who must be engaged for the performance of the Work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work. They are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the Contractor.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all Work specified herein shall conform to or exceed the requirements of such referenced documents which are not in conflict with the requirements of these Specifications or applicable codes.

- B. References herein to "Building Code" shall mean the Florida Building Code. The latest edition of the code shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

- C. In case of conflict between codes, reference standards, Drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or labor. The Contractor shall bid the most stringent requirements.

D. Applicable Standard Specifications: The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01200
PROJECT MEETINGS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Contractor participation in pre-construction conferences, progress meetings and specially called meetings.

1.02 MEETINGS CALLED BY THE COUNTY

- A. The County will schedule and administer a pre-construction conference, periodic progress meetings and specific topic meetings throughout the progress of the Work. The County will:
 - 1. Prepare and distribute a notification of the meeting to required attendees.
 - 2. Establish, prepare and distribute an agenda with the notification.
 - 3. Make physical arrangements for the meetings.
 - 4. Preside at meetings.
 - 5. Prepare and distribute minutes of meetings including significant proceedings and decisions, within 15 working days after each meeting. Minutes will be forwarded to all participants and to parties affected by decisions made at the meeting.
- B. Representatives of the Contractor, Subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. The meeting location will generally be a central site, convenient for all parties, designated by the County.

1.03 PRE-CONSTRUCTION CONFERENCE

- A. Attendance:
 - 1. County
 - 2. Contractor and superintendent
 - 3. Subcontractors as appropriate to the agenda
 - 4. Representatives of suppliers and manufacturers as appropriate to the agenda
 - 5. County MBE/WBE representative
 - 6. Other agency representatives (FDEP, EPA, City, etc.)
 - 7. Others as requested by the County or Contractor

B. Suggested Agenda:

1. Distribution and discussion of:
 - a. List of major Subcontractors and suppliers
 - b. Construction schedules
 - c. Contact information
2. Organizational arrangement of Contractor's forces and personnel, and those of Subcontractors, material and equipment suppliers, and the County
3. Critical work sequencing
4. Major equipment deliveries
5. Project coordination
 - a. Designation of responsible personnel
 - b. Channels and procedures for communication
6. Procedures and processing of:
 - a. Field decisions
 - b. Proposal requests
 - c. Submittals
 - d. Change orders
 - e. Applications for payment/Schedule of Values
 - f. Contractor quality control
 - g. Submittal of Shop Drawings, project data and samples
7. Adequacy of distribution of Contract Documents
8. Procedures for maintaining as built and record documents
9. Use of premises:
 - a. Office, work and storage areas
 - b. County's requirements
 - c. Housekeeping
10. Temporary construction facilities
11. Temporary utilities
12. Safety and first aid procedures
13. Rules and regulations
14. Security procedures
15. Place, date and time for regular progress meetings
16. Completion time for Contract and liquidated damages

1.04 PROGRESS MEETINGS

- A. The County will schedule progress meetings every month and as required by progress of the Work with the first meeting (one) 1-month after the pre-construction meeting. The Contractor will prepare and distribute the meeting minutes within 7 calendar days.
- B. Attendance:
 1. County
 2. Contractor
 3. Subcontractors as appropriate to the agenda
 4. Suppliers as appropriate to the agenda
 5. Others as appropriate

- C. The Contractor's representative is to attend the project meetings and have the authority to act on behalf of the entity represented on field related matters. Contractor's representative is to study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics and provide specific information including but not limited to:
 - 1. Status of submittals and actions necessary to expedite them
 - 2. Status of activities behind schedule and actions necessary to regain the approved schedule
 - 3. Status of materials and equipment deliveries and action necessary to expedite materials and equipment and maintain the approved schedule
 - 4. Status of open RFI's and actions necessary to address them
- D. To the maximum extent practicable, the Contractor is to assign the same personnel to represent the Contractor at Progress Meetings throughout the progress of the Work.
- E. The Contractor is to provide a current Shop Drawing submittal log at each progress meeting.
- F. The Contractor is to provide copies of the updated Progress Schedule at each project meeting in accordance with the General Conditions.
- G. Suggested Agenda:
 - 1. Review and approve minutes from previous meeting
 - 2. Review of Work progress since previous meeting to include current As-Builts
 - 3. Contractor's/Subcontractor's workforce and equipment
 - 4. Progressive As-Built Drawings
 - 5. Surveyor's submittals
 - a. As-Built Asset Attribute Data Table (see Table 01050-2)
 - b. Pipe Deflection Table (see Table 01050-3)
 - c. Gravity Main Table (see Table 01050-4)
 - 6. Field observations, problems and conflicts
 - 7. Construction progress and problems which impede construction schedule
 - 8. Shop Drawing submittal status
 - 9. Requests for Information (RFI) status
 - 10. Change order status
 - 11. Review of off site fabrication and delivery schedules
 - 12. Corrective measures and procedures to regain approved schedule
 - 13. Revisions to construction schedule
 - 14. Job progress and schedule for succeeding work period
 - 15. Coordination of schedules
 - 16. Maintenance of quality standards
 - 17. Review submittal schedule; expedite as required
 - 18. Pending requests for information, changes and substitutions
 - 19. Review proposed changes for effect on construction schedule and completion date
 - 20. Pay application status
 - 21. Other business

H. Revision to Minutes:

1. Unless minutes are challenged, in writing, prior to the next regularly scheduled Progress Meeting, they will be accepted as properly summarizing the discussions and decisions of the meeting.
2. Persons challenging minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
3. Challenge to minutes shall be settled as priority portion of "old business" at next regularly scheduled meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

Work completed without approved Shop Drawings and/or samples shall be considered installed at the Contractor's risk.

1.01 SHOP DRAWINGS AND DATA

- A. Shop Drawings defined in the General Conditions, shall complement design and construction Drawings, and shall contain sufficient detail to clearly define all aspects of the Construction. These Drawings shall be complete and detailed.
- B. Contractor and Supplier's catalog sheets, brochures, diagrams, illustrations and other standard descriptive data shall be clearly marked with specification title and numbers to identify pertinent materials, product or models. Delete information which is not applicable to the Work by striking or cross-hatching.
- C. If Shop Drawings show variations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in the letter of transmittal. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations, the Contractor shall not be relieved of the responsibility for executing the Work in accordance with the Contract, even though such Drawings have been reviewed.
- D. Data on materials and equipment shall include, without limitation, materials and equipment lists, catalog data sheets, cuts, performance curves, diagrams, verification of conformance with applicable standards or codes, materials of construction and similar descriptive material. Materials and equipment list shall, for each item, give the name and location of the Supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data.
- E. For all equipment furnished, the Contractor shall provide a list including the equipment name and address and telephone number of the Supplier's representative and service company so that service and/or spare parts can be readily obtained.
- F. The Contractor will obtain an installation list from suppliers and equipment suppliers who propose to furnish equipment or products for submittal to County/Professional along with the required Shop Drawings. The installation list shall include at least 5 installations where identical equipment has been installed and has been in operation for a period of at least 1-year.

1.02 REVIEW OF SHOP DRAWINGS AND SAMPLES

- A. The County /Professional's review of Shop Drawings, Data, and Samples as submitted by the Contractor will be to determine if the items(s) generally conform(s) to the information in the Contract Documents and is/are compatible with the design concept. The County/Professional's review and exceptions, if any, will not constitute an approval of dimensions, connections, quantities, and details of the material, equipment, device, or item shown.
- B. The review of drawings and schedules will be general, and shall not be construed:
 - 1. As permitting any departure from the Contract Documents
 - 2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials
 - 3. As approving departures from details furnished by the County/Professional, except as otherwise provided herein
- C. If the drawings or schedules as submitted describe variations and show a departure from the Contract Documents which the County/Professional finds to be in the interest of the County and to be so minor as not to involve a change in Contract Price or Contract Time, the County/Professional may return the reviewed drawings without noting an exception.
- D. "Approved As Noted": Contractor shall incorporate County/Professional's comments into the submittal before release to manufacturer. The Contractor shall send a letter to the County/Professional acknowledging the comments and their incorporation into the Shop Drawing.
- E. "Amend and Resubmit": Contractor shall resubmit the Shop Drawing to the County/Professional. The resubmittal shall incorporate the County/Professional's comments highlighted on the Shop Drawing.
- F. "Rejected": Contractor shall correct, revise and resubmit Shop Drawing for review by County/Professional.
- G. Resubmittals will be handled in the same manner as first submittals. For resubmittals the Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than the corrections requested by County/Professional on previous submissions. The Contractor shall make any corrections required by the County/Professional.
- H. If the Contractor considers any correction indicated on the Drawings to constitute a change to the Drawings or Specifications, the Contractor shall give written notice thereof to the County/Professional.

- I. When the Shop Drawings have been completed to the satisfaction of the County/Professional, the Contractor shall carry out the Construction in accordance therewith and shall make no further changes therein except upon written instructions from the County/Professional.
- J. No partial submittals will be reviewed. Submittals not deemed complete will be stamped "Rejected" and returned to the Contractor for resubmittal. Unless otherwise specifically permitted by the County/Professional, make all submittals in groups containing all associated items for:
 - 1. Systems
 - 2. Processes
 - 3. As indicated in specific Specifications Sections
All drawings, schematics, manufacturer's product data, certifications, and other Shop Drawing submittals required by a system specification shall be submitted at one time as a package to facilitate interfaces checking.
- K. Only the County/Professional shall utilize the color "red" in marking Shop Drawing submittals.
- L. Failure to comply with any of the above may result in the rejection of Shop Drawings.

1.03 PRODUCT DATA

- A. Submit not less than 6-copies, unless approved by the County/Professional. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information unique to the Work.

1.04 MANUFACTURERS' INSTRUCTIONS

- A. When required in an individual Specification Section, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing, in quantities specified for product data.

1.05 SAMPLES

- A. Submit full range of manufacturers' standard colors, textures and patterns for the County's selection. Submit samples for selection of finishes within 30-days after Award of Contract. All color and finish selections must be submitted by the Contractor in a single submission, properly labeled and identified.
- B. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.

- C. Submit the number of samples specified in the respective Specification section, but no less than two (2). After review one (1) will be retained by the County. Reviewed samples that may be used in the Work are indicated in the Specification Section.
- D. Samples shall be delivered to the County as directed. The Contractor shall prepay shipping charges on samples. Materials or equipment for which samples are required shall not be used in the Work until approved by the County/Professional.
- E. Samples shall be of sufficient size to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices
 - 2. Full range of color, texture and pattern
 - 3. Each sample shall have a label indicating:
 - a. Name of Project
 - b. Name of Contractor and Subcontractor
 - c. Material or equipment represented
 - d. Place of origin
 - e. Name of product and brand (if any)
 - f. Location in Project
 - g. Specification title and number
 - h. Submittal number
 - i. Note: Samples of finished materials shall have additional marking that will identify them under the finished schedules.
- F. The Contractor shall prepare a transmittal letter, in triplicate (3) for each shipment of samples containing the information required in paragraph herein. The Contractor shall enclose a copy of this letter with the shipment and send a copy of this letter to the County/Professional. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any Contract requirements.
- G. Approved samples not destroyed in testing shall be sent to the County or stored at the site of the Work. Approved samples of the hardware in good condition may be incorporated in the Work if requested in writing by the Contractor and approved in writing by the County/Professional. Samples that failed testing or were not approved will be returned to the Contractor at the Contractor's expense, if so requested at time of submission.

1.06 FIELD SAMPLES

- A. Provide field samples of finishes as required by individual Specifications sections. Install the sample completely and finished. Acceptable samples in place may be retained in completed Work.

1.07 DRAWINGS, PRODUCT DATA AND CERTIFICATES

- A. Each letter of transmittal shall identify each and every item transmitted by title, drawing number, revision number and date.

- B. The County generally will not check dimensions, quantities or schedules, except in cases where the information is lacking in the Specifications.
- C. The following is applicable to submitted drawings, data and certificates:
 - 1. Show relation to adjacent structures or materials.
 - 2. Clearly identify field dimensions.
 - 3. Show required dimensions and clearances.
 - 4. Performance characteristic and capabilities shall accompany original Shop Drawing submittals.
 - 5. Wiring diagrams and controls shall accompany original Shop Drawing submittals.
 - 6. Installation instructions shall accompany original Shop Drawing submittals.
 - 7. Each submittal shall identify applicable Standards, such as ASTM number or Federal Specification number.
 - 8. All information not pertinent shall be removed from the submittal, or shall be crossed out.
- D. When resubmission is required, the County/Professional will return only two (2) marked up copies. A third submission from the same manufacturer will not be accepted.

1.08 SUBSTITUTIONS

- A. The substitution requirements of this Section are in addition to the requirements of the General Conditions and Supplementary Conditions.
- B. When a particular product is specified or called for, it is intended and shall be understood that the proposal tendered by the Bidder includes those products in his Bid. Substitutions will only be considered in cases where original materials are unavailable or in an instance where substitute can be proven superior in its planned application
- C. The intent of these specifications is to provide the County with a quality facility without discouraging competitive bidding. For products specified only by reference standards, performance and descriptive methods, without naming manufacturer's products, the Contractor may provide the products of any manufacturer complying with the Contract Documents, subject to the review of product data by the County/Professional as specified herein.
- D. The County/Professional's approval is required for substitutions.
- E. The Contract is based on the materials, equipment and methods described in the Contract Documents.
- F. The County/Professional will consider proposals for substitution of materials equipment and methods only when such proposals are accompanied by full and complete technical data and all other information required by the County/Professional to evaluate the proposed substitution.

- G. Do not substitute materials, equipment or methods unless such substitution has been specifically approved for this Work by the County/Professional in writing. The Contractor must provide a submittal per this Section specifically requesting approval of the substitution. Failure to specifically identify the requested substitution may invalidate approval of a submittal.

1.09 AVAILABILITY OF SPECIFIED ITEMS

- A. Verify prior to bidding that all specified items will be available in time for installation during Construction for orderly and timely progress of the Work.
- B. In the event that specified items will not be available, notify the County/Professional prior to receipt of proposals.

1.10 OPERATING MANUALS

- A. Submit all manuals in accordance with requirements of Divisions 2 through 16 of the Contract Specifications and Section 01700 "Project Closeout."

1.11 WARRANTIES, GUARANTEES AND BONDS

- A. Provide as required by Technical Sections of the Specifications and Sections 01700 "Project Closeout" and Section 01740 "Warranties and Bonds."

1.12 CADD FILES

- A. The Professional's CADD files will be available on a limited basis to qualified firms at the County's prerogative. The procedure for requesting such files is noted elsewhere in these documents and there is a cost associated with handling and reproduction. Recipients are cautioned that these files may not accurately show actual conditions as constructed. Users are responsible to verify actual field conditions.
- B. The Professional's Drawings are to be used only for background information. If the Professional's Drawings are just reproduced and resubmitted (e.g. for ductwork drawings) they will be rejected.
- C. Copies of data furnished by the County/Professional to Contractor or Contractor to County/Professional that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

- D. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60-days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- E. When transferring documents in electronic media format, the transferring party makes no representations as to long-term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

1.13 PROGRESS PHOTOGRAPHS

- A. Photographs and digital pictures shall be in color. Provide 1 copy of each digital picture on each of three (3) CDs and provide 1 print of each photograph in two (2) separate albums.
- B. Photographs shall be from locations to illustrate the condition of Construction and state of progress adequately.
- C. Provide up to 12 digital photographs of views randomly selected by the County, taken prior to any construction and prior to each scheduled Application for Payment.
- D. Deliver electronic images, prints, and negatives to the County.
- E. Each print shall be single weight paper with glossy finish and the overall dimension shall be 7-1/2-inch x 10-inches (19.05 x 25.4 cm). The print shall be clear, sharp and free of distortion after the enlargement from the negative.
- F. Provide loose-leaf albums for each set of photographs to hold prints with a maximum of 50-leaves per binder.
- G. Each print shall be protected by flexible, transparent acetate or plastic sheet protector leaves with metal reinforced holes. Two (2) extra leaves shall be provided in each binder.
- H. Capture and provide digital, ortho-rectified, true-color, aerial photographs of the complete project site prior to start of Construction and at final completion. A final 6-inch or less ground pixel resolution is required. If using traditional photography, the photos will need to be captured at an appropriate scale and scanned at a high enough dpi to yield a final ground pixel size of 6-inches or less. If captured digitally, a final 6-inches or less ground sample distance is required. The final orthorectified photos shall use a projection of NAD 27, State Plane West and all vertical reference shall be NAVD 88, US feet. All orthophoto mosaics shall meet a final accuracy of plus or minus 5-feet.

- I. Provide a total of four (4) true-color, color balanced orthophoto mosaic prints. Three (3) prints each of the pre and post construction (final completion) orthophoto mosaics, for a total of six (6). Each orthophoto mosaic print shall be on double-weight paper with glossy finish and shall have overall dimensions of 36-inches x 58-inches. Two (2) copies of each of the digital orthophoto mosaics shall be supplied in Geotiff format on disk for each time period (pre and post construction). The final color balanced, true-color orthophoto mosaics will be projected in NAD 27, State Plane West and all vertical reference shall be NAVD 88, US feet and shall meet a final accuracy of plus or minus 5-feet.
- J. The Contractor shall provide before and after photographs of each portion of the site. The below ground facilities shall include all equipment, walls, floor, piping, supports and entrance. At major locations, photographs shall include before, during, and after prints and all prints shall be placed in binders in ascending date order to show the Work as it progresses.
- K. Descriptive Information:
 - 1. Each photograph shall have a permanent title block on the back and shall contain the typed information and arrangement as follows:
 - a. ORANGE COUNTY, FLORIDA
 - b. (ENTER PROJECT NAME)
 - c. BID No. (Enter Bid Number)
 - d. CONTRACTOR: (Name of Contractor)
 - e. DATE: (When photo was taken)
 - f. PHOTO NO.: (Consecutive Numbers)
 - g. PHOTO BY: (Firm Name of Photographer)
 - h. LOCATION: (Description of Location and View)
 - 2. The Contractor shall provide the Professional with a written description of each photograph. This description shall be included in the binders and a copy shall be submitted with the CDs.

1.14 PROJECT RECORD DOCUMENTS

Project Record Documents shall be submitted in accordance with Section 01720 "Project Record Documents" of these specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SUBMITTAL PROCEDURES

- A. Article 9 of the General Conditions contains additional provisions regarding submittals.

- B. Preliminary Shop Drawing Data: Within 20-days after the Award of the Contract or before the Pre-Construction Meeting, the Contractor shall submit to the County/Professional a complete listing of manufacturers for all items for which Shop Drawings are to be submitted.
- C. Shop Drawing Submittal Schedule: Within 30-days after the Notice to Proceed, the Contractor shall submit to the County/Professional a complete schedule of Shop Drawings submittals with the respective dates for submission, the beginning of manufacture, testing and installation of materials, supplies and equipment, noting those submittals critical to the progress schedule.
- D. Submittal Log: An accurate updated log of submittals will be maintained by the Contractor and subject to review by the County/Professional at each scheduled progress meeting.
- E. If the Contractor considers any correction indicated on the Drawings to constitute a change to the Contract Drawings or specifications, the Contractor shall give written notice thereof to the County/Professional. This does not constitute a change order until accepted by the County.
- F. Shop Drawing and submittal data shall be reviewed by the County/Professional for each original submittal and first resubmittal; thereafter review time for subsequent resubmittals shall be charged to the Contractor. The Contractor shall reimburse the County for services rendered by the County/Professional at the rate multiplied by the County's Professional multiplier based on the fee schedule provided to the County for this Project. If a County engineer is performing any portion of the review, this fee is based upon the hourly rate of the engineer times the County's multiplier for overhead, benefits, and expenses. The Contractor agrees that the County shall deduct such charges from the Contract Amount by a deductive Change Order.
- G. Contractor Shop Drawing and Sample submittals shall include 5 copies in addition to any other copies that the Contractor wants returned. The County will retain 5 copies of approved submittals.
- H. Identify Project, Project Number, date, dates of previous submittals, Contractor, Sub-Contractors, suppliers with their addresses, pertinent Drawings by sheet and detail number, and Specification Section number, as appropriate. Identify all deviations from the Contract Documents. Provide space for Contractor and Professional review stamps.
- I. Contractor's delivery of Shop Drawings for review shall follow a reasonable sequence, as is necessary to support the dates on the Progress Schedule and avoid an overload of Shop Drawings awaiting review at any one time. Coordinate submittal of related items.

- J. Submit Shop Drawings per the schedule of Shop Drawing submittals, inserted in 1 loose-leaf binder, with tabs and index to the County/Professional. All individual submittal sheets inserted in said binder must be clearly marked and referenced to proper paragraph and subparagraph of specifications. Cross out any items on sheets which constitute information not pertaining to equipment specified. Clearly mark all components that are provided as "optional" by manufacturer. Shop Drawings shall be approved by the Contractor prior to submittal to the County/Professional. Shop Drawings will be reviewed by the County/Professional. After County/Professional approval, reproduce and distribute in accordance with requirements herein.
- K. All submissions of Shop Drawings, brochures and catalog cuts shall be accompanied by a transmittal letter listing the Drawings submitted by number and title.
- L. When engineering calculations and/or professional certification of performance criteria of materials, systems, and/or equipment are required, the County is entitled to rely upon the accuracy and completeness of such calculations and certifications submitted by the Contractor. Calculations, when required, shall be submitted in a neat, clear and in an easy to follow format. Such calculations and/or certifications shall be signed and sealed by a Professional Engineer registered in the State of Florida.
- M. Distribute copies of reviewed submittals to concerned parties. Instruct recipients to promptly report any inability to comply with provisions.
- N. Prior to submission of Shop Drawings and samples, the Contractor shall stamp and sign the submittals. Any submission which, upon examination by the County, shows evidence of not having been thoroughly checked, or is not in compliance with the provisions of this Section will be returned to the Contractor for completion before it will be considered for review.
- O. Notify the County of the need for making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the material or equipment Contractor proposes to supply.
- P. On resubmittals, direct specific attention in writing or on the revised Drawings or sample to revisions other than the corrections required by County on previous submissions.
- Q. All drawings, schematics, manufacturer's product data, certifications and other drawing submittals required for a system specification shall be submitted at one time as a package to facilitate interface checking.
- R. The County will distribute Shop Drawings as follows for the indicated action taken:

SHOP DRAWING SUBMITTAL DISTRIBUTION

Representative Party	No Exception Taken or Make Correction Noted			Rejected or Revise & Resubmit		
	Submittal Transmittal	Shop Drawing	Review Comment Sheet	Submittal Transmittal	Shop Drawing	Review Comment Sheet
Engineer	2 Copies	File Copy	1 Copy	Original	File Copy	1 Copy
Contractor (see Note 1)	2 Copies	1 Copy Each Submittal	1 Copy	1 Copy	All Copies Except Engineers	1 Copy
County	1 Copy	1 Copy Each Submittal	1 Copy	1 Copy	None	1 Copy
Inspector	2 Copies	1 Copy Each Submittal	1 Copy	1 Copy	None	1 Copy
Project Record Data (see Note 2)	1 Copy	1 Copy Each Submittal	1 Copy	1 Copy	None	1 Copy

NOTES:

1. Contractor shall distribute additional copies to Subcontractors as required.
2. Stored by Contractor to be furnished to County upon closeout.

- S. All Shop Drawings shall be accompanied with a transmittal letter providing the following information:
1. Project Title and Contract Number
 2. Date
 3. Contractor's name and address
 4. The number of each Shop Drawing, project data, and sample required
 5. Notification of Deviations from Contract Documents
 6. Submittal Log Number conforming to specification section numbers
 - a. Submit each specification section separately.
 - b. Identify each Shop Drawing item required under respective specification section.
 - c. Identify resubmittal using specification section followed by A (first resubmittal), B (second resubmittal)...etc.

3.02 CONTRACTOR'S REVIEW

- A. Contractor's Responsibility for Coordination: Where the dimension, size, shape, location, capacity or other characteristic affects another item, and where the Contractor selects, fabricates or installs related or adjacent products to be used, the Contractor shall be responsible for coordination of related items. The Contractor shall insure that a proper exchange of information takes place prior to or during preparation of each submittal and that submittals reflect such coordination. The notation "verify" or "coordinate" on the Drawings indicates the necessity for Contractor coordination in the particular instances used.

- B. Contractor's Checking: When checking submittals from Subcontractors and suppliers, the Contractor shall mark all sets, indicating his corrections and comments in blue or green. Copies marked in red may be returned for revision.
- C. The Contractor is responsible to deliver and pick-up all submittals in a timely manner at the County/Professional's designated office. The Contractor is responsible for all related costs and expenses for the transmittal of such submittals.

3.03 COUNTY'S / PROFESSIONAL'S REVIEW

- A. Corrections or comments made on Shop Drawings during review do not relieve the Contractor from compliance with the requirements of Drawings and Specifications. This check is only for review of general conformance with the design concept of this Project and general compliance with information given in Contract Documents. Any substitutions or changes shall be properly noted.
- B. No action will be taken on "rough-in" Shop Drawings for plumbing and electrical connections when the items of equipment are not included in the same submittal.
- C. Review Time:
 - 1. On a normal basis, each submittal will be returned to the Contractor within 15 working days of the date it is received. Some submittals may require additional time.
 - 2. If, for any reason, the above schedule cannot be met, the Contractor will be so informed within a reasonable period and the Schedule of Submittals revised. If the specific submittal affects the critical path, the Contractor shall immediately notify the County/Professional in writing. In the event of separate submittals of individual components of a system, these submittals may be held until all components of the system are submitted, and the Contractor will be so notified.

END OF SECTION

SECTION 01301
PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.01 SUMMARY

A. General

1. Base all bids on materials and equipment specified in the Appendix D Orange County Utilities List of Approved Products.
2. Certain types of equipment and kinds of material are described in specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers.
 - a. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog numbers, provided said products are "or-equals," as determined by County/Professional.
3. Other types of equipment and kinds of material may be acceptable substitutions under the following conditions:
 - a. Or-equals are unavailable due to strike, discontinued production of products meeting specified requirements, or other factors beyond control of Contractor; or,
 - b. Contractor proposes a cost and/or time reduction incentive to the Owner.

1.02 QUALITY ASSURANCE

A. In making request for substitution or in using an approved product, Contractor:

1. Has investigated proposed product, and has determined that it is adequate or superior in all respects to that specified, and that it will perform the function for which it is intended.
2. Will provide same guarantee for substitute item as for product specified.
3. Waives all claims for additional costs related to substitution which subsequently arise.

1.03 DEFINITIONS

- A. Product: Manufactured material or equipment.

1.04 PROCEDURE FOR REQUESTING SUBSTITUTION

A. Substitution shall be considered only:

1. After award of Contract
2. Under the conditions stated herein

- B. Written request through Contractor only.

C. Transmittal Mechanics

1. Follow the transmittal mechanics prescribed for Shop Drawings in Specification Section 01300 "Submittals."
 - a. Product substitution will include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in Paragraph D below.

D. Transmittal Contents

1. Product identification:
 - a. Manufacturer's name
 - b. Telephone number and representative contact name
 - c. Specification Section or Drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
 - a. Size
 - b. Composition or materials of construction
 - c. Weight
 - d. Electrical or mechanical requirements
4. Product experience
 - a. Location of past projects utilizing product.
 - b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.
 - c. Available field data and reports associated with proposed product.
5. Data relating to changes in construction schedule.
6. Data relating to changes in cost.
7. Samples
 - a. At request of County/Professional.
 - b. Full size if requested by County/Professional.
 - c. Held until substantial completion.
 - d. County/Professional is not responsible for loss or damage to samples.

1.05 APPROVAL OR REJECTION

- A. Written approval or rejection of substitution to be given by the Engineer.
- B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.
- C. In the event the substitution is approved, the resulting cost and/or time reduction will be documented by Change Order in accordance with the General Conditions.
- D. Substitution will be rejected if:
 1. Submittal is not through the Contractor with his stamp of approval.
 2. Request is not made in accordance with this Specification Section.

3. In the County/Professional's opinion, acceptance will require substantial revision of the original design.
 4. In the County/Professional's opinion, substitution will not perform adequately the function consistent with the design intent.
- E. Contractor shall reimburse the County for the cost of the evaluation whether or not substitution is approved.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01310
PROGRESS SCHEDULES

PART 1 - GENERAL

1.01 REQUIREMENT

- A. The Contractor will submit precedence method cost loaded Critical Path Method (CPM) Progress Schedules to the County depicting the approach to prosecution and completion of the Work. This requirement includes, but is not limited to the Contractor's approach to Activity cost loading, recovering schedule and managing the effect of changes, substitutions and Delays on Work sequencing.
- B. The Progress Schedule shall show how the Contractor's priorities and sequencing for the Work (or Work remaining) conform to the Contract requirements and the sequences of Work indicated in or required by the Contract Documents; reflect how the Contractor anticipates foreseeable events, site conditions and all other general, local and prevailing conditions that may affect cost, progress, schedule, furnishing and performance of the Work; and show how the Contractor's Means and Methods translate into Activities and logic.
- C. The Progress Schedule will consist of the Initial Submittal, Payment Submittals and Revision Submittals. Upon acceptance by the County, the Initial submittal will become the As-Planned Schedule for the Work. Revision submittals upon acceptance will become the As-Planned Schedule for the Work remaining to be completed as of the submittal date for that Revision.
- D. References to the Critical Path Method (CPM) are to CPM construction industry standards that are consistent with the requirements of this Section.

1.02 GLOSSARY OF TERMS

- A. The following terms, whether or not already defined elsewhere in the Contract Documents, have the following intent and meanings within this Section:
 - 1. Activity Value (Value): That portion of the Contract Price representing an appropriate level of payment for the part of the Work designated by the Activity.
 - 2. As-Planned Schedule: The first, complete Initial Progress Schedule submitted by the Contractor with the intent to depict the entire Work as awarded and accepted by the County or returned as no resubmittal required.
 - 3. Contract Float: Days between the Contractors anticipated date for completion of the Work, or of a specified portion of the Work, if any, and the corresponding Contract Time.
 - 4. CPM Schedule: The Progress Schedule based on the Critical Path Method (CPM) of scheduling. The term Critical Path means any continuous sequence of Activities in the Progress Schedule controlling, because of their sum duration, the Early Date of a pertinent, specified Contract Time.

5. Early/Late Dates: Early/late times of performance, based on CPM calculations, for an Activity in the Progress Schedule. Early Dates will be based on proceeding with all or part of the Work on the date when the corresponding Contract Time commences to run. Late Dates will be based on completing all or part of the Work on the corresponding Contract Time, even if the Contractor plans early completion.
6. Milestones: Key, pre-determined points of progress in the completion of a facility, denoting interim targets in support of the Contract Times. Milestones may pinpoint targets for key excavation and substructure events, significant deliveries, critical path transition from superstructure to piping and electrical rough in and building enclosure. Also, hook-up of mechanical and electrical equipment, availability of power for testing, equipment shakedown, training of County personnel, start-up, Substantial Completion and other events of like import.
7. Official Schedule: The Initial or most recent Revision Submittal accepted by the County or returned as no resubmittal required and the basis for Payment Submittals until another Revision Submittal is submitted and accepted. The accepted Initial Submittal is also the As-Planned Schedule.
8. Payment Submittal: A monthly Progress Schedule update reflecting progress and minor adjustments on the Activities, sequencing and restraints for Work remaining.
9. Total Float: Days by which an activity may slip from its Early Dates without necessarily extending a pertinent Contract Time. Total Float at least equals Contract Float. Total Float may also be calculated and reported in working Days. When an activity is delayed beyond Early Dates by its Total Float it becomes a Critical Path activity and if delayed further will impact a Contract Time.

1.03 QUALITY ASSURANCE

- A. The Contractor may self-perform the Work covered by this Section or employ a Subcontractor, subject to the County's consent. Employment of a scheduling Subcontractor shall not in any way alter or reduce the Contractor's obligations under the Contract Documents.
- B. The Contractor will obtain a written interpretation from the County, if the Contractor believes that the selection of activities, logic ties and/or restraints requires a written interpretation of the Contract Documents. With each submission, the Contractor will point out by specific, written notation, any Progress Schedule feature that may reflect variations from any requirements of the Contract Documents.
- C. It is the Contractor's responsibility to obtain information directly from each Subcontractor and Supplier when scoping their respective Activities, Values, logic ties and restraints.
- D. Neither Acceptance nor Review of any Progress Schedule will relieve the Contractor from the obligation to comply with the Contract Times and any sequence of Work indicated in or required by the Contract Documents and to complete, within the Contract Times, any Work omitted from that Progress Schedule.

- E. Neither Acceptance nor Review of any Progress Schedule will imply approval of any interpretation of or variation from the Contract Documents, unless expressly approved by the County through a written interpretation or by a separate, written notation on the returned Progress Schedule Submittal.

1.04 ALLOWANCES

- A. Work covered by contractual allowances will be completed within the Contract Times. The Progress Schedule will incorporate the Contractor's best estimate of the activities, logic and restraints required, using the information in the Contract Documents or as indicated by the County in writing.

1.05 MILESTONES AND SCHEDULE RECOVERY

- A. The County will select Milestones and Milestone Dates on the basis of the As-Planned Schedule. As the Official Schedule is revised, Milestone Dates will be revised accordingly. Milestone Dates will serve as target dates.
- B. Whenever any Activity slips by 14 or more Days from the Late Date for an activity in the Official Schedule, Milestone Dates selected by the County, or a pertinent Contract Time, the Contractor will deliver a Revision Submittal documenting the Contractor's schedule recovery plan and/or a properly supported request for an extension in the Contract Time. The narrative will identify the Delay and actions taken by the Contractor to recover schedule, whether by adding labor, Subcontractors or construction equipment, activity re-sequencing, expediting of submittals and/or deliveries, overtime or shift Work, and so forth. Activity shortening and overlapping shall be explained as to their basis (and be supported by increases in resources).
- C. Upon evaluation of that Revision Submittal, if the County determines there is sufficient cause, the County may withhold liquidated damages or provide a notice of intent to do so, if schedule is indeed not recovered, and/or may give a notice of default.

1.06 PROGRESS SCHEDULE SOFTWARE

- A. The scheduling software employed by the Contractor to process the Progress Schedule will be the current version of Primavera P6.0®, or Primavera® Contractor 5.0 CPM scheduling software.
- B. If the Contractor intends to use companion schedule reporting, analysis or graphics software tools, the Contractor will furnish to the County descriptive materials and samples describing such software tools.

1.07 NON-PERFORMANCE

- A. The County may refuse to recommend all or any part of any payment, if the Contractor fails, refuses or neglects to provide the required Progress Schedule information on a timely basis. Partial payments without a properly updated Progress Schedule shall be returned to the Contractor as non-conforming.
- B. If justified under the circumstances, the County also may prepare alternate Progress Schedules, as appropriate, and deduct from the Contract Amount all related costs by Change Order and/or take other action commensurate with the breach.

1.08 REPORTS, SCHEDULES AND PLOTS

- A. Schedule Reports will include Activity (ID) code and description, duration, calendar, Early Dates, Late Dates and Total Float. Separate Schedule Reports will tabulate, for each Activity, all preceding and succeeding logic types and lead times, whether CPM Plots displaying logic ties are appended or not.
- B. CPM Schedule Plots will be plotted on a suitable time scale and identify the Contract Times, Critical Paths, phases and work areas on 24-inch x 36-inch or smaller sheets. Activities will be shown on the Early Dates with Total Floats noted by Late Date flags. For Payment and Revision Submittals plot a target comparison based on the current Official Schedule.
- C. The Activity Value report will tabulate Activity code and description and Activity Value, percent complete and earned value as calculated by the scheduling software. Cash flow plots shall be provided showing the monthly and cumulative actual and planned earned values with curves shown for Early and Late Dates in the schedules. For Payment and Revision Schedule submittals, the cash flow curves shall also plot the most current Official Schedule planned earnings curves.
- D. Each submittal shall include listings of all added and deleted activities, logic, constraints, Activity Value changes and update information vs. the previous Progress Schedule submittal. This list may be manually prepared or generated by accessory software that will generate such listings.

1.09 NARRATIVE REQUIREMENTS

- A. The Initial Submittal narrative will describe the Contractor's approach to prosecution of the Work and the basis for determination of activity durations, sequence and logic, including the Contractor's management of the site, e.g., lay down, staging, parking, etc.; Contractor's phasing of the Work; use of crewing and construction equipment; identification of non-work County/Professional's, shifts, weekend Work and multiple calendars applied to activities and an explanation of the basis for restraint dates.

- B. Revision and Payment Submittal narratives will explain any changes to the approach or planning referred to in Paragraph A above on account of any change, delay, schedule recovery, substitution and/or Contractor-initiated revision occurring since the previous submittal.
- C. Each narrative will list the Critical Path Activities and compare Early and Late Dates against Contract Times and Milestone Dates. Narratives shall also recap progress and Days gained or lost vs. the current Official Schedule, and identify delays, their extent and causes.
- D. The Initial Submittal narrative will describe all delays occurring since Contract Award and all pending and anticipated "or equal" and substitution proposals. Payment and Revision Submittal narratives will describe any new delays and shall certify that the Contractor has not been delayed, as of the cut off date, by any acts or omissions of the County, except as otherwise specifically stated.

1.10 ACTIVITY REQUIREMENTS

- A. Separate activities will identify permits, design when included in the Work, construction, Submittal preparation and review (and resubmission and re-review), deliveries (site or storage), testing, start-up, commissioning and Punch List.
- B. Activities will be detailed to the extent required to show the transition of trade Work. Activities will delineate the progression of the Work.
- C. Activities will not combine separate or non-concurrent items of Unit Price or lump sum Work.
- D. Activity durations will equal the Work Days required to sufficiently complete the Work designated by the Activity, (i.e., when finish-to-start successors could start, even if the Activity is not quite 100% complete). Installation Activities will last from 10 to 40 workdays. Submittal review activity durations shall conform to specified timeframes.
- E. Activities will be assigned consistent descriptions and identification codes. Sort codes will group Activities by meaningful schemes.
- F. Activities will be assigned Activity Values as appropriate and needed to reasonably allocate the Contract Amount to the time periods that they will be earned and eligible for payment based on the Progress Schedule and Schedule of Values. Separate pay activities may be used to simplify cost loading of the Progress Schedule. When used, pay activities shall be loaded with the cost of Work that is included, at no cost, in related (generally, concurrent) CPM activities. Pay activities shall not control the rate of progress; however, their start and finish dates shall be consistent with those of their related CPM activities to ensure accurate Early Date and Late Date cash-flow plots.

1.11 FLOAT TOLERANCES AND FLOAT OWNERSHIP

- A. Any Progress Schedule with Early Dates after a Contract Time will yield negative Total and Contract Floats, whether shown/calculated or not. Any Revision Submittal with less than negative 20-days of Float will be returned as "Revise and Resubmit," unless a time extension is requested or the County assesses liquidated damages or gives notice of intent to do so, in the event schedule is not recovered.
- B. Float calculated from the definitions given in this Section supersede any conflicting Float values in any early completion Progress Schedule.
- C. Neither the County nor the Contractor own the Float time, the Project owns the Float time. Neither the County nor the Contractor use of positive Total Float will impact a Contract Completion Date or justify an extension of Contract Time.

1.12 SUBMITTALS

- A. Each Progress Schedule Submittal will consist of a narrative, 5 copies of the required reports and plots and an optical ROM data disk with the Contractor's corresponding schedule and schedule layout files in Primavera ".XER" format.
- B. The County will review Progress Schedule Submittals and return a review copy within 14-days after receipt and the Contractor shall, if required, resubmit within 7-days after return of the review copy.
- C. Requirements for the Initial Submittal:
 - 1. Within 20-days after receipt of Notice to Proceed and prior to commencing Work on the Project, prepare and submit to the County the Initial Submittal of the Progress Schedule for the Work. The Initial Submittal will show the Work as awarded, without delays, Change Orders or substitutions.
 - a. Activity Values will prorate Schedule of Values costs and/or pay items through to Activities. Provide a cross-reference listing with two parts; a part that will list each activity with the respective amounts allocated from each Schedule of Values and Unit Price Item making up the total value of each activity and a second part that will list the Schedule of Values and Unit Price Items with the respective amounts allocated from each activity that make up the total value of each item.
 - 2. After the As-Planned Schedule is established, the County will select Milestones and record the Milestone Early and Late Dates. As the Official Schedule evolves, Milestone Dates will be revised accordingly.
 - 3. If the County refuses to endorse the Initial Submittal (or a resubmission) as "Resubmittal Not Required," the As-Planned Schedule will not be established. In that event, the Contractor will continue to submit Payment and Revision Submittals reflecting progress and the Contractor's approach to remaining Work. The County will rely on the available Payment and Revision Submittals, subject to whatever adjustments it determines appropriate.

D. Requirements for Payment Submittals:

1. Payment Submittals with progress up to the closing date and updated Early Dates and Late Dates for progress and remaining Activities will be due with each Progress Payment. As-built data will consist of actual dates, percent complete, earned payment, changes, Delays and other significant events occurring before the closing date.
2. Activity percent complete and earned value should indicate a level of completion that corresponds to the Application for Progress Payment for the same period. The earned value should be calculated by the scheduling software as Activity Value times percent complete. Explanation should be provided whenever the cumulative earned value of activities in a Payment Submittal is not within 10% of the value of Work completed as represented in the corresponding Application for Progress for Payment.
3. At the Contractor's option, a Payment Submittal may overlay minor adjustments on activities and sequencing for Work remaining. This excludes Activity re-scoping to reflect Delays, changes, schedule recovery or substitutions.

E. Requirements for Revision Submittals:

1. Revision Submittals will be submitted when necessary because of major changes or delays affecting activities, sequencing or restraints for Work remaining and/or to put forth a schedule recovery plan. Revision Submittals may also be required because of Contractor-initiated re-planning, or when Contractor plans to perform Work ahead or out-of-sequence that will require additional testing or inspection personnel, or when requested by the County when Work is performed out-of-sequence from the current Official Schedule such that the number of Days gained or lost can not be determined or the scheduled dates of completion of the Work in a Payment Submittal are not viewed as reliable.
2. If requesting a time extension, the Revision Submittal should show the impact of the delay after incorporating reasonable mitigation to minimize the impact and illustrate how the number of Days requested time extension was determined. The delay should be determined as the change in the forecast Contract Completion Date(s) resulting solely from delays that entitle the Contractor to a time extension as provided in the General Conditions. Any and all Contractor slippage and delay occurring prior to and concurrent with the delay potentially entitling the Contractor to a time extension shall be incorporated in the Revision and explained such that the concurrent and non-concurrent periods of delay are indicated. If the Contractor does not follow the procedures contained in this Section or, if the Contractor's analysis is not verifiable by an independent, objective evaluation by the County using the electronic files and data furnished by the Contractor, any such extension in Contract Time will not be granted.

F. Retrospective Delay Analysis.

1. If the County/Professional refuses to endorse any Revision Submittal as "Resubmittal Not Required," the Contractor and County will use the latest Official Schedule when evaluating the effect of Delays on Contract Time and/or Contract Price. The procedure to be used will consist of progressively updating the latest Official Schedule at key closing dates corresponding to starting and finishing dates of the delays and/or dates the delays became critical or dates the Critical Path may have changed for other reasons. For each Progress Schedule iteration, slippage between actual Milestone Dates and Initial Milestone Dates will be correlated to Delays occurring solely in that iteration.
2. For each iteration, revisions in Activities, logic ties and restraints affecting Work after the closing date will be included in that Progress Schedule only if they meet any of the following conditions. First, they are Progress Schedule revisions that the County consented to contemporaneously (i.e., before the closing date) in writing. Second, they reflect comments or objections raised by or on behalf of the County and that were actually confirmed by the as-built progress. Lastly, they represent Contractor's schedule recovery plans or other Progress Schedule revisions that were actually confirmed by the as-built progress.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01370
SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 DEFINITION

- A. Schedule of Values: Schedule that divides the Contract Amount into pay items, such that the sum of all pay items equals the Contract Amount for the Work, or for any portion of the Work having a separate specified Contract Amount.

1.02 REQUIREMENT

- A. The Schedule of Values established as provided in the General Conditions will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to the County. Progress payments on account of Unit Price Work will be based on the number of units completed.
- B. No payment will be made for Work performed on a lump sum contract or a lump sum item until the appropriate Schedule of Values is approved by the County.
- C. The equitable value of Work deleted from a lump sum contract or lump sum item shall be determined from the approved Schedule of Values.

1.03 SUBMITTALS

- A. Submit 3 copies of a Preliminary Schedule of Values within 15-days after the recommended award of the Contract.
- B. Submit 3 copies of a proposed final Schedule of Values within 20-days after receipt of Notice to Proceed as per the General Conditions.
- C. Submit the Schedule of Values, typed, on EJCDC 1910-8-E form or Orange County forms or spreadsheets provided by County. The Contractor's standard form or electronic media printout will be considered for acceptability by the County.
- D. List installed value of each major item of Work and each subcontracted item of Work as a separate line item to serve as a basis for computing values for Progress Payments. Round off values to nearest dollar.
- E. Coordinate listings with the Progress Schedule.
- F. For items on which payments will be requested for stored materials or equipment, list sub-values for cost of stored products with taxes paid.
- G. Submit a sub-schedule for each separate stage of Work specified in Section 01010 "Summary of Work."

- H. The sum of values listed shall equal the total Contract Amount for the Work or the Contract Amount for a part of the Work with a separate Contract Amount provided for by the Contract Documents.
- I. When the County requires substantiating information, submit data justifying line item amounts in question.

1.04 UNIT PRICE CONTRACTS

- A. For unit price contracts, the bid item prices on the Project Bid Schedule shall be used as the basis for the schedule of values. The Contractor shall resubmit the bid item prices in the format described herein, and may, at its option, or if requested by the County, divide the items in the Project Bid Schedule into sub-items to provide a more detailed basis of payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01380
AUDIO – VISUAL DOCUMENTATION

PART 1 - GENERAL

1.01 PURPOSE AND DESCRIPTION OF WORK

- A. The purpose of the audio - visual documentation is to provide the County with regularly documented audio - visual records of the Construction process from the existing conditions through final completion.

1.02 PRE-CONSTRUCTION VIDEO REQUIREMENTS INCLUDED

- A. The Contractor shall employ a professional videographer to take a Pre-Construction video of the entire site including the areas of adjacent properties within 100-feet of the limits of Work and shall be made within 30-days of Work beginning. Special attention shall be made to show the existing paved roads, shoulders, signs, and other existing features.
- B. The Contractor shall submit a quality audio-video recording documenting Pre-Construction field conditions for the entire project. When the Work includes construction of water, wastewater, reuse, or other lines in the vicinity of any street or road, the Contractor shall take digital audio-video recordings of existing conditions along both sides of the street or road. The Pre-Construction video shall be submitted to the County and accepted prior to commencing any Work or using any Contractor laydown areas.
- C. Electronic digital photography shall also be used as necessary to record and facilitate resolution of on-site issues through the transmission of electronic photographs by e-mail from the site to the Professional's and County's offices.

PART 2 - PRODUCTS

2.01 AUDIO-VIDEO RECORDING

- A. Each audio-video recording shall be saved on appropriate DVD media viewable on standard DVD players or computer.

- B. Each DVD shall contain the following information and arrangement at the beginning as a title screen:
- Orange County, Florida
 - PROJECT NAME
 - PROJECT NUMBER
 - CONTRACTOR: (Name of Contractor)
 - DATE: (When photo was taken)
 - VIDEO BY: (Firm Name of Videographer)
 - LOCATION: (Description of Location(s) and View(s))
- C. Each DVD recording section shall begin with an audio description of the County's name, Contract name and number, Contractor's name, date and location information such as street name, direction of travel, viewing side, etc.
- D. Information appearing on the video recording must be continuous and run simultaneously by computer generated transparent digital information. No editing or overlaying of information at a later date will be acceptable.
- E. Digital information to appear in the upper left corner shall be as follows:
1. Name of Contractor
 2. Day, date and time
 3. Name of Project & Specification Number
- F. Time must be accurate and continuously displayed on the video record
- G. Written documentation must coincide with the information on the DVD so as to make easy retrieval of locations at a later date.
- H. The video system shall have the capability to transfer individual frames of video electronically into hard copy prints or photographic negatives.
- I. Audio shall be recorded at the same time as the video recording and shall have the same information as on the viewing screen. Special commentary shall be given for unusual conditions of buildings, sidewalks and curbing, foundations, trees and shrubbery, structures, equipment, pavement, etc.
- J. All DVDs and boxes shall bear labels with the following information:
1. DVD Number
 2. County's Name
 3. Date of Recording
 4. Project Name and Number
 5. Location and Standing Limit of Video

2.02 CONSTRUCTION PHOTOGRAPHS

- A. The Contractor shall employ a competent photographer to take construction record photographs periodically during the course of the Work.

- B. Prints: Date imprinted 8-inch x 10-inch high resolution glossy single weight color print paper; 5 sets, bound in 3-ring binders to be provided to the County with each respective Application for Payment and distributed by the County as follows:
1. County (2 sets)
 2. Engineer (1 set)
 3. Contractor (1 set)
 4. Project Record Data (1 set stored by Contractor to be furnished to County upon Closeout)

PART 3 - EXECUTION

3.01 VIDEO VIEWS REQUIRED

- A. Complete coverage shall include all surface features within 100-feet of the Work area to be used by the Contractor and shall be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culverts, headwalls, and retaining walls, equipment, structures, pavements, manholes, vaults, handrails, etc. located within the work zone. Video coverage shall extend to the maximum height of all structures within this zone.
- B. The video recorder shall take special efforts to point out and provide audio commentary on cracking, breakage, damage, and other defects in existing features.
- C. All video recording shall be done during times of good visibility. No video recording shall be done during periods of visible precipitation, or when more than 10% of the ground area is covered with standing water, unless otherwise authorized by County.
- D. Prior to commencement of audio-video recording, the Contractor shall notify the County in writing within 48-hours of the audio-video recording. The County may provide a designated representative to accompany and observe all video recording operations. Audio-video recording completed without a County Representative present will be unacceptable unless specifically authorized by the County.

3.02 AUDIO-VIDEO REQUIREMENTS

- A. Major Locations:
1. The Contractor shall provide color digital video of each major facility and structures and facilities adjacent to the Construction before construction starts.
 2. All videos shall be recorded with character generator operating with date, time, and location on screen. During video recording, the Contractor shall narrate video explaining what is being shown. All master videos shall be delivered to the County.

3. The audio and video portions of the recording shall maintain viewer orientation. To this end, overall establishing views of all visible house and business addresses shall be used. In areas where the proposed construction location will not be readily apparent to the video recording viewer, highly visible yellow flags shall be placed, by the Contractor, in such a fashion as to clearly indicate the proposed centerline of Construction. When conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed 10-feet. The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.
4. All video recording shall be done during time of good visibility. No video recording shall be done during precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects of recording and to produce bright, sharp video recordings of those subjects.
5. The average rate of travel during a particular segment of coverage shall be directly proportional to the number, size and value of the surface features within that construction area's zone of influence. The rate of speed in the general direction of travel of the vehicle used during taping shall not exceed 44-feet per minute.

3.03 PHOTOGRAPHS

- A. A minimum of 3 views (top, upstream, and downstream) each shall generally be taken prior to backfilling pipelines or structures. Photographs shall be provided for:
 1. Utility conflicts/relocations
 2. Manholes
 3. Pump stations
 4. Boring and jacking
 5. Directional drilling pipe entrance and exit
 6. Valve installation
 7. Air release valve installation
 8. Fire hydrant assembly
- B. Photo Identification
 1. Name of Project
 2. Name of Structure
 3. Orientation of View
 4. Date & Time of Exposure
 5. Film numbered identification of exposure

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 - GENERAL

1.01 SITE INVESTIGATION AND CONTROL

- A. Contractor shall verify all dimensions in the field and check field conditions continuously during construction. Contractor shall be solely responsible for any inaccuracies built into the Work due to Contractor's failure to comply with this requirement.
- B. Contractor shall inspect related and appurtenant Work and report in writing to County any conditions which will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor at Contractor's sole cost and expense.

1.02 INSPECTION OF THE WORK

- A. The Work shall be conducted under the general observation of representatives of the County acting on behalf of the County to ensure strict compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. The County shall be permitted access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated. Inspection by the County are in addition to the inspections required of Contractor by his QC Representatives.
- B. The presence of the County, however, shall not relieve the Contractor of the responsibility for the proper execution of the Work in accordance with all requirements of the Contract Documents. Compliance is a duty of the Contractor, and said duty shall not be avoided by any act or omission on the part of the County. Further, no requirement of this Contract may be waived or modified except by change order or formal (written) substitution approval.
- C. All materials and articles furnished by the Contractor shall be subject to rigid inspection, and no materials or articles shall be used in the Work until they have been inspected and accepted by the County. No Work shall be backfilled, buried, cast in concrete, hidden, or otherwise covered until it has been inspected. Any Work so covered in the absence of inspection shall be subject to uncovering. Where uninspected Work cannot be uncovered, such as in concrete cast over reinforcing steel, all such Work shall be subject to demolition, removal, and reconstruction under proper inspection and no additional payment will be allowed therefore.

- D. The Contractor is responsible for the Quality of his own work and shall designate a qualified individual, to be approved by the County, who will ensure that all work is performed in strict accordance with the Contract Documents. This quality representative shall inspect the work for the Contractor and provide to the County and the Contractor a report outlining all work accomplished, all inspections, and all testing performed for all days when work is performed. The objective of this report is to provide "Objective Evidence of Compliance" by the Contractor with the requirements of the Contract.

1.03 TIME OF INSPECTION AND TESTS

- A. Samples and testing required under these Specifications shall be furnished and prepared in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. Except as otherwise provided in the Contract Documents, performance of the required tests will be by the Contractor and all costs therefore will be borne by the Contractor at no cost to the County. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any Work under this Contract, the County shall be notified not less than 24-hours in advance to request inspection before beginning any such Work of covering. Failure of the Contractor to notify the County at least 24-hours in advance of any such inspections shall be reasonable cause for the County to order a sufficient delay in the Contractor's schedule to allow time for such inspection, any remedial, or corrective work required, and all costs of such delays, including its impact on other portions of the Work, shall be borne by the Contractor.

1.04 SAMPLING AND TESTING

- A. When not otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, the County reserves the right to use any generally accepted system of inspection which, in the opinion of the County, will ensure the County that the quality of the workmanship is in full accord with the Contract Documents.
- B. Any waiver of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the County shall reserve the right to make independent investigations and tests as specified in the following paragraph and, upon failure of any portion of the Work to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the County to require the removal or correction and reconstruction of any such Work.

- D. In addition to any other inspection or quality assurance provisions that may be specified, the County shall have the right to independently select, test, and analyze, at the expense of the County, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the Work is discovered, as a result of such independent testing or investigation by the County which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such Work shall be borne by the Contractor.

1.05 RIGHT OF REJECTION

- A. The County shall have the right at all times and places to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the site. If the County or inspector, through an oversight or otherwise, has accepted materials or Work which is defective or which is contrary to the Contract Documents, such material, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected by County.
- B. Contractor shall promptly remove rejected articles or materials from the site of the Work after notification or rejection.
- C. All costs of removal and replacement of rejected articles or materials, as specified herein, shall be borne by the Contractor.
- D. If the Contractor fails to remove or replace defective work after notification to do so, the County may have the work removed and replaced by others and deduct all costs from the Contractor's pay requests.

1.06 TESTING LABS

- A. All geotechnical testing laboratory services for field testing will be paid by the County. The lab(s) shall function as independent lab(s) and report independently to the County and the Contractor. The test lab(s) may not approve or allow any deviation from the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01410
TESTING AND TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. County will employ, and pay for services of an Independent Testing Laboratory to perform Testing specifically indicated on the Contract Documents or specified in the Specifications and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents.
2. Contractor shall cooperate with the laboratory to facilitate the execution of its required services.
3. Employment of laboratory by County shall in no way relieve Contractor's obligations to perform the Work of the Contract.

B. Related Requirements Described Elsewhere:

1. Conditions of the Contract.
2. Respective section of Specifications: Certification of products.
3. Each Specification section listed: Laboratory tests required, and standards for testing.

1.02 LABORATORY DUTIES: LIMITATIONS OF AUTHORITY

A. Submit 5 copies of inspection reports to the County. The reports shall include the following components:

1. Project title and County's project number
2. Testing laboratory name and address
3. Date of report issuance
4. Name and signature of field technician
5. Date of inspections, sampling, and/or testing
6. Record of weather conditions
7. Identification of product tested and associated specification section
8. Testing location
9. Description of testing performed
10. Observations made regarding compliance with the Contract Documents

B. Laboratory is not authorized to:

1. Release, revoke, alter, or enlarge on requirements of Contract Documents
2. Approve or reject any portion of Work
3. Perform any duties of the Contractor

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with County's personnel; provide access to Work and manufacturer's operations.

- B. Secure and deliver to the County adequate representational samples of materials proposed to be used and which require testing.
- C. Provide to the County the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.
- D. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacturer or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. The County may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the County shall be allowed on account of such testing and certification.
- E. Contractor shall not have direct contact with laboratory or laboratory personnel. All testing shall be coordinated through County.
- F. Furnish incidental labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.
- G. Notify County sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests. When tests or inspections cannot be performed after such notice, reimburse County for laboratory personnel and travel expenses incurred due to Contractor's negligence.
- H. Employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Contractor's convenience.
- I. If the test results indicate the material or equipment complies with the Contract Documents, the County shall pay for the cost of the testing laboratory. If the tests and any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the Contractor shall pay for the laboratory costs directly to the County or the total costs shall be deducted from any payments due to the Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01516
COLLECTION SYSTEM BYPASS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Work covered by this section consists of providing all temporary bypassing to perform all operations in connection with the flow of wastewater around pipe segment(s) or pump stations. The purpose of bypassing is to prevent wastewater overflows and provide continuous service to all wastewater customers. The Contractor will maintain wastewater flow in the construction area in order to prevent backup and/or overflow and provide reliable wastewater service to the users of the wastewater system at all times.

1.02 SUBMITTALS

- A. Prior to implementation of any bypass, the Contractor will submit and receive County acceptance of a bypass plan. The Contractor will submit to the County a comprehensive written plan for approval and acceptance that describes the intended bypass for the maintenance of flows during construction. The Contractor will also provide a sketch showing the location of bypass pumping equipment for each pump station or line segment(s) around which flows are being bypassed. The plan will include proposed tanker(s), pump(s), bypass piping, backup plan and equipment, work schedule, monitoring log for bypass pumping, monitoring plan of the bypass pumping operation, and maintenance of traffic plan.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The Contractor will provide and maintain adequate equipment, piping, tankers, and other necessary appurtenances in order to maintain continuous and reliable wastewater service in all wastewater lines as required for construction. The Contractor will have tankers, backup pump(s), piping, and appurtenances ready to deploy immediately.
- B. All piping will be designed to withstand at least twice the maximum system pressure or a minimum of 50-psi, whichever is greater.
- C. When bypassing a pump station, 1 back-up pump equal to the primary unit will be provided by the Contractor. Bypass pumps must comply with sound requirements.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall have all materials, equipment and labor necessary to complete the repair, replacement, or rehabilitation on the job site prior to isolating the gravity main segment, manhole, or pump station. The Contractor will demonstrate that the temporary bypass pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24-hours prior to beginning the Work.

3.02 TRAFFIC CONSIDERATIONS

- A. The Contractor shall locate bypass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways, and alleys, to include the possible temporary trenching of piping at critical intersections. Additional traffic maintenance requirements are found in Section 01570 "Maintenance of Traffic".

3.03 BYPASS OPERATION

The County shall accept the bypass plan prior to implementation of the bypass operation. Contractor will plug off and pump down the sewer manhole or line segment in the immediate work area and will maintain the wastewater system so that surcharging does not occur. A successful 3-day test period shall be performed during normal County workdays (no weekend).

- A. Where Work requires the line to be blocked after normal working hours and bypass pumping is being used, the Contractor shall be responsible for monitoring the bypass operation 24-hours per day, 7-days per week. Any electronic monitoring in lieu of on-site monitoring must be detailed in the comprehensive written plan and approved by the County.
- B. The Contractor shall ensure that no damage will be caused to private property as a result of bypass pumping operations. The Contractor will complete the Work as quickly as possible and satisfactorily pass all tests, inspections, repair all deficiencies prior to discontinuing bypassing operations, and returning flow to the sewer manhole or line segment.
- C. During bypassing, no wastewater will be leaked, dumped, or spilled in or onto, any area outside of the existing wastewater system.
- D. The Contractor shall immediately notify the County should a sanitary sewer overflow occur and take the necessary action to clean up and disinfect the spillage to the satisfaction of the County or other governmental agency. If sewage is spilled onto public or private property, the Contractor will wash down, clean up and disinfect the spillage to the satisfaction of the County and or other governmental agencies.

- E. When bypassing a pump station, 1 back-up pump equal to the primary unit shall be required. Bypass pumps shall have a maximum rating of 55 decibels for sound attenuation.
- F. The Contractor shall cease bypass operations and return flows to the new and/or existing sewer when directed by the County. When bypass operations are complete, all bypass piping shall be drained into the wastewater system prior to disassembly.

3.04 CONTRACTOR LIABILITY

- A. The Contractor shall be responsible for all required pumping, equipment, piping, and appurtenances to accomplish the bypass and for any and all damage that results directly or indirectly from the bypass pumping equipment, piping and/or appurtenances. The Contractor shall also be liable for all County personnel labor and equipment costs, penalties and fines resulting from sanitary sewer overflows. It is the intent of these specifications to require the Contractor to establish adequate bypass pumping as required regardless of the flow condition.

END OF SECTION

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SECTION 01560
EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The Work specified in this Section consists of designing, providing, maintaining and removing temporary erosion and sedimentation controls as necessary to protect the Work and prevent sedimentation from the Contractor's activities from entering water bodies or enter other parts of the County's or other property owners sites outside the Construction limits.
- B. Temporary erosion controls include, but are not limited to; grassing, mulching, netting, watering and reseeded on-site surfaces and soil and borrow area surfaces, and providing interceptor ditches at end of berms and at those locations which will ensure that erosion during Construction will be either eliminated or maintained within acceptable limits as established by the regulatory agencies having jurisdiction.
- C. Temporary sedimentation controls include, but are not limited to; silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the regulatory agencies having jurisdiction.

1.02 REQUIREMENTS

- A. The Contractor is responsible for providing effective temporary erosion and sediment control measures during Construction or until final controls become effective.
- B. The Contractor shall be responsible for filing Notice of Intent for Construction Activities with regulatory agencies (SJRWMD, SFWMD, and FDEP) as required by law, if thresholds are expected to be exceeded.
- C. The areas of unstabilized soil cover shall be minimized at all times to limit erosion and sedimentation.

1.03 SUBMITTALS:

- A. The Contractor shall prepare and submit an Erosion and Sedimentation Control Plan (Stormwater Pollution Prevention Plan) for County review and approval. The Plan shall be in effect throughout the Construction duration.

PART 2 - PRODUCTS

2.01 EROSION CONTROL

- A. Seed: Scarified Argentine Bahia.
- B. Sod: Bermuda grass, Argentine Bahia grass, Pensacola Bahia grass or St. Augustine. Grassing and Sodding Materials: As specified in Section 981 FDOT Specification for Road & Bridge Construction.
- C. Netting: Polypropylene mesh netting 5/8-inch x 3/4-inch (16 x 19mm) mesh with interwoven curlex fibers as manufactured by American Excelsior Company or equal. Netting: Fabricated of material in conformance with Section 985 FDOT Specification for Road & Bridge Construction.

2.02 SEDIMENTATION CONTROL

- A. Bales: Clean, synthetic hay type. Minimum dimensions of 14-inch by 18-inch by 36-inches at the time of placement.
- B. Netting: Fabricated of material in conformance with Section 985 FDOT Specification for Road & Bridge Construction.
- C. Sediment Control Fencing (Silt Fencing): As manufactured by American Excelsior Company or equal.
- D. Filter stone: Crushed stone conforming to Florida Department of Transportation Specifications.
- E. Concrete block: Hollow, non-load bearing type.
- F. Concrete: Exterior grade not less than 1-inch thick.
- G. Turbidity Barriers: Floating or staked as required.

PART 3 - EXECUTION

3.01 TEMPORARY EROSION CONTROL

- A. See Section 02578 "Solid Sodding."

3.02 SEDIMENTATION CONTROL

- A. Install and maintain silt fences and dams, traps, barriers, and appurtenances as shown on the approved descriptions and working Drawings. Replace deteriorated hay bales and dislodged filter stone. Repair portions of any devices damaged at no additional expense to the County.

- B. Install all sediment control devices in a timely manner to ensure the control of sediment. At sites where exposure to sensitive areas is likely, complete installation of all sediment control devices before starting earthwork.
- C. Use approved temporary erosion control features to correct conditions that develop during Construction that were not foreseen when the Erosion and Sedimentation Control Plan was first approved.

3.03 PERFORMANCE

- A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results that comply with the requirements of the Regulatory agency having jurisdiction, the County or the Professional, the Contractor shall immediately take whatever steps necessary to correct the deficiency at its own expense to protect the Work and any adjacent property to the site, as well as to prevent contamination of any river, stream, lake, tidal waters, reservoir, canal or other water impoundments.
- B. The side slope areas with unstabilized or unprotected soil cover shall be minimized at all times to limit erosion and sedimentation.
- C. Incorporate permanent erosion control features into the Project at the earliest practical time.
- D. Remove temporary erosion and sedimentation controls when the Work is complete and in accordance with the Erosion and Sedimentation Control Plan (Stormwater Pollution Prevention Plan) and the Notice of Intent for Construction Activities filed with regulatory agencies.

3.04 MAINTENANCE OF EROSION AND CONTROL FEATURES

- A. Provide routine maintenance of permanent and temporary erosion control features, at no expense to the County, until the Project is complete and accepted.

END OF SECTION

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SECTION 01570
MAINTENANCE OF TRAFFIC

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes identifying safety hazards and then furnishing all necessary labor, materials, tools, and equipment including, but not limited, to signs, barricades, traffic drums, cones, flashers, construction fencing, flag persons, warning devices, temporary pavement markings, delineators, etc., to control vehicular and pedestrian traffic through and adjacent to the project area. These measures and actions shall be taken to safely maintain the accessibility of public and construction traffic by preventing potential construction hazards. This Work shall also include all costs associated with the erecting, maintaining, moving, adjusting, cleaning, relocating, and storing the materials necessary to ensure safe movement of vehicular and pedestrian traffic throughout the project area. The Contractor may request that the County approve the detouring of traffic around the Construction area if it is in the best interest of public safety and the County. Detouring shall be limited to normal construction hours and two-way traffic patterns shall be re-established at the end of each workday.

1.02 REQUIREMENTS

- A. Traffic planning and control for the maintenance and protection of pedestrian and vehicular traffic affected by the Contractor's Work includes, but is not limited to:
 - 1. Construction and maintenance of any necessary detour equipment and facilities.
 - 2. Providing necessary facilities for access to residences and businesses.
 - 3. Furnishing, installing, and maintenance of traffic control and safety devices (e.g. signage, barricades, barriers, message boards, etc.), and flag persons as appropriate during Construction.
 - 4. Control of water runoff, dust and any other special requirements for safe and expeditious movement of traffic.

- B. Planning, maintenance and control of traffic shall be provided at the Contractor's expense. The Contractor will bear all expense of maintaining the vehicle and pedestrian traffic throughout the work area.

- C. The Contractor will ensure all personnel involved in traffic control are properly trained and capable of communicating with the public during closures and detours. The Contractor may be required to hire off-duty uniformed police officers, in addition to flag persons, to direct and maintain traffic on heavily traveled thoroughfares on which traffic is subject to delays or detours caused by the Contractor's operations. Locations and conditions requiring such uniformed police officers shall be as directed by the County.

- D. The Contractor will remove temporary equipment and facilities when no longer required, restore grounds to original, or to specified conditions.

1.03 SUBMITTALS

- A. Submit at Contractor's own expense a Traffic Control Plan for approval by the County. Sequence the Work in a manner that will minimize disruption of vehicular and pedestrian access through and around the construction area.
- B. The Traffic Control Plan will detail procedures and protective measures proposed by the Contractor to provide for protection and control of traffic affected by the Work consistent with the following applicable standards:
 - 1. Standard Specifications for Road and Bridge Construction, latest edition including all subsequent supplements issued by the Florida Department of Transportation, (FDOT Spec.).
 - 2. Manual of Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations, FDOT.
 - 3. Right-of-Way Utilization Regulations, Orange County, Florida, latest edition.
- C. All references to the respective agencies in the above referenced standards shall be construed to also include the municipality as applicable for this Work.
- D. The Traffic Control Plan will be signed and sealed by a Professional Engineer registered in the state of Florida and shall include proposed locations and time durations of the following, as applicable:
 - 1. Pedestrian and public vehicular traffic routing.
 - 2. Lane and sidewalk closures, other traffic blockage and lane restrictions and reductions anticipated to be caused by construction operations. Show and describe the proposed location, dates, hours and duration of closure, vehicular and pedestrian traffic routing and management, traffic control devices for implementing pedestrian and vehicular movement around the closures, and details of barricades.
 - 3. Location, type and method of shoring to provide lateral support to the side of an excavation or embankment parallel to an open travel-way.
 - 4. Allowable on-street parking within the immediate vicinity of worksite.
 - 5. Access to buildings immediately adjacent to worksite.
 - 6. Driveways blocked by construction operations.
 - 7. Temporary traffic control devices, temporary pavement striping and marking of streets and sidewalks affected by construction
 - 8. Temporary commercial and industrial loading and unloading zones.
 - 9. Construction vehicle reroutes, travel times, staging locations, and number and size of vehicles involved.

- E. Obtain and submit prior to erection, or otherwise impacting traffic, all required permits from all authorities having jurisdiction, including Orange County Public Works, if applicable.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. The Contractor will furnish barricades, warning signs, delineators, pilot cars and other traffic control materials and equipment in accordance with the Manual of Uniform Traffic Control Devices for Streets and Highways published by the United States Government Printing Office.

2.02 FLAG PERSONS

- A. All flag persons used on this Project will adhere to the following requirements:
 1. Any person acting as a flag person on this Project will have attended a training session taught by a Contractor's qualified trainer before the start date of this Contract.
 2. The Contractor's qualified trainer will have completed a "Flag person Train the Trainer Session" in the 5-years previous or before the start date of this Contract and will be on file as a qualified flag person trainer.
 3. The flag person trainer's name and Qualification Number will be furnished by the Contractor at the Pre-Construction meeting. The Contractor will provide all flag persons with the Flag Person Handbook and will observe the rules and regulations contained therein. This handbook will be in the possession of all flag person while flagging on the Project.
 4. Flag persons will not be assigned other duties while working as authorized flag persons.
 5. Any person replacing flag person for break shall have the same training.

PART 3 - EXECUTION

3.01 NOTIFICATIONS

- A. The Contractor will notify individual owners, owner's agents, and tenants of buildings adjacent to worksite in writing, with copies to the county, 72-hours in advance of any disruption to their access to those buildings and/or use of public ways adjacent to the buildings or prohibiting the stopping and parking of vehicles.
- B. Before closing any vehicle or pedestrian thoroughfare, the Contractor will give written notice to the County. Notice will be given no less than 72-hours in advance of the proposed closure, or as may be otherwise provided in the accepted Traffic Control Plan, so that the final approval of such closings can be obtained at least 48-hours in advance.

- C. The Contractor is responsible for notifying Fire and Ambulance Departments whenever roads are impassable.
- D. The Contractor will immediately notify the County of any vehicular or pedestrian safety or efficiency problems incurred as a result of the construction of the Project.

3.02 GENERAL TRAFFIC CONTROL

- A. The Contractor will sequence and plan construction operations and will generally conduct Work in such a manner as not to unduly or unnecessarily restrict or impede normal traffic.
- B. Unless otherwise provided, all roads within the limits of the Work will be kept open to all traffic by the Contractor. The Contractor will keep the portion of the project being used by public traffic, whether it is through or local traffic, in such condition that traffic will be adequately accommodated.
- C. The Contractor will be responsible for installation and maintenance of all traffic control devices and requirements for the duration of the construction period. Necessary precautions for traffic control will include, but not be limited to, warning signs, signals, lighting devices, markings, barricades, canalizations and hand signaling devices.
- D. The Contractor will provide and maintain in a safe condition temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, residences, garages and farms.
- E. The Contractor will provide emergency access to all residences and businesses at all times. Residential and business access will be restored and maintained at all times outside of the Contractor's normal working hours.
- F. Traffic is to be maintained on one section of existing pavement, proposed pavement, or a combination thereof. Alternating one-way traffic may be utilized and limited to a maximum length of 500-feet during construction hours. Lane width for alternating one-way traffic will be kept to a minimum width of 10-feet, or as directed by the County.
- G. Travel lanes and pedestrian passways will be drained and kept reasonably smooth, and in a suitable condition at all times in order to provide minimum interference to traffic consistent with the prosecution of the Work.
- H. The Contractor will make provisions at all "open cut" street crossings to allow for free passage of vehicles and pedestrians, either by bridging or other temporary crossing structures. Such structures will be of adequate strength and proper construction and will be maintained by the Contractor in such a manner as not to constitute an undue traffic hazard.

- I. The Contractor will keep all signs in proper position, clean, and legible at all times. Care will be taken so that weeds, shrubbery, construction materials, equipment, and soil are not allowed to obscure any sign, light, or barricade. Signs that do not apply to construction conditions should be removed or adjusted so that the legend is not visible to approaching traffic.
- J. The County may determine the need for, and extent of, additional striping removal and restriping.
- K. Excavated material, spoil banks, construction materials, equipment and supplies will not be located in such a manner as to obstruct traffic, as practicable. The Contractor will immediately remove from the site all demolition material, exercising such precaution as may be directed by the County. All material excavated shall be disposed of so as to minimize traffic and pedestrian inconvenience and to prevent damage to adjacent property.
- L. During any suspension, the Contractor will make passable and open to traffic such portions of the Project and/or temporally roadways as directed by the County for accommodation of traffic during the anticipated period of suspension. Passable conditions will be maintained until issuance of an order for the resumption of construction operations. When Work is resumed, the Contractor will replace or renew any Work or materials lost or damaged because of such temporary use in every respect as though its prosecution had been continuous and without interferences.

3.03 TEMPORARY SHORING

- A. Use shoring to maintain traffic when it is necessary to provide lateral support to the side of an excavation or embankment parallel to an open travel-way. Provide shoring when a theoretical 2:1 or steeper slope from the bottom of the excavation or embankment intersects the existing ground line closer than 5-feet (1.5 m) from the edge of pavement of the open travel-way.
- B. The Contractor will furnish, install, and remove sheeting, shoring, and bracing necessary to maintain traffic at locations shown on the Traffic Control Plan and other locations determined during construction.

END OF SECTION

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SECTION 01580
PROJECT IDENTIFICATION AND SIGNS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. The Contractor shall furnish, install, and maintain all sign materials including sign posts, weighted stands, brackets, any required mounting hardware, and miscellaneous materials required for temporary signs for the purpose of:
 - 1. Project Identification.
 - 2. Informational signs to direct traffic
 - 3. On-site safety signs as appropriate for the Work
- B. Remove temporary signs on completion of Construction prior to obtaining Certificate of Occupancy and Substantial Completion.
- C. Allow no other signs to be displayed without written approval of the County.

1.02 SUBMITTALS

- A. Submit complete Shop Drawings identifying locations, material, layout, sign content, font type and size, and sample colors. Make sign and lettering to scale, clearly indicating condensed lettering if used. The sign details will be submitted to the County for approval prior to fabrication.
- B. Submit method of erection to include materials, fasteners, and other items to assure compliance with the requirements for wind pressures as required by the authorities having jurisdiction.
- C. Submit signs in accordance with any details provided in the Drawings.
- D. Prior to erection obtain and submit all required permits from the authorities having jurisdiction.

1.03 PROJECT IDENTIFICATION SIGN

- A. Provide 1 painted sign at the site, or at each end of the Work if a linear project, or at each of the separate sites of Work, if applicable. The sign will be not less than 32-square feet area, with a minimum dimension of 4-feet and painted graphics with content to include:
 - 1. Title of Project
 - 2. Orange County Government name and logo
 - 3. Names and titles of the Board of County Commissioners, County Administrator, Director of Orange County Utilities Department, the Consulting Engineer, and the Contractor

- B. Erect on the site at a lighted location of high public visibility, adjacent to main entrance to site, as approved by the County. The sign must be located 5-feet from all rights-of-way and 20-feet from all property lines.

1.04 INFORMATIONAL SIGNS

- A. All signs and other traffic control devices shall conform to the requirements for shape, color, size, and location as specified in the latest Manual on Uniform Traffic Control and Safe Streets and Highways and the Florida Manual of Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations. Information as to the above may be obtained from FDOT Division engineers.

PART 2 - PRODUCTS

2.01 SIGN MATERIALS

- A. Structure and Framing: New construction grade lumber, structurally adequate and suitable for exterior application and specified finish.
- B. Sign Panels: New A-B Grade, exterior type, APA DF plywood with inset hardwood edges and mitered corners, standard large sizes to minimize joints.
 - 1. Thickness: As required by standards to span framing members, to provide even, smooth surface without waves or buckles, minimum 3/4-inch.
- C. Rough Hardware: Galvanized steel, of sizes and types to enable sign assemblies to resist wind pressures as required by the authorities having jurisdiction but not less than a wind velocity of 50-mph.
 - 1. Use minimum 1/2-inch diameter button head carriage bolts to fasten sign panels to supporting structures. Bolt heads to be painted to match sign face.
- D. Paint: Exterior quality, as specified in Division 9 or as a minimum as specified herein.
 - 1. Primer and finish coat: exterior, semi-gloss, alkyd enamel.
 - 2. Colors for structure, framing, sign surfaces, and graphics: As shown on the Drawings or as selected by the County.
- E. Safety Sign Number Tags
 - 1. Removable aluminum or galvanized steel, with 4-inch high, blue numerals and steel tag hooks.

PART 3 - EXECUTION

3.01 PROJECT IDENTIFICATION SIGN

- A. Install project identification signs within 10-days of the Notice to Proceed date. Failure to erect the signs may be reason to delay approval of the initial Application for Payment.

- B. Paint exposed surfaces of supports, framing, and surface material; one (1) coat of primer and two (2) coats of finish paint.
- C. Set signs plumb and level and solidly brace as required to prevent displacement during the Construction period. If mounted on posts, sink posts 3-feet to 4-feet below grade, leaving a minimum of 8-feet of each post above grade for mounting the sign.
- D. Install informational signs at a height for optimum visibility, on ground mounted poles or attached to temporary structural surfaces.

3.02 MAINTENANCE

- A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing, or sign.
- B. Relocate informational signs as required by the progress of the Work.
- C. Poorly maintained, defaced, damaged, or dirty signs shall be replaced, repaired, or cleaned without delay.
- D. Special care must be taken to ensure that construction materials and dust are not allowed to obscure the face of a sign.
- E. Signs not in effect shall be covered or removed.

3.03 REMOVAL

- A. Remove signs, framing, supports, and foundations at Substantial Completion of the Work.
- B. Leave areas clean and patch as required to remove any traces of temporary signs.

END OF SECTION

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SECTION 01610
DELIVERY, STORAGE AND HANDLING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section specifies the general requirements for the delivery, handling, storage and protection for all items required in the construction of the Work.
- B. Deliver, handle and store products in accordance with manufacturer's recommendations and by methods and means that will prevent damage, deterioration, and loss including theft and protect against damage from climatic conditions. Control delivery schedules to minimize long-term storage of products at the site and overcrowding of construction spaces. In particular, provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss. Damaged or defective items, in the opinion of the County, will be replaced at no cost to the County.

1.02 REQUIREMENTS

- A. The Contractor is responsible for all material, equipment and supplies sold and delivered to the County under this Contract until final inspection of the Work and acceptance thereof by the County.
- B. All materials and equipment to be incorporated in the Work will be handled and stored by the Contractor before, during and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage of any kind whatsoever to the material or equipment.
- C. All materials and equipment, which in the opinion of the County, have become so damaged as to be unfit for the use intended or specified, will be promptly removed from the site of the Work, and the Contractor will receive no compensation for the damaged materials or equipment or for its removal.
- D. In the event any such material, equipment and supplies are lost, stolen, damaged or destroyed prior to final inspection and acceptance, the Contractor will replace same without additional cost to the County.

1.03 DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.

- B. The County and the Contractor's project superintendent must be on-site to accept all deliveries shipped directly to the job site. If the project superintendent is not present for a delivery, that delivery may be rejected by the County. If any delivery is rejected due to non-availability of the Contractor's project superintendent, delivery shall be rescheduled at no additional cost to the County.
- C. Schedule delivery to reduce long-term on-site storage prior to installation and/or operation. Under no circumstances will materials or equipment be delivered to the site more than 1-month prior to installation without written authorization from the County.
- D. Coordinate deliveries in order to avoid delay in, or impediment of, the progress of the Work.
- E. Schedule deliveries to the site not more than 1-month prior to scheduled installation without written authorization from the County.
- F. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
- G. All items delivered to the site will be unloaded and placed in a manner that will not hamper the Contractor's normal construction operation or those of Subcontractors and other Contractors and will not interfere with the flow of necessary traffic.
- H. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible. Maintain packaged materials with seals unbroken and labels intact until time of use.
- I. Immediately on delivery, inspect shipments with the County to ensure compliance with requirements of Contract Documents and accepted submittals, and that products are properly protected and undamaged. If the Contractor does not notify the County regarding the delivery and the County rejects any part of the delivery, there will be no additional cost to the County for the material to be returned. For items furnished by others (i.e. County), perform inspection in the presence of the County. Provide written notification to the County of any problems.
- J. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the County.

1.04 STORAGE AND HANDLING

- A. Provide equipment and personnel to handle products by methods recommended by the manufacturer to prevent soiling or damage to products or packaging, with seals and labels intact and legible.
- B. The Contractor is responsible for securing a location for on-site storage of all material and equipment necessary for completion of the Work. The location and storage layout will be submitted to the County at the Pre-Construction conference.

- C. Manufacturer's storage instructions will be carefully studied by the Contractor and reviewed with the County. These instructions will be carefully followed and a written record of this kept by the Contractor.
- D. All material delivered to the job site will be protected from dirt, dust, dampness, water, and any other condition detrimental to the life of the material from the date of delivery to the time of installation of the material and acceptance by the County.
- E. When required or recommended by the manufacturer, the Contractor will furnish a covered, weather protected storage structure providing a clean, dry, non-corrosive environment for all mechanical equipment valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into this Project.
- F. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions and free from damage or deterioration.
- G. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within 7-days after written notice to do so has been given, the County retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contract Amount. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.

1.05 SPECIFIC STORAGE AND HANDLING

(Additional specific storage and handling requirements may be found in the specification sections addressing the material requirements.)

- A. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) will be stored in a weather tight building to prevent damage. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the County. The building will be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.
 - 1. All equipment will be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer. Mechanical equipment to be used in the Work, if stored for longer than 90-days, will have the bearings cleaned, flushed and lubricated prior to testing and startup, at no extra cost to the County.
 - 2. Moving parts will be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding." Upon installation of the equipment, the Contractor will start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

3. Lubricants will be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants will be put into the equipment at the time of acceptance. Prior to acceptance of the equipment, the Contractor will have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer will be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment will be judged to be defective. It will be removed and replaced at the Contractor's expense.
 4. Electric motors provided with heaters will be temporarily wired for continuous heating during storage. Upon installation of the equipment, the Contractor will start the equipment, at least half load, and once weekly for an adequate period of time to insure that the equipment does not deteriorate from lack of use.
- B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 - C. Cement and lime will be stored under a roof and off the ground and will be kept completely dry at all times.
 - D. Brick, block and similar masonry products will be handled and stored in a manner to minimize breakage, chipping, cracking and spilling to a minimum.
 - E. Precast Concrete will be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking.
 - F. All structural and miscellaneous steel and reinforcing steel will be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting. Beams will be stored with the webs vertical.
 - G. Metals will be stored dry, all under cover and vented to prevent build-up of humidity, all off ground to provide air circulation.
 - H. Lumber will be stacked to provide air circulation. Store materials for which maximum moisture content is specified in an area where moisture content can be maintained.
 - I. Gypsum wallboard systems will be stored to protect all metal studs, furring, insulation boards, batts, accessories and gypsum board to prevent any type of damage to these materials. Rusted material components, damp or wet insulation or gypsum boards will not be accepted.

- J. Acoustical materials will be delivered to the job site in unbroken containers labeled and clearly marked. Materials will not be removed from containers until ready to install, but will be stored in dry area with cartons neatly stacked. Before installation, acoustical board will be stored for not less than 24-hours in the Work area at the same temperature and relative humidity.
- K. Linear items will be stored in dry area with spacers to provide ventilation. Stack linear items to prevent warping, complying with manufacturer's instructions.
- L. Paints and other volatile materials will be stored within approved safety containers. No glass jugs will be permitted. Storage areas will be equipped with not less than 2 fire extinguishers (C02 type) sufficient to discharge a distance of 25-feet when fully charged and have current tags. No other building materials will be stored in this area. Used rags will be removed daily. Clean rags will be stored in metal closed containers.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01700
PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 DESCRIPTION

The term "Project Closeout" is defined to include requirements near the end of the Contract Time, in preparation for Substantial Completion acceptance, occupancy by the County, release of retainage, final acceptance, final payment, and similar actions evidencing completion of the Work. Time of closeout is directly related to "Substantial Completion"; therefore, the time of closeout may be either a single period for the entire Work or a series of time periods for individual elements of Work that has been certified as substantially complete at different dates. This time variation, if any, will be applicable to the other provisions of this section.

1.02 SCOPE OF WORK

- A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
 - 1. Final Cleaning
 - 2. Substantial Completion
 - 3. Final Acceptance

1.03 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 2 through 16.
- C. Section 01720 "Project Record Documents"
- D. Section 01740 "Warranties and Bonds"

1.04 PREREQUISITES FOR SUBSTANTIAL COMPLETION.

When the Contractor considers the Work as substantially complete, submit to the County a written notice stating so and requesting an inspection to determine the status of completion. The Contractor will attach to the notice a list of items known to be incomplete or yet to be corrected. Complete the following before requesting the County's inspection for certification of substantial completion.

- A. In the progress payment request that coincides with or is the first request following, the date substantial completion is claimed, show 100% completion or list incomplete items, the value of incomplete Work, and reasons for the Work being incomplete. Inspection procedures include supporting documentation for completion as indicated in these Contract Documents.
- B. Submit a statement showing an accounting of changes to the Contract Sum.
- C. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents in accordance with Section 01740 "Warranties and Bonds."
- D. Obtain and submit lien releases enabling the County's full, unrestricted use of the Work and access to services and utilities.
- E. Consult with County before submitting Record Documents in accordance with Section 01720 "Project Record Documents."
- F. Submit Operation and Maintenance Manuals.
- G. Make final changeover of permanent locks. Submit keys and keying schedule.
- H. Deliver tools, spare parts, extra stock, and similar items.
- I. Complete final cleaning requirements necessary for Substantial Completion.

1.05 FINAL CLEANING.

Complete the following cleaning operations prior to Substantial Completion or Owner occupancy.

- A. Remove from job site all tools, surplus materials, construction equipment, storage sheds, debris, waste and temporary services.
- B. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.
- C. Structures:
 - 1. Visually inspect exterior surfaces and remove all traces of soil, waste materials, smudges and other foreign matter.
 - 2. Remove all traces of splashed materials from adjacent surfaces.
 - 3. Ensure exterior surfaces have a uniform degree of cleanliness.
 - 4. Visually inspect interior surfaces and remove all traces of soil, waste materials, smudges and other foreign matter.
 - 5. Remove paint droppings, spots, stains and dirt from finished surfaces.
 - 6. Remove labels that are not permanent labels.
 - 7. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

8. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Leave concrete floors broom clean.
9. Wipe surface of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean light fixtures and lamps.
10. Clean permanent filters of ventilating systems and replace disposable filters if units were operated during construction. Clean ducts, blowers and coils if units were operated without filters during construction.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor will submit the proposed format, content and tab structure for all Operating and Maintenance Manuals for the County's review and approval. The tab structure for Operating and Maintenance Manuals will follow specification division format as accepted by the Construction Specification Institute. After the County approves the proposed format, content, and tab structure for the Operating and Maintenance Manuals, the Contractor will create and deliver 5 complete sets.
- B. Operation and Maintenance documentation is required for each piece of mechanical, electrical, communications, instrumentation and controls, pneumatic, hydraulic, conveyance, and special construction. If required by the technical specifications, provide Operation and Maintenance documentation for any other product not listed in the foregoing.
- C. The requirements of this Section are separate, distinct and in addition to product submittal requirements that may be established by other Sections of the Specifications. Owner's manuals, manufacturer's printed instructions, parts lists, test data and other submittals required by other Sections of the Specifications may be included in the Operating and Maintenance Manuals provided that they are approved and are formatted in a manner consistent with the requirements of this Section.
- D. Deliver Operation and Maintenance Manuals directly to the County.
- E. Operating and Maintenance Manual documents must include, but are not limited to, table of contents, approved submittals, manufacturer's operating and maintenance instructions, brochures, Shop Drawings, performance curves and data sheets annotated to indicate equipment actually furnished (e.g. identifying impeller size, model, horsepower, etc), procedures, wiring and control diagrams, records of factory and field tests and device/controller settings and calibration, program lists or data compact discs, maintenance and warranty terms and contact information, spare parts listings, inspection procedures, emergency instructions, and other Operating and Maintenance documentation that may be useful to the County. The material and equipment data required by this Section must include all data necessary for the proper installation, removal, normal operation, emergency operation, startup, shutdown, maintenance, cleaning, adjustment, calibration, lubrication, assembly, disassembly, repair, inspection, trouble-shooting, and warranty service of the equipment or materials.

- F. The Contractor must bind the Operating and Maintenance Manual documents in heavy-duty, 3-ring vinyl-covered binders including pocket folders for folded sheet information. Mark binder identification on both the front and spine of each binder. Binder information must list the project title, identify separate structures or locations as applicable, identify the general subject matter covered in the manual and must include the words "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - 1. The Contractor must submit the Operating and Maintenance documents on three-hole punched, 8-1/2-inch x 11-inch sheets or on three-hole punched sheets that are foldable in multiples of 8-1/2-inch x 11-inch. The three-hole punched edge will be the left 11-inch edge.
 - 2. The Contractor may request waivers to the size requirement for specific instances. The Contractor's waiver request must be in writing to the County. The Contractor's waiver request must include a justification for seeking the waiver.

- G. The Contractor must provide an electronic version of the complete and final Operating and Maintenance Manuals in original electronic file format on compact disc or DVD. The Contractor must also provide one (1) electronic pdf file of each bound Operating and Maintenance Manual that represents each Manual's content. The electronic pdf file must match the Operating and Maintenance Manual content and organizational structure.

1.07 SUBSTANTIAL COMPLETION INSPECTION PROCEDURES

- A. Upon receipt of the Contractor's request for inspection, the County will either proceed with inspection or advise the Contractor of incomplete prerequisites.

- B. Following the initial inspection, the County will either prepare the certificate of Substantial Completion, or advise the Contractor of Work which must be performed before the certificate will be issued. The County will repeat the inspection when requested in writing and when assured that the Work has been substantially completed.

- C. Results of the completed inspection will form the initial "punch list" for final acceptance.

1.08 PREREQUISITES FOR FINAL ACCEPTANCE.

Complete the following before requesting the County's final inspection for certification of final acceptance, and final payment. List known exceptions, if any, in the request.

- A. Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates for insurance for products and completed operations where required.

- B. Submit written certification that:
 - 1. The County's final punch list of itemized Work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance.
 - 2. The Contract Documents have been reviewed and Work has been completed in accordance with Contract Documents.

3. Equipment and systems have been tested in the presence of the County and are operational.
4. Work is completed and ready for final inspection.

C. Submit consent of surety.

D. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

1.09 FINAL ACCEPTANCE INSPECTION PROCEDURES

A. The County will re-inspect the Work upon receipt of the Contractor's written notice that the Work, including punch list items resulting from earlier inspections, has been completed, except for those items for which completion has been delayed because of circumstances that are acceptable to the County.

B. Upon completion of re-inspection, the County will either prepare a certificate of final acceptance or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled, which are required for final acceptance.

C. If necessary, the re-inspection procedure will be repeated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The purpose of the Project Record Documents is to provide the County with factual information regarding all aspects of the Work, both concealed and visible, to enable future location, identification and modification of the Work without lengthy and expensive site measurement, investigation or examination.
- B. These standards and procedures are for integration of digital engineering CAD drawings and attribute data into the database environments, while maintaining the integrity and positional accuracy of the data. The requirement for digital submittal of approved construction plans is to provide the County GIS with a parcel and utility base for field maintenance and operations.
- C. The location of the constructed improvements as depicted in the Contract Drawings is required. To insure the Work was constructed in conformance with the Contract Drawings, the following survey documents are required to be prepared and certified by the Surveyor:
 - 1. As-Built Asset Attribute Data Table (see Table 01050-2)
 - 2. Pipe Deflection Table (see Table 01050-3)
 - 3. Gravity Main Table (see Table 01050-4)
 - 4. Boundary Survey and Survey Map Report for pump stations and easements with constructed improvements.

1.02 DEFINITIONS

Except where specific definitions are used within a specific section, the following terms, phrases, words and their derivation shall have the meaning given herein when consistent with the context in which they are used. Words used in the present tense include the future tense, words in the plural number include the singular number and words in the singular number include the plural number.

- A. As-Built Drawings: Drawings prepared by the Contractor's Surveyor shall depict the actual location of installed utilities for the completed Work in a full size hard copy and an electronic AutoCAD file (dwg) format.
- B. Record Documents: All documents as required in subsections 1.04 and 2.02 in this specification section.
- C. Boundary Survey: Boundary survey, map and report certified by a Surveyor shall be provided that meets the requirements of Chapter 5J-17 'Minimum Technical Standards', FAC.

- D. Surveyor: Contractor's Surveyor that is licensed by the State of Florida as a Professional Surveyor and Mapper pursuant to Chapter 472, F.S.
- E. Survey Map Report: As a minimum the Survey Map Report shall identify any corners that had to be reset, measurements and computations made, pump station and easement boundary issues, locations of constructed improvements outside boundaries, and accuracies obtained.

1.03 QUALITY ASSURANCE

- A. Delegate the responsibility for maintenance of the Record Documents to one person on the Contractor's staff as approved by the County.
- B. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of specifications and each sheet of Drawings and other documents where such entry is required to show progress and changes properly.
- C. Make entries within 24-hours after receipt of information has occurred.

1.04 RECORD DOCUMENTS AT SITE

- A. Maintain at the site and always available for County's use one (1) record copy of:
 - 1. Construction Contract, Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents
 - 2. Change Orders, Verbal Orders, and other modifications to Contract
 - 3. Written instructions by the County as well as correspondence related to Requests for Information (RFIs)
 - 4. Accepted Shop Drawings, Samples, product data, substitution and "or-equal" requests
 - 5. Field test records, inspection certificates, manufacturer certificates and construction photographs
 - 6. Progressive As-Built Drawings
 - 7. Current Surveyor's tables for the As-Built Assets Attribute Data, Pipe Deflection Data, and Gravity Main Data
- B. Maintain the documents in an organized, clean, dry, legible condition and completely protected from deterioration and from loss and damage until completion of the Work, transfer of all record data to the final As-built Drawings for submittal to the County.
- C. Store As-Built Documents and samples in Contractor's office apart from documents used for construction. Do not use As-Built document for construction purposes. Label each document "AS-BUILT" in neat large printed letters. File documents and samples in accordance with CSI/CSC format.
- D. Record information concurrently with construction progress. Do not conceal any Work until required information is recorded.

PART 2 - PRODUCTS

2.01 AS-BUILT DRAWINGS

- A. Maintain the electronic As-Built Drawings to accurately record progress of Work and change orders throughout the duration of the Contract.
- B. Date all entries. Enter RFI No., Change Order No., etc. when applicable.
- C. Call attention to the entry by highlighting with a "cloud" drawn around the area affected.
- D. In the event of overlapping changes, use different colors for entries of the overlapping changes.
- E. Design call-outs shall have a thin strike line through the design call-out and all As-Built information must be labeled (or abbreviated "AB") and be shown in a bolder text that is completely legible.
- F. Make entries in the pertinent other documents while coordinating with the County for validity.
- G. Entries shall consist of graphical representations, plan view and profiles, written comments, dimensions, State Plane Coordinates, details and any other information as required to document field and other changes of the actual Work completed. As a minimum, make entries to also record:
 - 1. Depths of various elements of foundation in relation to finish floor datum and State Plane Coordinates and elevations.
 - 2. As-Built Asset Attribute Data Table shall be completed in the Drawings.
 - 3. When electrical boxes, or underground conduits and plumbing are involved as part of the Work, record true elevations and locations, dimensions between boxes.
 - 4. Actually installed pipe or other work materials, class, pressure-rating, diameter, size, specifications, etc. Similar information for other encountered underground utilities, not installed by Contractor, their owner and actual location if different than shown in the Contract Documents.
 - 5. Details, not on original Contract Drawings, as needed to show the actual location of the Work completed in a manner that allows the County to find it in the future.
 - 6. The Contractor shall mark all arrangements of conduits, circuits, piping, ducts and similar items shown schematically on the construction documents and show on the As-Built Drawings the actual horizontal and vertical alignments and locations.
 - 7. Major architectural and structural changes including relocation of doors, windows, etc. Architectural schedule changes according to Contractor's records and Shop Drawings.

2.02 RECORD DOCUMENTS

- A. Three (3) hard copy sets and three (3) digital media sets of the final Record Documents and shall include all of the documents described below under this subsection 2.02.

- B. The following documents shall be signed and sealed by the Surveyor:
1. As-Built Asset Attribute Data Table (see Specification Section 01050 "Surveying and Field Engineering," Table 01050-2 for an example)
 2. Boundary Survey of pump station and Survey Map Report
 3. Boundary Survey and Survey Map Report for the location of constructed pipes within any easements and right-of-way. As a minimum the Survey Map Report shall identify or describe the locations where the pipe centerline was constructed within 3-feet of the easement or right-of-way boundary, where the pipe was constructed outside the easement or right-of-way boundary, any corners that had to be reset, measurements and computations made, pump station boundary issues, and accuracies obtained. Survey map report shall be dated after the Work within the right-of-ways or easements have been completed.
 4. Gravity Main Table (see Specification Section 01050 "Surveying and Field Engineering", Table 01050-4 for an example)
 5. Pipe Deflection Table (see Specification Section 01050 "Surveying and Field Engineering" Table 01050-3 for an example). An electronic blank table will be supplied by the County.
- C. Digital sets of the final Record Documents including but not limited to:
1. Scanned digital copies of the final As-Built Drawings
 2. Electronic Survey documents electronically sealed by the Surveyor
 3. Final Record Documents information
 4. Digital As-Built Drawing in the Engineer's current version of AutoCAD file (dwg) format for the Contract Drawings, updated to match the final Record Drawing information
- D. Pump station site Boundary Survey and Map Report.
- E. New Boundary Survey to re-establish easement corners, right-of-way monuments, or pump station site corners with monuments if destroyed by the Work.
- F. Scanned Documents: Scan the Survey Documents and other Record Documents reflecting changes from the Bid Documents.
- G. The scanned "As-Built" Drawing sets shall be complete and include the title sheet, plan/profile sheets, cross-sections, and details. Each individual sheet contained in the printed set of the As-Built Drawings shall be included in the electronic drawings, with each sheet being converted into an individual tif (tagged image file). The plan sheets shall be scanned in tif format Group 4 at minimum of 400 dpi resolution to maintain legibility of each drawing. Then, the tif images shall be embedded into a single pdf (Adobe Acrobat) file representing the complete plan set. Review all Record Documents to ensure a complete record of the Project.

- H. Provide an encompassing digital AutoCAD file that includes all the information of the As-Built Drawings and any other graphical information in the As-Built Drawings. It shall include the overall Work, utility system layout and associated parcel boundaries and easements. Feature point, line and polygon information for new or altered Work and all accompanying geodetic control and survey data shall be included. The surveyor's certified As-Built Asset Attribute Data shall be added to the As-Built Drawings and Surveyor shall electronically seal the data in a comma-delineated ASCII format (txt).

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION MEETING

- A. Pre-construction Meeting: It is recommended that the Surveyor attend the Pre-construction meeting. At the pre-construction meeting the Contractor shall be provided with a blank electronic version of the spreadsheet for the tables: Asset Attribute Data and Pipe Deflection. The Contractor's surveyor shall use these tables to input the data and shall not alter the table format or formulas.

3.02 CONSTRUCTION PROGRESS MEETINGS

- A. Contractor shall provide progressive Record Documents described below:
1. Construction Contract, As-Built Drawings, Specifications, General Conditions, Supplemental Conditions, Bid Proposal, Instruction to Bidders, Addenda, and all other Contract Documents.
 2. Specifications and Addenda: Record manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed as well as any changes made by Field Order, Change Order or other.
 3. Change orders, verbal orders, and other modifications to Contract.
 4. Written instructions by the County as well as correspondence related to Requests for Information (RFIs).
 5. Accepted Shop Drawings, samples, product data, substitution and "or-equal" requests.
 6. Field test records, inspection certificates, manufacturer certificates and construction photographs.
 7. As-Built Asset Attribute Data Table: Surveyor shall obtain field measurements of vertical and horizontal dimensions of constructed improvements. The monthly submittal shall include the Surveyor's certified statement regarding the constructed improvements being within the specified accuracies as described in Specification Section 01050 "Surveying and Field Engineering", Table 01050-1 Minimum Survey Accuracies or if not, indicating the variances.
 8. Gravity Main Table: Surveyor shall prepare and update a Gravity Main Table to include as a minimum the pipe segment identification, pipe lengths, manhole inverts and tops, and slopes for gravity mains. Surveyor shall certify the data entered are correct and indicate if the minimum slopes have not been met.

9. Pipe Deflection Table: Surveyor shall input the type of pipe, pipe manufacturer, PVC manufacturer deflection allowance, allowable angle of offset and radius of curvature, laying length of pipe, and coordinates. Surveyor shall certify the data entered are correct and indicate if the deflection allowance, offset or radius of curvature exceeds the manufacturer's recommendations.

3.03 FINAL RECORD DOCUMENTS SUBMITTAL

- A. Submit the Final Record Documents within 20-days after Substantial Completion.
 1. Participate in review meetings as required and make required changes and promptly deliver the Final Record Documents to the County.

3.04 STORAGE AND PRESERVATION

- A. Store Record Documents and samples at a protected location in the project field office apart from documents used for construction.
 1. Provide files and racks for storage of documents
 2. Provide locked cabinet or secure space for storage of samples
- B. File documents and samples in accordance with CSI format with section numbers matching those in the Contract Documents.
- C. In the event of loss of recorded data, use means necessary to again secure the data to the County's approval.
 1. Such means shall include, if necessary in the opinion of the County, removal and replacement of concealing materials.
 2. In such cases, provide replacements of the concealing materials to the standards originally required by the Contract Documents.

END OF SECTION

SECTION 01740
WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

- A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.
- B. General closeout requirements are included in Section 01700 "Project Closeout."
- C. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual Sections of Division 2 through 16.

1.03 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the County.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the County.

1.04 SUBMITTALS

- A. Submit written warranties to the County prior to requesting a Substantial Completion Inspection as outlined in Section 01700 "Project Closeout." If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the County.
- B. When a designated portion of the Work is completed and occupied or used by the County, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the County within 15-days of completion of that designated portion of the Work.

- C. When a special warranty is required to be executed by the Contractor, or the Contractor and a Subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the County for approval prior to final execution.
- D. Refer to individual Sections of Divisions 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.
- E. Prior to Substantial Completion Inspection, submit to the County two (2) copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, Subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents and sized to receive 8-1/2-inch by 11-inch three-hole punched paper.
 - 2. Table of Contents will be neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification Section in which specified and the name of the product or work item.
 - 3. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address and telephone number of the installer, supplier and manufacturer.
 - 4. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name and the name, address and telephone number of the Contractor.
 - 5. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.05 WARRANTY REQUIREMENT

- A. The Contractor will warrant all equipment in the Contractor's one-year warranty period even though certificates of warranty may not be required. For all major pieces of equipment, the Contractor shall submit a warranty from the equipment manufacturer. "Major" equipment is defined as a device having a 5 HP or larger motor or which lists for more than \$1,000.00.
- B. In the event that an equipment manufacturer or supplier is unwilling to provide a one-year warranty commencing at Substantial Completion, the Contractor will obtain from the manufacturer a warranty of sufficient length commencing at the time of equipment delivery to the job site, such that the warranty will extend to at least 1-year past substantial completion.
- C. If an individual specification section requires a particular warranty more stringent than that required by this Section or the General Conditions, the more stringent requirements will govern for the applicable portion of the Work.

- D. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- E. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty will be equal to the original warranty with an equitable adjustment for depreciation.
- F. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the County has benefited from use of the Work through a portion of its anticipated useful service life.
- G. County's Recourse: Written warranties made to the County are in addition to implied warranties, and will not limit the duties, obligations, rights and remedies otherwise available under the law, nor will warranty periods be interpreted as limitations on time in which the County can enforce such other duties, obligations, rights, or remedies.
- H. Rejection of Warranties: The County reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- I. The County reserves the right to refuse to accept Work for the project where a special warranty, certification, or similar commitment is required on such work or part of the Work, until evidence is presented that entities required to counter-sign such commitments are willing to do so.
- J. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors required to countersign special warranties with the Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 DELIVERABLES

- A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and Subcontractors, and bind into a commercial quality standard 3-ring binder; submit 5 copies of the warranties and bonds to the County for review.
 - 1. The warranties and bonds shall include:
 - a. Equipment or product description
 - b. Manufacturer's name, principal, address and telephone number

- c. Contractor, name of responsible principal, address and telephone number
- d. Local supplier's or representatives name and address
- e. Scope of warranty or bond
- f. Proper procedure in case of failure
- g. Instances which might affect the validity of warranty or bond
- h. Date of beginning of warranty, bond or service and maintenance contract
- i. Duration of warranty, bond or service maintenance contract

B. Warranties

1. Furnish an extended warranty for sanitary sewer main liner certified by the manufacturer for specified material properties for a particular job. The manufacturer warrants the liner to be free from defects in raw materials for 1-year from the date of acceptance. During the warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the Contractor's expense in a manner acceptable to the County.
2. Furnish an extended warranty for sanitary lateral liner certified by the manufacturer for specified material properties for a particular job. The manufacturer warrants the liner to be free from defects in raw materials for 1-year from the date of acceptance. During the warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the Contractor's expense in a manner acceptable to the County.

END OF SECTION

SECTION 02080

ABANDONMENT, REMOVAL, AND SALVAGE OR DISPOSAL OF EXISTING PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This section specifies the furnishing of all labor, materials, equipment, and incidentals required to abandon, remove, salvage, and/or dispose of existing pipelines and appurtenances as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

- A. Permits and Licenses: Contractor shall obtain and pay respective fees for all necessary permits and licenses for performing the Work and shall furnish a copy of same to the County prior to commencing the Work. The Contractor shall comply with the requirements of the permits. All removal or abandonment of asbestos pipe material shall be performed by a licensed asbestos abatement Contractor or Subcontractor registered in the State of Florida.
- B. Notices: Contractor shall issue written notices of planned Work to companies or local authorities owning utility conduit, wires, or pipes running to or through the project site. Copies of said notices shall be submitted to the County.
- C. Standards:
 - 1. Florida Administrative Code, Chapter 62-204.800
 - 2. National Emission Standards Hazardous Air Pollution (NESHAP), 40 CFR Part 61, Subpart M, latest revision
 - 3. Occupational Safety and Health Act, 29 CFR
 - 4. The Environmental Protection Agency (EPA) Asbestos Abatement Worker Protection Rule
 - 5. Florida Statute 455.300
 - 6. Asbestos pipe handling best management practices provided at the end of this section
- D. Quality Control
 - 1. It shall be the responsibility of the Contractor to provide supervision and inspections to ensure that the existing piping is removed and disposed, salvaged, or abandoned as designated in the Drawings and as specified herein.
 - 2. Asbestos Pipe
 - a. All removal or abandonment of pipe material containing asbestos shall be performed by a licensed asbestos abatement Contractor or Subcontractor.

- b. The asbestos abatement Contractor or Subcontractor shall contact the Orange County Environmental Protection Division (407-836-1400) prior to removal or abandonment of any asbestos material and shall obtain all required permits and licenses and issue all required notices as required by the Orange County Environmental Protection Division. The Contractor shall be responsible for all fees associated with permits, licenses, and notices to the governing regulatory agencies.
- c. The asbestos abatement Contractor shall perform Work in accordance with all applicable standards referenced in paragraph 1.02.C of this section.
- d. The asbestos abatement Contractor shall have experience performing asbestos removal similar to this Project.

1.03 SHOP DRAWINGS AND SUBMITTALS

A. Shop Drawings

1. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
2. Shop Drawings shall be submitted to the County for review and acceptance prior to construction in accordance with these specifications for the following:
 - a. Grout
 - b. Caps and plugs
 - c. Credentials of licensed asbestos abatement Contractor including current certification.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 REMOVAL, ABANDONMENT, SALVAGE, AND DISPOSAL

- A. General: Existing piping designated on the Drawings to be removed shall be exposed and removed by the Contractor.
- B. Removal and Disposal
 1. Pipe designated to be removed shall be completely drained and the contents properly disposed. The piping system including fittings and valves shall then be completely removed from the site.
 2. Existing services and/or connections not shown on the Drawings shall be removed in accordance with this section at no additional cost. Existing live services encountered shall be maintained.
 3. Asbestos: Pipe material containing asbestos shall be removed and disposed by a licensed asbestos abatement Contractor or Subcontractor.

4. Structures shall be removed in accordance with Section 02050 "Demolition of Existing Structures."

C. Removal of material to be salvaged

1. Pipe designated on the Drawings to be removed and salvaged shall be completely drained and the contents properly disposed. The pipe shall then be thoroughly pressure washed, palletized on wooden skids to a dimension not exceeding the recommendation of the manufacturer, and conveyed to the County at the location designated by the County.
2. Items to be salvaged:
 - a. Air release valves
 - b. Sanitary manhole rings and covers
 - c. Isolation valves
 - d. Valve boxes
 - e. Fire hydrant and valve assemblies

D. Abandonment

1. Pipe designated on the Drawings to be abandoned (or retired in place) shall be left in place, drained, and its contents properly disposed. Pipe requires end caps or plugs. All air release valves and vaults, valve boxes, fire hydrants, manholes, and manhole rings and covers shall be removed and disposed of or salvaged as specified above.
2. All pipe 4-inches or larger to be abandoned in place shall be completely filled with grout and each end of the pipe shall be plugged in a manner acceptable to the County.
3. Grout: Where designated on the Drawings, pipe to be abandoned shall be filled with grout in accordance with Section 03600 "Grouting."
4. Plugs: Pipe to be abandoned shall be capped or plugged with a mechanical joint fitting that will prevent soil or other deposits from entering the pipe.

E. Asbestos Pipe Handling Best Management Practices

1. Projects will require worker documentation before entering the regulated Work area. A copy of: their current training certificate (workers and their supervisor); current medical condition showing the doctor approved their working with asbestos and wearing a respirator; signed acknowledgment forms; and current record (6-months) of each workers respirator fit test will be required from all workers.
2. Projects also require air monitoring. OSHA will accept historic data on air monitoring within 12-months of the Project, provided the data is from a project of like material and conditions with a crew of the same experience, supervision, and training. Otherwise, monitoring is required throughout the Project. OSHA requires two (2) types of personnel air monitoring, full shift and 30-minute excursion level (when highest levels are anticipated).
3. Some provisions should be made for worker showering or otherwise washing following work before removing respirators, etc. Even if direct exposure is not anticipated, and at a minimum, a source of water to rinse the respirators, wash workers faces and hands, and (in the event of unanticipated direct exposure) some place to shower is required. The workers will also need a change room and some place to keep their street clothes and personal possessions.

4. Proposals to remove asbestos pipe sections by cutting must address how the cutting debris will be captured and kept from becoming airborne. Soil that could be considered contaminated may also have to be removed.
5. Licensed asbestos abatement Contractors or Subcontractors should have a pollution endorsement in their liability insurance in case of asbestos fiber release. A contingency plan, in case the project does not run as smoothly as expected, should be developed and include emergency phone numbers kept on site during the Project.
6. Daily logs of the asbestos removal work should be kept, and should include sign in sheets for the workers and whatever air monitoring was done. Accident reports and other reports or correspondence if something unusual happened should also be included.
7. Waste receipts must be kept through all stages of transport from the site to, and including, the acceptance at the dumpsite where the material will be abandoned. Amount of material removed must be equal to the amount of material to be turned into to the dump.
8. The primary Contractor will give "approval for tear down" at project completion, indicating that all asbestos removal operations are complete and whether there is a need for any air monitoring. Air monitoring, if not required by any governing agency or approved permit as discussed previously, may also be required by the County if documentation to the general public pertaining to contamination is deemed necessary. This air monitoring is normally done by collecting area samples downwind of the project at the barrier tape or just inside it. It requires a source of electricity to run the pumps, which is often provided by a generator.

END OF SECTION

SECTION 02100
TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. The Work specified in this Section consists of designing, providing, maintaining and removing temporary erosion, sedimentation and turbidity controls as necessary.
2. Temporary erosion controls include, but are not limited to, grassing, mulching, setting, watering and reseeding on-site surfaces and soil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by federal, state and local requirements and by the County.
3. Temporary sedimentation controls include, but are not limited to; silt fence, silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by federal, state and local requirements and by the County.
4. Temporary turbidity controls include, but are not limited to, floating or staked turbidity barriers which will ensure that turbidity pollution will be either eliminated or maintained within acceptable limits as established by Federal, state, and local requirements and by the County.
5. Contractor is responsible for providing effective temporary erosion, sediment, and turbidity control measures during construction or until permanent controls become effective.

- B. Related Work Described Elsewhere: South Florida Building Code and Standard Building Code, FDOT Standard Specifications for road and bridge construction and FDOT Design Standards.

PART 2 - PRODUCTS

2.01 EROSION CONTROL

- A. Netting Fence: fabricated of material acceptable to the County.
- B. Sod is specified in Section 02578, "Solid Sodding."

2.02 SEDIMENTATION CONTROL

- A. Bales: clean, seed-free cereal hay type.
- B. Netting: fabricated of material acceptable to the County.
- C. Filter stone: crushed stone conforming to Florida Department of Transportation specifications.

- D. Concrete block: hollow, non-load bearing type.
- E. Concrete: exterior grade not less than 1-inch thick.
- F. Rock Bags: conforming to FDOT Specifications.

2.03 TURBIDITY CONTROL

- A. Conforming to FDOT Design Standards Index 103 - Turbidity Barriers.

PART 3 - EXECUTION

3.01 EROSION CONTROL

- A. Minimum Procedures for Grassing Are:
 1. Scarify slopes to a depth of not less than 6-inches and remove large clods, rock, stumps and roots larger than 1/2-inch in diameter and debris.
 2. Sow seed within 24-hours after the ground is scarified with either mechanical seed drills or rotary hand seeders.
 3. Apply mulch loosely and to a thickness of between 3/4-inch and 1-1/2-inches.
 4. Apply netting over mulched areas on sloped surfaces.
 5. Roll and water seeded areas in a manner which will encourage sprouting of seeds and growing of grass. Reseed areas which exhibit unsatisfactory growth. Backfill and seed eroded areas.

3.02 SEDIMENTATION CONTROL

- A. Install and maintain silt fence, silt dams, traps, barriers and appurtenances as shown on the approved descriptions and working Drawings. Hay bales which deteriorate and filter stone which is dislodged shall be replaced.

3.03 TURBIDITY CONTROL

- A. Install and maintain turbidity barriers daily and as described in FDOT Index #103.

3.04 PERFORMANCE

- A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results which comply with the requirements of the State of Florida, the Contractor shall immediately take whatever steps are necessary to correct the deficiency at his own expense.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. **Scope of Work:** This Section specifies the furnishing of equipment; labor and materials necessary to remove storm or subsurface waters from excavation areas in accordance with the requirements set forth, as shown on the Drawings, and/or geotechnical report.

1.02 QUALITY ASSURANCE

- A. **Qualifications:** The Contractor shall engage a Geotechnical Engineer registered in the State of Florida, to design the temporary dewatering system. The Contractor shall submit conceptual plan for the dewatering system prior to commencing work. The dewatering system installed shall be in conformity with the overall construction plan and certification of this shall be provided by the Geotechnical Engineer. The dewatering system shall be designed by a firm who regularly engages in the design of dewatering systems and who is fully experienced, reputable and qualified in the design of such dewatering systems.
- B. The dewatering of any excavation areas and the disposal of the water shall be in strict accordance with the latest revision of all local and state government rules and regulations.
- C. **Permits:** The Contractor shall obtain and pay respective fees for all local, state, and federal permits (including the Orange County, St. Johns River Water Management District, and/or South Florida Management District discharge permits) required for the withdrawal, treatment and disposal/discharge of water from the dewatering operation, prior to start of work.
- D. Comply with Florida Administrative Code, Chapter 62-621.300 (2).

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. In accordance with FAC 62-621.300(2), submit analytical test results from a certified laboratory for the parameters listed in the FDEP "Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity" to the FDEP and the County. The submitted information shall show the location of the work, where the water will be going to, as well as an estimate for the amount, rate and duration of discharge being proposed.

- C. Provide notification to all jurisdictional permitting agencies in accordance with the requirements of the respective agency.
- D. Provide a detailed plan and operation schedule for dewatering of excavations.
 - 1. Provide descriptive literature of the dewatering system.
 - 2. Provide a plan for erosion and sedimentation control during dewatering.
 - 3. Provide copies of all permits/approvals for disposal/discharge of water during dewatering.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall have on-site and available the analytical test results performed in accordance with the FDEP "Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity" (FAC 62-621.300(2)).
- B. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters which may accumulate within the excavation.
- C. The Contractor's attention is directed to the water surface elevations discussed in the report(s) on subsurface investigations. Water levels will normally vary from season to season.
- D. The Contractor shall be required to monitor the performance of the dewatering system during the progress of the Work and make such modifications as may be required to assure that the systems will perform satisfactorily. The dewatering system shall be designed in such a manner as to preserve the undisturbed bearing capacity of the sub-grade soils at the bottom of the trench or excavation.
- E. Prior to excavation, the Contractor shall submit his proposed method of dewatering and maintaining dry conditions to the County. Approval of the dewatering plan shall not relieve the Contractor of the responsibility for the satisfactory performance of the system. The Contractor shall be responsible for correcting any disturbance of natural bearing soils or damage to structures caused by an inadequate dewatering system or by interruption of the continuous operation of the system as specified.
- F. If subsurface water is encountered, the Contractor shall utilize suitable equipment to adequately dewater the excavation. A wellpoint system or other County acceptable dewatering method shall be utilized if necessary to maintain the excavation in a dry condition for preparation of the trench bottom and for pipe laying. Within and adjacent to residential areas and other areas as required by the County, engines driving dewatering pumps shall be equipped with residential type mufflers and the noise shall not exceed 55 decibels within 50-feet.

3.02 DEWATERING AND DISPOSAL

- A. The Contractor shall construct and place all pipelines, structures, concrete work, structural fill, backfill and bedding material in-the-dry. In addition, the Contractor shall make the final 24-inches of excavation in-the-dry and not until the water level is a minimum of 2-foot below proposed bottom of excavation. For purposes of this Contract, in-the-dry is defined as $\pm 2\%$ of the optimum moisture content of the soil.
- B. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove promptly and dispose of all water entering excavations. Contractor shall keep excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure, or pipes have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- C. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- D. It is expected that dewatering will be required for pre-drainage of the soils prior to final excavation for most of the in-ground structures or piping and for maintaining the lowered groundwater level until construction has been completed so that the structure, pipeline or fill will not be floated or otherwise damaged.
- E. If wellpoints are used, Contractor shall adequately space wellpoints to maintain the necessary dewatering. Provide suitable filter sand and/or other means to prevent pumping of fine sands and silts. A continual check shall be maintained by the Contractor to ensure that the subsurface soil is not being removed by the dewatering operations. Pumping from wellpoints shall be continuous and standby pumps shall be provided.
- F. The Contractor's proposed method of dewatering shall include groundwater observation wells to determine the water level during construction. Observation wells shall be installed along pipelines as required to verify depth to water level and at locations approved by the County.
- G. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from the surface shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped or drained by gravity to maintain an excavation bottom free from standing water.
- H. Flotation shall be prevented by the Contractor by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible for all damages which may result from failure to adequately keep excavations dewatered.
- I. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent properties or facilities. No water shall be discharged without appropriate treatment for adverse contaminants. No water shall be drained in work built or under construction without prior consent from the County. Water shall be filtered to remove sand and fine soil particles before disposal into any drainage system.

- J. Dewatering of excavations shall be considered incidental to the construction of the Work and all costs shall be included in the various Contract prices in the Bid Form, unless a separate bid item has been established for dewatering.

3.03 GROUNDWATER TREATMENT (IF REQUIRED)

- A. If concentrations of tested groundwater quality parameters exceed those allowable in the FDEP Generic Permit for the Discharge of Produced Groundwater from any Non-Contaminated Site Activity (62-621.300(2), F.A.C.), the Contractor shall treat the effluent.
- B. The Contractor shall immediately notify the County and discuss the parameters that exceed allowable limits.
- C. The Contractor shall meet with the FDEP to determine alternatives that are acceptable to the FDEP.
- D. The Contractor shall apply for and obtain any and all permits and/or treatment approvals that FDEP requires including but not limited to:
 - 1. Generic Permit for Discharges from Petroleum Contaminated Sites (62-621.300(1)). Allows discharges from sites with automotive gasoline, aviation gasoline, jet fuel, or diesel fuel contamination; or
 - 2. Permit for all Other Contaminated Sites (62-04; 62-302; 62-620 & 62-660). The coverage is available only through the individual NPDES permit issued by FDEP, allows discharges from sites with general contaminant issues i.e. ground water and/or soil contamination other than petroleum fuel contamination; or
 - 3. Generic Permit for the Discharge of Produced Ground Water from Any Non-Contaminated Site Activity (62-621.300(2), F.A.C.); or
 - 4. Generic Permit for Stormwater Discharge from Large or Small Construction Activities (62-621.300(4)(a), F.A.C.); or
 - 5. An Individual Wastewater Permit (62-604.300(8) (a))
- E. The Contractor shall implement the appropriate treatment that is acceptable to FDEP and County to attain compliance for all excess limits encountered during dewatering activities. Treatment may include, but is not limited to: Chemical, Biological, Electrolysis or any combination of the three.
- F. The Contractor shall make every effort to minimize the spread of contamination into uncontaminated areas. Provide for the health and safety of all workers at the job site and make provisions necessary for the health and safety of the public that may be exposed to any potentially hazardous conditions. Ensure provision adhere to all applicable laws, rules or regulations covering hazardous conditions and will be in a manner commensurate with the level of severity of the conditions.
- G. If necessary, provide contamination assessment and remediation personnel to handle site assessment, determine the course of action necessary for site security and perform the necessary steps under applicable laws, rules and regulations for additional assessment and/or remediation work to resolve the contaminations issue.

- H. Delineate the contamination area(s) and any staging or holding area required and develop a work plan that will provide the schedule of projected completion dates for the final resolution of the contamination issue.
- I. Maintain jurisdiction over activities inside any delineated contamination areas and any associated staging or holding areas. Be responsible for the health and safety of workers within the delineated areas. Provide continuous access to representatives of regulatory or enforcement agencies having jurisdiction.

3.04 REMOVAL

Immediately upon completion of the dewatering system, the Contractor shall remove all of his equipment, materials, and supplies from the site of the Work, remove all surplus materials and debris, fill in all holes or excavations, and grade the site to elevations of the surface levels which existed before work started. The site shall be thoroughly cleaned and approved by the County.

END OF SECTION

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SECTION 02215
FINISH GRADING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Provide finish grading to all areas within the limits of construction.
- B. Grade sub-soil. Cut out areas to receive stabilizing base course materials for paving and sidewalks. Place, finish grade, and compact topsoil.

1.02 PROTECTION

- A. Prevent damage to existing fencing, trees, landscaping, natural features, benchmarks, pavement, and utility lines. Correct damage at no cost to the County.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.
- B. Topsoil: Friable loam free from subsoil, roots, grass, excessive amount of weeds, stones, and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4% and a maximum of 25% organic matter. The topsoil shall be suitable for the proposed plant growth shown on the Drawings and specified. Use topsoil stockpiles on site if conforming to these requirements. If there is not sufficient topsoil available at the project site, the Contractor shall furnish additional topsoil as required to complete the Work at no additional cost to the County.

PART 3 - EXECUTION

3.01 SUB SOIL PREPARATION

- A. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc. Remove sub-soil that has been contaminated with petroleum products.

- B. Cut out areas to subgrade elevation which are to receive stabilizing base for paving and sidewalks.
- C. Bring sub soil to required levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- D. Slope grade away from building a minimum of 2-inches in 10-feet unless indicated otherwise on the Drawings.
- E. Cultivate subgrade to a depth of 3-inches where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted sub-soil.

3.02 PLACING TOPSOIL

- A. Place topsoil in areas where seeding, sodding, and planting is to be performed. Place to the following minimum depths, up to finished grade elevations.
 - 1. 6-inches for seeded areas
 - 2. 4-1/2-inches for sodded areas
 - 3. 24-inches for shrub beds
 - 4. 18-inches for flower beds
- B. Use topsoil in relatively dry state. Place during dry weather.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of subgrades.
- D. Remove stones, roots, grass, weeds, debris, and other foreign material while spreading.
- E. Manually spread topsoil around trees, plants, and buildings to prevent damage which may be caused by grading equipment.
- F. Lightly compact placed topsoil.

3.03 SURPLUS MATERIAL

- A. Remove surplus sub soil and topsoil from site.
- B. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

END OF SECTION

SECTION 02220
EXCAVATING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Excavate, backfill, and compact as required for the construction of the utility system consisting of piping and appurtenances, and structural construction as shown on the Drawings and specified herein. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary to perform all excavation, backfill, compaction, grading, and slope protection to complete the Work. The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, all under ground utilities locations and appurtenances shown on the construction Drawings.
- B. Definitions:
1. Maximum Density: Maximum weight in pounds per cubic foot of a specific material as determined by AASHTO T-180 (ASTM D155).
 2. Optimum Moisture: Percentage of water in a specific material at maximum density.
 3. Rock Excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels, or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery.
 4. Suitable: Suitable materials for fills shall be non-cohesive, non-plastic granular local sand and shall be free from vegetation, organic material, marl, silt, or muck. The Contractor shall furnish all additional fill material required.
 5. Unsuitable: Unsuitable materials are highly organic soil (peat or muck) classified as A-8 in accordance with AASHTO Designation M 145.
- C. Plan For Earthwork: The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrata, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the Work, the general and local conditions, and all other matters which can in any way affect the Work under this Contract. Prior to commencing the excavation, the Contractor shall submit a plan of his proposed operations, including maintenance of traffic, to the County for review. The Contractor shall consider, and his plan for excavation shall reflect, the equipment and methods to be employed in the excavation. The prices established in the Proposal for the Work to be done will reflect all costs pertaining to the Work.

1.02 QUALITY ASSURANCE

- A. Testing laboratory employed by the County will make such tests as are deemed advisable. The Contractor shall schedule his work to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress. Costs for initial testing shall be paid by the County; however, tests which have to be repeated because of the failure of the tested material to meet specification shall be paid for by the Contractor and the cost of re-testing shall be deducted from payments due the Contractor.
- B. Standards
 - 1. AASHTO: American Association of State Highway and Transportation Officials
 - 2. ANSI: American National Standards Institute
 - 3. ASCE: American Society of Civil Engineers
 - 4. ASTM: American Society for Testing and Materials
 - 5. AWWA: American Water Works Association
 - 6. OSHA 29 CFR Subpart P – Excavations and Trenches a) 1926.650, 1926.651, 1926.652
 - 7. OSHA 29 CFR Subpart J - a) 1910.146 for Confined Space Entry

1.03 JOB CONDITIONS

- A. Existing Utilities
 - 1. The Contractor is responsible for subsurface verification of existing utilities prior to construction. Locate existing utilities in the area of work in accordance with Sunshine State One Call regulations, Chapter 556, "Underground Facility Damage Prevention and Safety Act", FS.
 - 2. Should uncharted or incorrectly charted piping or other utility be encountered during excavation, notify the County. Keep all facilities in operation and repair damaged utilities to the satisfaction of the County.
 - 3. Damage and repair costs to such piping or utilities are the Contractor's responsibility.
 - 4. If utilities are to remain in place, the Contractor shall provide adequate means of protection.
- B. Test borings and the sub-surface exploration data if previously done on the site will be made available upon request and are for the Contractor's information only.

1.04 PROTECTION

- A. Sheet piling and Bracing
 - 1. Requirements of the Trench Safety Act shall be adhered to at all times.

2. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, to protect adjacent structures and power poles from undermining, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other acceptable methods. If the County is of the opinion that at any point sufficient or proper supports have not been provided, the County may order additional supports put in at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and compacted. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the County.
3. The Contractor shall construct the sheeting outside the neat lines of the foundation unless indicated otherwise for the method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall be adequate to withstand all pressure to which the structure or trench will be subjected. Any movement or bulging which may occur shall be corrected by the Contractor at their own expense so as to provide the necessary clearances and dimensions.
4. Where sheeting and bracing is required to support the sides of excavations for structures, the Contractor shall engage a Professional Geotechnical Engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design, and the Professional Engineer shall provide certification of this.
5. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
6. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing not shown on the Drawings but which the County may direct him in writing to leave in place at any time during the progress of the Work for the purpose of preventing damage to structures, utilities, or property, whether public or private. The County may direct that timber used for sheeting and bracing be cut off at any specified elevation.
7. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, or otherwise as may be directed by the County.
8. The right of the County to order sheeting and bracing left in place shall not be construed as creating any obligation on the County's part to issue such orders, and their failure to exercise this right shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the Work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.

9. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than 1-foot above the top of any pipe.

B. Pumping and Drainage:

1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing the water level to return to the natural level as stipulated in Section 02140 "Dewatering." The Contractor shall engage a Professional Geotechnical Engineer registered in the State of Florida to design the dewatering systems. The Contractor shall submit to the County for a plan for dewatering systems prior to commencing work. The dewatering system installed shall be in conformity with the overall construction plan, and the Professional Engineer shall provide certification of this. The Professional Engineer shall be required to monitor the performance of the dewatering systems during the progress of the Work and require such modifications as may be required to assure that the systems are performing satisfactorily.
2. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the proposed bottom of excavation and to preserve the integrity of adjacent structures. Dewatering by trench pumping will not be permitted if migration of fine grained natural material from bottom, sidewalls, or bedding material will occur.
3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
4. The Contractor shall take all additional precautions to prevent uplift of any structure during construction.
5. Permission to use any storm sewers or drains for water disposal purposes shall be obtained from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. However, the Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by the County or the authority having jurisdiction, at no cost to the County.
6. The Contractor shall prevent flotation by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.
7. Removal of dewatering equipment shall be accomplished after compaction/density testing has been completed and the system is no longer required. The Contractor shall remove the material and equipment constituting the system.
8. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, or other contaminants in order to prevent adverse effects on groundwater quality.

1.05 TESTING AND INSPECTION SERVICE

- A. The County will provide a geotechnical testing and inspection service. The services include testing soil materials and quality control testing during filling and backfilling operations. Samples of soil materials shall be furnished to the testing service by the Contractor. The County shall pay costs of initial geotechnical testing. The Contractor shall pay for any subsequent testing required due to failure and laboratory stand-by charges incurred.
- B. The Contractor shall provide monthly density testing reports to the County during backfilling activities. Density testing reports not submitted in a timely manner shall result in rejection of the pipe installed and rejection of the density testing reports until such time that density re-testing is coordinated and repeated at the Contractors expense.
- C. Density testing scheduled subsequent to backfilling activities shall be coordinated with, and witnessed by the County. Failure by the Contractor to coordinate or have the County present shall result in rejection of the submitted density testing reports and re-testing at the Contractor's expense.
- D. Dewatering systems shall not be removed until compaction/density testing has been completed.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. All fill material shall be subject to the review and acceptance of the County.
 - 2. All fill material shall be free of organic material, trash, or other objectionable material. The Contractor shall remove excess or unsuitable material from the job site.
- B. Common Fill Material: Common fill shall consist of mineral soil, substantially free of clay, organic material, muck, loam, wood, trash, and other objectionable material which may be compressible or which cannot be compacted properly. Common fill shall not contain stones larger than 3-1/2-inches in any dimension in the top 12-inches or 6-inches in any dimension in the balance of fill area. Common fill shall not contain asphalt, broken concrete, masonry, rubble or other similar materials. It shall have physical properties that allow it to be easily spread and compacted during filling. Additional common fill shall be no more than 12 % by weight finer than the No. 200 mesh sieve, unless finer material is approved for use in a specific location by the County. Select Common Fill shall be as specified as above from common fill, except that the material shall contain no stones larger than 1/2-inches in largest dimension, and shall be no more than 5 % by weight finer than the No. 200 mesh sieve.

C. Structural Fill: Structural fill shall be reasonably well graded sand to gravelly sand having the following gradation:

US Sieve Size	Percent Passing By Weight
No. 1	100
No. 4	75 - 100
No. 40	15 - 80
No. 100	0 - 30
No. 200	0 - 12

D. Class 1 Soils*: Manufactured angular, granular material, 1/4 to 1-1/2-inches (6 to 4 mm) size, including materials having significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells. Sieve analysis for crushed stone is given below separately.

Crushed Stone: Crushed stone shall consist of clean mineral aggregate free from clay, loam or organic matter, conforming to ASTM C33 stone size No. 89 and with particle size limits as follows:

U.S. Sieve Size	% Passing By Weight
1/2	100
3/8	100
No. 4	20 - 25
No. 8	5 - 30
No. 16	0 - 10
No. 50	0 - 2

E. Class II Soils**:

1. GW: Well graded gravels and gravel-sand mixtures, little or no fines. Fifty percent or more retained on No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.
2. GP: Poorly graded gravels and gravel-sand mixtures, little or no fines. Fifty percent or more retained on No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.
3. SW: Well graded sands and gravelly sands, little or no fines. More than passes No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.
4. SP: Poorly graded sands and gravelly sands, little or no fines. More than 50 % passes No. 4 sieve. More than 95 % retained on No. 200 sieve. Clean.

*Soils defined as Class I materials are not defined in ASTM D2487.

**In accordance with ASTM D2487, less than 5 % pass No. 200 sieve.

- F. Coarse Sand: Sand shall consist of clean mineral aggregate with particle size limits as follows:

U.S. Sieve Size	Percent Passing By Weight
3/8	100
No. 10	85 – 100
No. 40	20 – 40
No. 200	0 - 12

- G. Other Material: All other material, not specifically described, but required for proper completion of the Work shall be selected by the Contractor and acceptable by the County.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clearing:

1. The construction areas shall be cleared of all obstructions and vegetation including large roots and undergrowth within 10-feet of the lines of the excavation.
2. Strip and stockpile topsoil on the site at the location to be determined by the County.

3.02 EXCAVATION

- A. General: Excavations for roadways, structures, and utilities must be carefully executed in order to avoid interruption of utility service.

B. Excavating for Roadways/Structures/Utilities:

1. Excavation shall be made to such dimensions as will give suitable room for building the foundations and the structures, for bracing and supporting, for pumping and draining, and for all other work required.
 - a. Excavation for precast or prefabricated structures shall be carried to an elevation 2-feet lower than the proposed outside bottom of the structure to provide space for the select backfill material. Prior to placing the select backfill, the excavation shall be measured by the County to verify that the excavation has been carried to the proper depth and is reasonably uniform over the area to be occupied by the structure.
 - b. Excavation for structures constructed or cast in place in dewatered excavations shall be carried down to the bottom of the structure where dewatering methods are such that a dry excavation bottom is exposed and the naturally occurring material at this elevation leveled and left ready to receive construction. Material disturbed below the founding elevation in dewatered excavations shall be replaced with Class B concrete.
 - c. Footings: Cast-in-place concrete footing sides shall be formed immediately after excavation.
2. Immediately document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during the course of construction.

3. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Drawings and should anticipate the encounter of unknown obstructions during the course of the Work.
4. Encounters with subsurface obstructions shall be hand excavated.
5. Excavation and dewatering shall be accomplished by methods that preserve the undisturbed state of subgrade soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support of structures as a result of inadequate dewatering or other construction methods shall be removed and replaced by crushed stone as required by the County at the Contractor's expense.
6. The bottom of excavations shall be rendered firm and dry before placing any piping or structure.
7. All pavements shall be cut with saws or approved power tools prior to removal.
8. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered. Excavated material not suitable for backfill shall be removed from the site and disposed of by the Contractor.

3.03 DRAINAGE

- A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations, and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition. The dewatering method used shall prevent disturbance of earth below grade.
- B. All water pumped or drained from the Work shall be disposed of in a suitable manner without undue interference with other work, without damage to surrounding property, and in accordance with pertinent rules and regulations.
- C. No construction, including pipe laying, shall be allowed in water. No water shall be allowed to contact masonry or concrete within 24-hours after being placed. The Contractor shall constantly guard against damage due to water and take full responsibility for all damage resulting from his failure to do so.
- D. The Contractor will be required at his expense to excavate below grade and refill with crushed stone (gradation 57 or 89) or other acceptable fill material if the County determines that adequate dewatering has not been provided.

3.04 UNDERCUT

- A. If the bottom of any excavation is below that shown on the Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due the Contractor's excavation methods, he shall refill to normal grade with fill at his own cost. Fill material and compaction method shall be approved by the County.

3.05 FILL AND COMPACTION

- A. Compact and backfill excavations and construct embankment according to the following schedule. (Modified Proctor standard shall be ASTM D-1557):

STRUCTURES AND ROADWORK

Area	Material	Compaction
Beneath Structures	Structural Fill	12-inch lifts, compacted to 98% maximum density as determined by AASHTO T-180. Fill Should not be placed over any in-place soils until those deposits have been compacted to 98% Modified Proctor.
Around Structures	Structural Fill	12-inch lifts, 95% of maximum density as determined by AASHTO T-180. Rubber Tire or vibratory plate compactors shall be used
Beneath Paved Surfaces	Common Fill	12-inch lifts, 98% by maximum density as determined by AASHTO T-180 or as required by the FDOT Standards.
Open Areas	Common Fill	12-inch lifts, 95% by maximum density as determined by AASHTO T-180.

- B. Pipe shall be laid in open trenches unless otherwise indicated on the Drawings or elsewhere in the Contract Documents.
- C. Excavations shall be backfilled to the original grade or as indicated on the Drawings. Deviation from this grade because of settling shall be corrected. The backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard.
- D. Embankments shall be constructed true to lines, grades, and cross sections shown on the plans or ordered by the County. Embankments shall be placed in successive layers of not more than 8-inches in thickness, loose measure, for the full width of the embankment. As far as practicable, traffic over the Work during the construction phase shall be distributed so as to cover the maximum surface area of each layer.
- E. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified herein, such request shall be in writing to the County. Acceptance will be considered only after the Contractor has performed tests, at the Contractor's expense, to identify the material used and density achieved throughout the backfill area utilizing the method of backfill requested. The County's acceptance shall be in writing.
- F. One compaction test location shall be required for each 300 linear feet of pipe and for every 100 square feet of backfill around structures as a minimum. The County may determine that more compaction tests are required to certify the installation depending on field conditions. The locations of the compaction tests within the trench shall be in conformance with the following schedule:
1. At least one test at the spring line of the pipe.

2. At least one test for each 12-inch layer of backfill within the pipe bedding zone for pipes 24-inches and larger.
3. One test at an elevation of 1-foot above the top of pipe.
4. One test for each 2-feet of backfill placed from 1-foot above the top of the pipe to finished grade elevation.
5. Density testing is required for sanitary sewer manholes. Tests shall be staggered around the manhole within 3-feet of the structure's outside diameter.
 - a. First test shall be 1-foot above the structure base.
 - b. Second test shall be 2-feet above the first test and subsequent tests every 2-feet up the finished grade.
6. The Contractor shall provide additional compaction and testing prior to commencing further construction if the County's testing reports and inspection indicate that the fill has been placed below specified density.
7. The Contractor shall coordinate testing with the County approved testing laboratory and shall provide monthly test results to the County in a timely manner during construction activities. Density testing scheduled subsequent to backfilling activities shall be coordinated with the County and witnessed by the County representative. Failure by the Contractor to coordinate or have the County representative present shall result in rejection of the submitted density testing reports and re-testing at the Contractor's expense. Density testing reports not submitted in a timely manner shall result in rejection of the pipe installed and rejection of the density testing reports until such time that density re-testing is coordinated and repeated at the Contractor's expense as deemed necessary by the County's representative.
8. Dewatering systems shall not be removed until compaction/density testing has been completed.

END OF SECTION

SECTION 02570
STABILIZED SUBGRADE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: All labor, materials, and equipment required to install stabilized subgrade.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO) latest edition:
 - 1. AASHTO T-180 – Moisture-Density Relations of Soils Using a 10-lb Rammer and 18-in Drop
- B. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition:
 - 1. Section 914 – Stabilization Materials

1.03 QUALITY ASSURANCE

- A. Field compaction density, stability, and thickness testing frequencies of the subgrade shall be tested once every 300 linear feet of paving per 24-foot wide strip, staggered left, center, and right of centerline. Where less than 300 linear feet of asphalt is placed in 1-day, provide minimum of 1 test for each per day's construction at a location designated by the County.

1.04 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
 - 1. Materials certificates signed by material producer and Contractor, certifying that each material item complies with specified requirements.

1.05 SYSTEM DESCRIPTION

- A. Stabilize the roadbed below the proposed base to provide a firm and unyielding subgrade.
- B. Provide a finished roadbed section that meets the bearing value requirements regardless of the quantity of stabilizing materials necessary to be added.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.
- B. The Contractor may choose the type of stabilizing material.
- C. Materials may be lime rock, shell rock, cemented coquina, or shell-base sources approved by the FDOT.
- D. At least 97% by weight of the total material shall pass a 3-1/2-inch (90-mm) sieve. Material having a plasticity index greater than 10 or a liquid limit greater than 40 shall not be used as a stabilizer.

2.02 LIMEROCK

- A. For limerock, carbonates of calcium and magnesium shall be at least 70%.

2.03 CRUSHED SHELL

- A. Crushed shell for this use shall be mollusk shell (i.e., oysters, mussels, clams, cemented coquina). Steamed shell will not be permitted.
- B. At least 50% by weight of the total material shall be retained on the No. 4 (4.75 µm) sieve.
- C. Not more than 20% by weight of the total material shall pass the No. 200 (75 µm) sieve. The determination of the percentage passing the No. 200 (75 µm) sieve shall be by washing only.

2.04 LOCAL MATERIALS

- A. Local materials used for this stabilizing may be soils or recyclable materials such as crushed concrete, roof tiles, asphalt coated base, or reclaimed pavement. However, no materials that deteriorate over time, cause excessive deformations, contain hazardous substances, contaminates, or do not improve the bearing capacity of the stabilized material may be used.

PART 3 - EXECUTION

3.01 GENERAL

- A. Prior to the beginning of stabilizing operations, construct the area to be stabilized to an elevation such that, upon completion of stabilizing operations, the completed stabilized subgrade will conform to the lines, grades, and cross-section shown in the plans. Prior to spreading any additive stabilizing material, bring the surface of the roadbed to a plane approximately parallel to the plane of the proposed finished surface.

- B. Process the subgrade to be stabilized in 1 course, unless the equipment and methods being used do not provide the required uniformity, particle size limitation, compaction, and other desired results, in which case, the County will direct that the processing be done in more than 1 course.

3.02 APPLICATION OF STABILIZING MATERIAL

- A. When additive stabilizing materials are required, spread the designated quantity uniformly over the area to be stabilized.
- B. When materials from an existing base are to be used in the stabilizing at a particular location, place and spread all of such materials prior to the addition of other stabilizing additives.
- C. Spread commercial stabilizing material by the use of mechanical material spreaders, except that where use of such equipment is not practicable, use other means of spreading, but only upon written approval of the proposed alternate method.

3.03 MIXING

- A. Perform mixing using rotary tillers or other equipment meeting the approval of the County. The Contractor may mix the materials in a plant of an approved type suitable for this Work. Thoroughly mix the area to be stabilized throughout the entire depth and width of the stabilizing limits.
- B. Perform the mixing operations as specified (either in place or in a plant) regardless of whether the existing soil, or any select soils placed within the limits of the stabilized sections, have the required bearing value without the addition of stabilizing materials.

3.04 MAXIMUM PARTICLE SIZE OF MIXED MATERIALS

- A. At the completion of the mixing, ensure that the gradation of the material within the limits of the area being stabilized is such that 97% will pass a 3-1/2-inch sieve and that the material does not have a plasticity index greater than 8 or liquid limit greater than 30. Note that clay balls or lumps of clay size particles (2 microns or less) cannot be considered as individual particle sizes. Remove any materials not meeting the plasticity requirements from the stabilized area. The Contractor may break down or remove from the stabilized area materials not meeting the gradation requirements.

3.05 COMPACTION

- A. Compact the materials at a moisture content permitting the specified compaction. If the moisture content of the material is improper for attaining the specified density, either add water or allow the material to dry until reaching the proper moisture content for the specified compaction.

3.06 FINISH GRADING

- A. Shape the completed stabilized subgrade to conform to the finished lines, grades, and cross-section indicated in the Drawings. Check the subgrade using elevation stakes or other means approved by the County.

3.07 CONDITION OF COMPLETED SUBGRADE

- A. After completing the stabilizing and compacting operations, ensure that the subgrade is firm and substantially unyielding to the extent that it will support construction equipment and will have the bearing value required by the Drawings.
- B. Remove all soft and yielding material, and any other portions of the subgrade that will not compact readily. Replace yielding material with suitable material so that the whole subgrade is brought to line and grade with proper allowance for subsequent compaction.

3.08 MAINTENANCE OF COMPLETED SUBGRADE

- A. After completing the subgrade, maintain it free from ruts, depressions, and any damage resulting from the hauling or handling of materials, equipment, and tools. The Contractor is responsible for maintaining the required density until the subsequent base or pavement is in place including any repairs or replacement of curb and gutter or sidewalk which might become necessary in order to recompact the subgrade in the event of underwash or other damage occurring to the previously compacted subgrade. Perform any such recompaction at no expense to the County. Construct and maintain ditches and drains along the completed subgrade section.

3.09 FIELD QUALITY CONTROL

- A. When proper moisture conditions are attained, compact the material to not less than 98% of maximum density determined by AASHTO T-180, and a minimum LBR of 40.

END OF SECTION

SECTION 02572
SOIL CEMENT BASE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Furnish and install base course using a combination of soil, Portland cement, and water.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO) latest edition:
1. AASHTO T-88: Particle Size Analysis of Soils
 2. AASHTO T-89: Determining the Liquid Limit of Soils
 3. AASHTO T-90: Determining the Plastic Limit and Plasticity Index of Soils
 4. AASHTO T-134: Moisture-Density Relations of Soil-Cement Mixtures
 5. AASHTO T-135: Wetting and Drying Test of Compacted Soil-Cement Mixtures
 6. AASHTO T-267: Determination of Organic Content in Soils by Loss on Ignition
- B. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, latest implemented edition:
1. Specification Section 911: Limerock Material for Base and Stabilized Base
 2. Specification Section 916: Bituminous Materials
 3. Specification Section 921: Portland Cement and Blended Cement

1.03 QUALITY ASSURANCE

- A. For density and thickness determination, a LOT is defined as 2,500 square yards of base, plus any small section of base at the end of a day's operation in the preceding LOT. The County may include small irregular areas as part of another LOT. Areas such as an intersection, crossover, and ramp will be considered as a separate LOT. No LOT shall include more than 3,500 square yards or it shall be considered as a separate LOT.
- B. Five (5) density tests shall be performed at locations randomly selected by the County within each LOT.
- C. Five (5) thickness measurements shall be performed at locations randomly selected by the County within each LOT. Three-inch minimum diameter test holes are required to determine the thickness.

1.04 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
1. Soil-cement design mix

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

- A. Cement shall be Portland cement, Type I, II, III, or Type 1-P per FDOT Specification Section 921.
- B. Use water that is free from substances deleterious to hardening of the soil-cement mixture.
- C. Curing Material shall be per FDOT Specification Section 916.
- D. Emulsified asphalt shall be Grade SS, RS, or MS as approved by the County. Dilute as recommended by the manufacturer.
- E. Soils for base course construction shall be either limerock material per FDOT Specification Section 911 or soils meeting the following requirements:

**Table 02572-1
Soil Requirements**

Physical Characteristic	Acceptance Level	Testing Standard
Organic Material	Maximum 5%	AASHTO T-267
Total Clay and Silt Content (Minus No. 200 Sieve)	Maximum 25%	AASHTO T-88
Plastic Index	Maximum 10%	AASHTO T-90
Liquid Limit	Maximum 25%	AASHTO T-89

**Table 02572-2
Soil Gradation Requirements**

Soil Gradation Requirements (Per AASHTO T-88)	
Passing 2-inch sieve	Minimum 100%
Passing No. 4 sieve	Minimum 55%
Passing No. 10 sieve	Minimum 37%

2.03 PROPORTIONING OF MIX

- A. Submit for approval a design mix for the soil proposed for use in soil-cement construction prepared by a testing laboratory approved by the County. The design mix submittal shall include the results of tests run to verify that the soil meets the requirements; results of tests used to establish the cement content; and a final design laboratory sample. Submit the design mix to the County for approval a minimum of 60-calendar days prior to beginning of soil-cement construction for Brush Loss Design Method or 15-calendar days prior to beginning of soil-cement construction for Strength Design Method. Express the cement as a percentage of the dry unit weight of the soil. For mixed-in-place construction, use a ratio of cement based on the maximum density of the soil determined in accordance with AASHTO T-99 and rounded up to the nearest pound per cubic yard.
- B. When proportioning the soil-cement mixture in accordance with strength design, determine the minimum cement content using FM 5-520. The design compressive strength specified shall be achieved in 7-days. Ensure that the cement content is not less than 5% by weight except as noted below.
- C. When proportioning the soil-cement mixture in accordance with Brush Loss Design criteria, determine the minimum cement content in accordance with AASHTO T-135. Ensure that the cement content is not less than 5% by weight except as noted below. Ensure that the soil-cement loss at the completion of 12 cycles of testing conforms to the limits in the following table.

**Table 02572-3
Soil Limits**

Soil Group	Limits
AASHTO Soils Groups A-1, A-2-4, A-2-5, and A-3	Not over 14%
AASHTO Soils Groups A-2-6, A-2-7, A-4, and A-5	Not over 10%
AASHTO Soils Groups A-6 and A-7	Not over 7%

- D. When proportioning of soil-cement mixture by the Brush Loss Design Criteria Method and processing by Central-Plant-Mixing where the requirements noted below are met, the County will not require strength testing of field specimens. Verify the properties of the parent material during the processing, on a random frequency, to ensure that the final mix has not changed from the original design. Provide the County a printout of each day's production that shows proportioning of the mixture meets the approved Brush Loss Design, including cement.
- E. Do not apply the minimum 5% cement content specified above if obtaining the soil material used in producing a soil-cement mixture from a commercial source (not to exclude recycled materials) where soil properties are consistently uniform, and if processing the mixture in a central mix plant that automatically weighs components and automatically records the weight of each component on a printed ticket, tape, or other digital record.

PART 3 - EXECUTION

3.01 GENERAL

- A. Use any machine, combination of machines, or equipment that is in good, safe working condition and that will produce results meeting the requirements for cement application, soil pulverization, mixing water application, compaction, finishing, and curing, as required herein. Compaction equipment shall be used that will produce a base at the required density.

3.02 SUBGRADE PREPARATION

- A. Subgrade shall be completed before beginning base construction operations. Ensure that the subgrade is firm enough to support the equipment used in the soil-cement base operations without appreciable distortion or displacement. Remove any unsuitable material and replace it with suitable material.
- B. When constructing the base with central-plant-mixed soil-cement, grade and shape the subgrade to the lines, grades, and typical cross-section shown in the plans. Ensure that the subgrade is moist but not ponded at the time of placing the mixed base course material.

3.03 BASE SOIL FOR MIXED-IN-PLACE PROCESSING

- A. Grade and shape the area over which the base is to be constructed to an elevation that will provide a base in conformance with the grades, lines, thickness, and typical cross-sections shown on the plans. Remove all roots, sticks, and other deleterious matter during processing.

3.04 PROCESSING OF SOIL-CEMENT MIXTURE

- A. Mix the soil, cement, and water either by mixed-in-place or central-plant-mix methods.
- B. Do not allow the percentage of moisture in the soil at the time of cement application to exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations.
- C. During seasons of freezing temperature, do not spread any cement or soil-cement mixture unless the ambient temperature is at least 40°F in the shade.
- D. At the completion of moist-mixing, pulverize the soil so that 100% passes a 1-1/2-inch sieve, 95 to 100% passes the 1-inch sieve and a minimum of 80% passes a No. 4 sieve, exclusive of gravel, shell, or stone.
- E. Operations shall be completed within a period of 4-hours starting at the time mixing commences.

3.05 MIXED-IN-PLACE METHOD

- A. Where feasible, process the entire width of the base in a single operation. Uniformly spread the design quantity of cement on the soil at the required rate of application, by means of an approved method. Replace spread cement that becomes displaced before starting mixing. Check the uniformity of spread rate by:
 - 1. Weight of cement spread/square yards covered for a short trial section that is between 100 and 300-feet in length; or
 - 2. Use of a square yard cloth/box
- B. After applying the cement, begin mixing within 60-minutes. Initially mix the soil and cement until the cement has sufficiently blended with the soil to prevent formation of cement balls when applying additional water; then add water if necessary, and re-mix the soil-cement mixture. Do not perform windrow mixing.
- C. Process up to the full depth in 1 course, provided the distribution of cement and water and the specified density are satisfactory to the County. If not, construct courses of such thickness to obtain satisfactory results. Make provisions to achieve adequate bonding between courses.
- D. Immediately after mixing of the soil and cement, add any additional water that is necessary. If the moisture content exceeds that specified, manipulate the soil-cement mixture by re-mixing or grading as required to reduce the moisture content to within the specified range. Avoid excessive concentrations of water. Continue mixing during and after applying water until obtaining a uniform mixture of soil, cement, and water.
- E. As an alternative to the above-described procedure, the Contractor may use an approved machine that will blend the cement and the soil. Additional water may be added and mixed as necessary.

3.06 CENTRAL-PLANT-MIXED METHOD

- A. Mix the soil, cement, and water in a pugmill of either the batch or continuous-flow type. Equip the plant with feeding and metering devices that will accurately proportion the soil, cement, and water in the quantities specified. Mix soil and cement sufficiently to prevent cement balls from forming when adding additional water. Continue mixing until obtaining a uniform mixture of soil, cement, and water.
- B. Haul the mixture to the roadway in trucks equipped with protective covers. Place the mixture on the moistened subgrade in a uniform layer with suitable equipment. Do not allow more than 60-minutes to elapse between placing of soil-cement in adjacent passes of the spreader at any location, except at construction joints. Ensure that the layer of soil-cement is uniform in thickness and surface contour and in such quantity that the completed base will conform to the required grade and cross-section. Do not perform windrow mixing.

3.07 CONSTRUCTION JOINTS

- A. Prior to joining any previously constructed section of base, form a vertical construction joint by cutting back into the completed work to form a true vertical face of acceptable soil-cement to the full depth of the base course. Moisten the vertical face as needed prior to placing new material against it.

3.08 SHAPING AND FINISHING

- A. Prior to final compaction, shape the surface of the soil-cement to the required lines, grades, and cross-section. In all cases where adding soil-cement mixture to any portion of the surface, lightly scarify the surface with a spring tooth harrow, spike drag, or other approved device to uniformly loosen the surface prior to adding material and prior to the initial set of the soil-cement mixture. Compact the resulting surface to the specified density. Continue rolling until all rutting ceases and until the base conforms to the density requirements.
- B. Ensure that the surface material is moist but not ponded, and maintained at not less than 2% below its specified optimum moisture content, during finishing operations. Perform surface compaction and finishing in such a manner as to produce a smooth dense surface, free of compaction planes, construction cracks, ridges, and loose material.
- C. If the time limits specified above are exceeded, either remove and replace the base or leave the base undisturbed for a period of 7-days, after which, the County will examine it to determine its suitability. If found unsuitable, remove and replace the base at no additional cost to County.

3.09 COMPACTION

- A. Begin compacting the soil-cement mixture immediately after mixing or placing. Do not allow more than 30-minutes to elapse between the last pass of moist-mixing or spreading and the start of compaction of the soil-cement mixture at a particular location.
- B. Determine the optimum moisture content and the maximum density in the field by the methods prescribed in AASHTO T-134 on representative samples of the soil-cement mixture obtained immediately after the initial mixing. Determine the density for each day's run or change of material.
- C. Uniformly compact the loose material to meet the density requirements specified below. During compaction operations, reshape the material to obtain required grade and cross-section.

3.10 PROTECTION AGAINST DRYING

- A. While finishing and correcting the surface, keep the surface of the base continuously moist by sprinkling water as necessary until applying the emulsified asphalt curing material. As soon as practicable, protect the base from drying for 7-days by applying the emulsified asphalt at the rate of 0.20 to 0.25-gallons of the diluted mixture per square yard. Provide complete coverage without excessive runoff. While applying the bituminous material, ensure that the soil-cement surface is dense, free of all loose and extraneous material, and contains sufficient moisture to prevent excessive penetration of the bituminous materials.
- B. If it is necessary to allow construction equipment or other traffic to use the completed base before the bituminous material has cured sufficiently to prevent pickup or displacement, sand the bituminous material, using approximately 10-lbs of clean sand per square yard. Do not use cover material containing organic acids or other compounds detrimental to the soil-cement base.
- C. Maintain the curing material during the 7-day protection period.

3.11 OPENING TO TRAFFIC

- A. Do not allow traffic on the base subsequent to completion of the finishing operations for a minimum period of 72-hours. As an exception to this requirement, allow equipment necessary for correction of surface irregularities, application of water, and application of curing materials on the base, if the tire contact pressures of such equipment do not exceed 45-psi. Under special conditions (i.e. low speed limit, low traffic volume, urban conditions), the County may waive the 72-hour period.

3.12 MAINTENANCE

- A. Maintain the base to a true and satisfactory surface until the wearing surface is constructed. If the County requires any repairing or patching, extend the repair or patch to the full depth of the base, and make them in a manner that will ensure restoration of a uniform base course in accordance with the requirements of these Specifications. Do not repair the base by adding a thin layer of soil-cement or concrete to the completed work. Make full depth repairs to small or minor areas, such as at manholes or inlets, with Class I concrete.
- B. For patching of deficient areas less than 100-square feet and less than 1-inch in depth, correct the areas using Type S-III Asphalt Concrete. For patching of deficient areas less than 100-square feet and greater than 1-inch in depth, remove the areas to full depth and replace them using Asphalt Base Course Type 3, Type S Asphaltic Concrete, or soil-cement.

3.13 DENSITY TESTING REQUIREMENTS

- A. As soon as possible after completing compaction, perform field density testing to ensure that the density is 97% of the maximum density as determined by methods prescribed in AASHTO T-134.
- B. If an individual test value within a LOT is less than 94% of the maximum density, determine the extent of this deficiency by performing density tests using a 5-foot grid pattern until a test value of 95% or greater is located in all directions. Remove the delineated area of base, and replace it with base meeting all requirements of this section, at no cost to the County.
- C. As an exception to the foregoing, if 3 or more of the original 5 individual test values within a LOT are less than 94% of the maximum density, the County will reject the entire LOT, and the Contractor shall remove all base within the LOT and replace it with base meeting all requirements of this Section, at no expense to the County.

3.14 SURFACE FINISH ACCEPTANCE REQUIREMENTS

- A. After compacting and finishing, and not later than the beginning of the next calendar day after constructing any section of base, measure the surface with a template cut to the required cross-section and a 15-foot straightedge placed parallel to the centerline of the road. Both templates shall be provided by the Contractor. Correct all irregularities greater than 1/4-inch to the satisfaction of the County with a blade adjusted to the lightest cut which will ensure a surface that does not contain depressions greater than 1/4-inch under the template or the straightedge. The County may approve other suitable methods for measurement.

3.15 THICKNESS ACCEPTANCE REQUIREMENTS

- A. Construction tolerances for thickness are as follows:

**Table 02572-4
Thickness Tolerances**

	Allowable Deviation From Plan Thickness
Central-Plant-Mixed Processing	-1-inch
Mixed-in-Place Processing	+/- 1-inch

- B. When any thickness measurement is outside the construction tolerance, the County will take additional thickness measurements at 10-foot intervals parallel to the centerline in each direction from the measurement which is outside the construction tolerance until a measurement in each direction is within the construction tolerance.
- C. The County will evaluate an area of base found to have a thickness outside the construction tolerance and may require the Contractor to remove and replace it with acceptable base of the thickness shown in the plans at no expense to the County.

3.16 STRENGTH TESTING OF FIELD SPECIMENS

- A. Check the adequacy of cement content and uniformity of distribution of cement within the base by sampling and testing the completed mix.
- B. Take samples at the project site just prior to final compaction and perform a minimum of 2 Strength Test Values (STV) each day, with at least 1 STV per each 2,500 square yards mixed.
- C. Ensure that each STV is the average strength value of a minimum of 3 individual specimens.
- D. Take representative samples of the mixed soil-cement material for determining an STV just prior to final compaction, recording the sample location, and ensuring that the samples are large enough to mold 3 or more compressive strength test specimens as prescribed in FM 5-520.
- E. Mold test specimens at the field moisture content and cast the individual test specimens as close to identical as possible
- F. Rest the molds during compaction of strength test specimens on a 200-pound concrete block that the Contractor provides.
- G. Gently extrude these test specimens from the compaction mold, and carefully place them in a moist curing environment (not in direct contact with water) such as a tightly closed container under wet cloth or burlap at locations where they will not be disturbed.

- H. Continue the initial field cure for at least 24-hours, and if after 24-hours it is determined that the specimens have not gained sufficient strength to be moved without probable damage, continue field curing until the County determines that each specimen can be safely moved without probable damage occurring. When the County determines that the specimens can be safely moved, transport them to the laboratory where they will be cured, as described in the design procedure (FM 5-520), to 7-days of age. At 7-days of age, test the individual specimen for determination of compressive stress and ensure that the loading procedure and rates are the same, as described in FM 5-520.
- I. If an STV is less than 60% of the Laboratory Design Strength, remove and replace the material represented by the STV, at no expense to the County.
- J. When the LOT average thickness of soil-cement base is deficient by more than 1-inch and the judgment of the County is that the area of such deficiency should not be removed and replaced, payment for the area retained will be at 50%.
- K. When multiple deficiencies occur, the applicable percent payment schedule will be applied to the LOT of base that is identified with each deficiency. The penalty for each deficiency will be applied separately to the unit price.

END OF SECTION

SECTION 02573

ASPHALT PAVEMENT REMOVAL AND REPLACEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Mill or remove existing asphalt pavement and base materials and install asphalt paving on a prepared base or as an overlay to existing asphalt pavement sections. Provide Maintenance of Traffic and coordinate and install temporary and permanent replacement of traffic signalization and pavement striping and markings.

1.02 REFERENCES

- A. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, 2000 and 2004 editions.
 - 1. Section 300 – Prime and Tack Coats for Base Courses (2000 and 2004 Editions)
 - 2. Section 320 – Hot Bituminous Mixtures – Plant, Methods, and Equipment (2000 and 2004 Editions)
 - 3. Section 327 – Milling of Existing Asphalt Pavement (2000 and 2004 Editions)
 - 4. Section 330 – Hot Bituminous Mixtures – General Construction Requirements (2000 and 2004 Editions)
 - 5. Section 331 – Type S Asphalt Concrete (2000 Edition)
 - 6. Section 334 – Superpave Asphalt Concrete (2004 Edition)
 - 7. Section 901 – Coarse Aggregate (2000 and 2004 Editions)
 - 8. Section 902 – Fine Aggregate (2000 and 2004 Editions)
 - 9. Section 916 – Bituminous Materials (2000 and 2004 Editions)
 - 10. Section 917 – Mineral Filler (2000 and 2004 Editions)
- B. Florida Department of Transportation (FDOT) Design Standards, 2000 and 2004 editions.

1.03 QUALITY ASSURANCE

- A. Asphalt pavements shall be plant-mixed hot bituminous mixtures. Plant operations shall not begin unless all weather conditions are suitable for laying operations. A prime and tack coat shall be first applied to newly constructed bases. A tack coat shall be applied on existing pavements that are to be overlaid with an asphalt mix and between successive layers of asphalt mix. Apply prime and tack coats when ambient or base surface temperature is above 40°F, and when temperature has been above 35°F for 12-hours immediately prior to application. Construct asphaltic concrete paving when ambient temperature is above 45°F. Do not apply when base is wet, contains excess moisture, or during rain. Establish and maintain required lines and elevations.

- B. Do not spread the mixture when the wind is blowing to such an extent that proper and adequate compaction cannot be maintained or when sand, dust, etc., are being deposited on the surface being paved to the extent that the bond between layers will be diminished.
- C. Field compaction density and thickness testing frequencies of the asphalt shall be tested once every 300-linear feet of paving per 24-foot wide strip, staggered left, center, and right of centerline. Where less than 300-linear feet of asphalt is placed in 1-day, provide minimum of 1 test for each per day's construction at a location designated by the County.
- D. Asphalt extraction gradation shall be tested from grab samples collected once every 1,800-square yards of asphalt delivered to the site, or a minimum of once per day. Obtain the results in a timely manner (no later than the end of the day) so that adjustments can be made if necessary.
- E. On initial use of a Type S mix design at a particular plant, as a minimum, run an additional extraction gradation analysis if more than 500-tons [450-metric tons] of mixture are produced on the first day of production.
- F. Tolerances for Quality Control Tests (Extraction Gradation Analysis) shall be in accordance with FDOT Specification Section 331.

1.04 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
 - 1. Submit for each proposed design mix the Gradation analysis; Grade of asphalt cement used; and Marshall Stability in pounds flow.
 - 2. Provide a single percentage of asphalt by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1%. For structural mixes (S-1, S-3) establish the optimum asphalt content at a level corresponding to a minimum of 4.5% air voids. Provide the laboratory density of the asphalt mixture for all mixes except Open-Graded Friction Courses.
 - 3. Identify source and description of the materials to be used.
 - 4. Provide certification that the mix design conforms to specification requirements.
 - 5. Field compaction density and thickness testing.
 - 6. Field asphalt extraction gradation.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

- B. Type S Asphalt Concrete (Type S-1 or S-3) is required. The equivalent fine Type SP (Superpave) Asphalt Concrete mixture (Traffic Level C) meeting the requirements of FDOT Specification Section 334 may be selected as an alternate at no additional cost to the County. The equivalent mixes are as follows:
 1. Type S-1: Type SP-12.5
 2. Type S-3: Type SP-9.5
- C. Asphalt plant and equipment shall meet the requirements in FDOT Specification Section 320.

2.02 AGGREGATE

- A. Coarse Aggregate, Stone, Slag, or Crushed Gravel shall meet the requirements in FDOT Specification Section 901.
- B. Fine Aggregate shall meet the requirements in FDOT Specification Section 902.
- C. Aggregate gradation shall meet the following:

**Table 02573-1
Bituminous Concrete Mixtures
(Gradation Design Range)**

Type	Total Aggregate Passing Sieves ¹							
	3/4-inch [19.0 mm]	1/2-inch [12.5 mm]	3/8-inch [9.5 mm]	No. 4 [4.75 mm]	No. 10 [2.0 mm]	No. 40 [425 μm]	No. 80 [180 μm]	No. 200 [75 μm]
S-1 ⁴	100	88-98	75-93	47-75	31-53	19-35	7-21	2-6
S-3 ⁴		100	88-98	60-90	40-70	20-45	10-30	2-6
ABC-1		100						0-12
ABC-2		100			55-90			0-12
ABC-3 ²	70-100			30-70	20-60	10-40		2-10
FC-2 ³		100	85-100	10-40	4-12			
FC-3 ⁴		100	88-98	60-90	40-70	20-45	10-30	2-6
1. In inches [mm] or sieves [μm]. 2. 100% passing 1-1/2-inch [37.5 mm] sieve. 3. The County may increase the design range for the No. 10 [200 mm] sieve for lightweight aggregates. 4. The County may retain up to 1% on the maximum sieve size.								

- D. Use clean aggregate containing no deleterious substances. Do not use coarse or fine aggregate which contains more than 0.5% of phosphate.
- E. In laboratory tests, and for the purpose of proportioning the paving mixture, consider all material passing the No. 10 [2.00-mm] sieve and retained on the No. 200 [75 μm] sieve as fine aggregate, and the material passing the No. 200 [75 μm] sieve as mineral filler.

- F. Do not use any screenings in the combination of aggregates containing more than 15% of material passing the No. 200 [75 µm] sieve. When two screenings are blended to produce the screening component of the aggregate, one of such screenings may contain up to 18% of material passing the No. 200 [75 µm] sieve, as long as the combination of the two does not contain over 15% material passing the No. 200 [75 µm] sieve. Screenings may be washed to meet these requirements.

2.03 ASPHALT CEMENT

- A. Superpave PG Asphalt Binder or Recycling Agent shall meet the requirements in FDOT Specification Section 916.
- B. Mineral Filler shall meet the requirements in FDOT Specification Section 917.
- C. Marshall design mix shall be in accordance with the following:

**Table 02573-2
Marshall Design Properties For Bituminous Concrete Mixes**

Mix Type	Minimum Marshall Stability (lbs.)	Flow* (0.01 in)	Minimum VMA (%)	Air Voids (%)	Minimum Effective Asphalt Content (%)	VFA Voids Filled with Asphalt (%)
S-1	1,500	8-13	14.5	4-5	**	65-75
S-3	1,500	8-13	15.5	4-6	**	65-75
ABC-1	500	7-15	15	5-16	6.0	-
ABC-2	750	7-15	15	5-14	5.5	-
ABC-3	1,000	8-13	14	4-7	**	65-78
FC-2	-	-	-	-	-	-
FC-3	1,500	8-13	15.5	4-6	**	65-75

* The maximum Flow value during production shall not exceed one point more than shown in the Table.
 ** The ratio of the percentage by weight of total aggregate passing the No. 200 sieve to the effective asphalt content expressed as a percentage by weight of total mix shall be in the range of 0.6 to 1.2.

2.04 BITUMINOUS MIXTURE

- A. Use a bituminous mixture composed of a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and bituminous material. Ensure that no more than 20% by weight of the total aggregate used is silica sand or local materials as defined in FDOT Specification Section 902. Size, grade, and combine the several aggregate fractions in such proportions that the resulting mixture meets the grading and physical properties of the verified mix design.

PART 3 - EXECUTION

3.01 GENERAL

- A. Set up, install and maintain temporary traffic control devices and detours as necessary in accordance with Specification Section 1570 "Maintenance of Traffic."
- B. Asphalt pavements, including all surface courses and base courses, where shown to be open cut and removed on the Drawings or specified in the Project Manual, shall be removed to a line back from each edge of the trench, other excavation, or to the limits indicated on the Drawings. Pavements shall be cut straight, clean and square with a power saw or other tools and equipment suitable for the Work.
- C. Asphalt pavements, where shown to be milled on the Drawings or specified in the Project Manual, shall be milled according to FDOT Specification Section 327.
- D. Asphalt mixtures shall meet the general construction requirements specified in FDOT Specification Section 330.
- E. Spread the mixture only when the surface upon which it is to be laid has been previously prepared, is intact, firm, and properly cured, and is dry. Do not spread mixture that cannot be finished and compacted during daylight hours.
- F. Deliver the asphalt cement from the asphalt plant at a temperature not to exceed 350°F and equip the transport tanks with sampling and temperature sensing devices meeting the requirements of FDOT. Maintain the asphalt cement in storage within a range of 230°F to 350°F in advance of mixing operations. Maintain constant heating within these limits, and do not allow wide fluctuations of temperature during a day's production.
- G. Produce a homogeneous mixture, free from moisture and with no segregated materials, that meets all specification requirements for the mixture, including compliance with the Marshall Properties. Also apply these requirements to all mixes produced by the drum mixer process and all mixes processed through a hot storage or surge bin, both before and after storage.

3.02 PREPARATION OF APPLICATION SURFACES

- A. Prior to the laying of the mixture, clean the surface of the base or pavement to be covered of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.
- B. Where an asphalt mix is to be placed on an existing pavement or old base that is irregular, and wherever the plans indicate, bring the existing surface to proper grade and cross-section by the application of patching or leveling courses.
- C. Where an asphalt mix is to be placed over a newly constructed surface treatment, sweep and dispose of all loose material from the paving area.

- D. Paint all structures which will be in actual contact with the asphalt mixture, with the exception of the vertical faces of existing pavements and curbs or curb and gutter, with a uniform coating of asphalt cement to provide a closely bonded, watertight joint.
- E. Apply a prime and tack coat on newly constructed bases and apply a tack coat, as specified in FDOT Specification Section 300, on existing pavement structures that are to be overlaid with an asphalt mix and between successive layers of all asphalt mixes.

3.03 PLACING MIXTURE

- A. Lay all asphaltic concrete mixtures, including leveling courses, other than adjacent to curb and gutter or other true edges, by the string line method to obtain an accurate, uniform alignment of the pavement edge.
- B. For each paving machine operated, use a separate crew, each crew operating as a full unit. The Contractor's Certified Paving Technician in charge of the paving operations may be responsible for more than one crew but must be physically accessible to the County at all times when placing mix.
- C. Check the depth of each layer at frequent intervals, and make adjustments when the thickness exceeds the allowable tolerance. When making an adjustment, allow the paving machine to travel a minimum distance of 32-feet to stabilize before the second check is made to determine the effects of the adjustment.
- D. In limited areas where the use of the spreader is impossible or impracticable, the Contractor may spread and finish the mixture by hand.
- E. Straightedge and back-patch after obtaining initial compaction and while the material is still hot.
- F. Upon arrival, dump the mixture in the approved mechanical spreader, and immediately spread and strike-off the mixture to the full width required, and to such loose depth for each course that, when the Work is completed, the required weight of mixture per square yard [square meter], or the specified thickness, is secured. Carry an excess amount of mixture ahead of the screed at all times. Hand-rake behind the machine as required.
- G. Construct each course in layers of the thickness as shown on FDOT Design Standards Index No. 513.
- H. Before starting any rolling, check the surface; correct any irregularities; remove all drippings, fat sandy accumulations from the screed, and fat spots from any source; and replace them with satisfactory material. Do not skin patch. When correcting a depression while the mixture is hot, scarify the surface and add fresh mixture.

3.04 APPLICATION OF LEVELING COURSES

- A. Before spreading any leveling course, fill all depressions in the existing surface more than 1-inch deep by spot patching with leveling course mixture, and then compact them thoroughly.
- B. Place all courses of leveling by the use of two (2) motor graders; equip one with a spreader box. Use other types of leveling devices after they have been approved by the County.
- C. When the total asphalt mix provided for leveling exceeds 50-lb/yds² [27-kg/m²], place the mix in two or more layers, with the average spread of any layer not to exceed 50-lb/yd² [27-kg/m²]. When using Type S-3 Asphaltic Concrete for leveling, do not allow the average spread of a layer to be less than 50-lb/yd² [27-kg/m²] or more than 75-lb/yd² [40-kg/m²]. The Contractor may vary the rate of application throughout the Project as directed by the County. When leveling in connection with base widening, the County may require placing all the leveling mix prior to the widening operation.

3.05 COMPACTING MIXTURE

- A. The coverage is the number of times the roller passes over a given area of pavement. Regardless of the rolling procedure used, complete the final rolling before the surface temperature of the pavement drops below 160°F.
- B. Seal Rolling: Provide two (2) coverages with a tandem steel-wheeled roller (either vibratory or static), weighing 5 to 12-tons, following as close behind the spreader as possible without pick-up, undue displacement, or blistering of the material. Use vibratory rollers in the static mode for layers of 1-inch or less in thickness.
- C. Intermediate Rolling: Provide five (5) coverages with a self-propelled pneumatic-tired roller, following as close behind the seal rolling operation as the mix will permit.
- D. Final Rolling: Provide one (1) coverage with a tandem steel-wheeled roller (static mode only), weighing 5 to 12-tons, after completing the seal rolling and intermediate rolling, but before the surface pavement temperature drops below 160°F.
- E. Operate the self-propelled, pneumatic-tired roller at a speed of 6 to 10-mph. For each roller, do not exceed an area of coverage of 4,000 yd²/hour; if rolling Type S Asphaltic Concrete, do not exceed an area of coverage of 3,000 yd²/hour.
- F. Use a sufficient number of self-propelled pneumatic-tired rollers to ensure that the rolling of the surface for the required number of passes does not delay any other phase of the laying operation and does not result in excessive cooling of the mixture before completing the rolling. In the event that the rolling falls behind, discontinue the laying operation until the rolling operations are sufficiently caught up.

- G. Use hand tamps or other satisfactory means to compact areas which are inaccessible to a roller, such as areas adjacent to curbs, headers, gutters, manholes, etc.
- H. Use self-propelled pneumatic-tired rollers to roll all patching and leveling courses. Where placing the initial leveling course over broken concrete pavement, use a pneumatic-tired roller that weighs at least 15-tons. For Type S-3 Asphaltic Concrete leveling courses, use a steel-wheeled roller to supplement the traffic rollers. On other leveling courses, use a steel-wheeled roller to supplement the traffic rollers on all passes after the first pass.
- I. Do not allow the rollers to deposit gasoline, oil, or grease onto the pavement. Remove and replace any areas damaged by such deposits as directed by the County. While rolling is in progress, test the surface continuously, and correct all discrepancies to comply with the surface requirements. Remove and replace all drippings, fat or lean areas, and defective construction of any description. Remedy depressions that develop before completing the rolling by loosening the mixture and adding new mixture to bring the depressions to a true surface. Should any depression remain after obtaining the final compaction, remove the full depth of the mixture, and replace it with sufficient new mixture to form a true and even surface. Correct all high spots, high joints, and honeycombing as directed by the County. Remove and replace any mixture remaining unbonded after rolling. Correct all defects prior to laying the subsequent course.
- J. Use a self-propelled pneumatic-tired roller on the first structural layer placed on a milled surface. Compact with a minimum of three passes.

3.06 JOINTS

- A. Place the mixture as continuously as possible. Do not pass the roller over the unprotected end of the freshly laid mixture except when discontinuing the laying operation long enough to permit the mixture to become chilled. When thus interrupting the laying operation, construct a transverse joint by cutting back on the previous run to expose the full depth of the mat.
- B. For all layers of pavement except the leveling course, place each layer so that longitudinal construction joints are offset 6-inches to 12-inches laterally between successive layers.
- C. When laying fresh mixture against the exposed edges of joints (trimmed or formed as provided above), place it in close contact with the exposed edge to produce an even, well-compacted joint after rolling.

3.07 SURFACE REQUIREMENTS

- A. Obtain a smooth surface on all pavement courses placed, and then straightedge all intermediate and final courses with a 15-foot rolling straightedge. Furnish a 15-foot [4.572-m] manual straightedge, and make it available at the job site at all times during the paving operation for checking joints and surface irregularities.

- B. Produce a finished surface of uniform texture and compaction with no pulled, torn, or loosened portions and free of segregation, sand streaks, sand spots, or ripples.

3.08 ACCEPTANCE REQUIREMENTS

- A. Upon completion of the final surface or friction course, the County will test the finished surface with a 15-foot rolling straightedge. Correct all deficiencies in excess of 3/16-inch.
- B. If correction is made by removing and replacing the pavement, remove the full depth of the course and extend at least 50-feet on either side of the defective area for the full width of the paving lane.
- C. If correction is made by overlaying, cover the length of the defective area and taper uniformly to a featheredge thickness at a minimum distance of 50-feet on either side of the defective area. Extend the overlay the full width of the roadway. Maintain the specified cross slope. The County may adjust, as necessary, the mix used for the overlay for this purpose.
- D. The maximum deficiency from the specified thickness as follows:
 - 1. For pavement of a specified thickness of 2-1/2-inches or more: 1/2-inch
 - 2. For pavement of a specified thickness less than 2-1/2-inches: 1/4-inch
- E. Where the deficiency in thickness is: (1) in excess of 3/8-inch for pavement of less than 2-1/2-inches in specified thickness, or (2) in excess of 3/4-inch for pavement of specified thickness of 2-1/2-inches or more, correct the deficiency either by replacing the full thickness for a length extending at least 50-feet from each end of the deficient area.
- F. For any case of excess deficiency of the pavement, if approved by the County for each particular location, correct the deficient thickness by adding new surface material, and compact it to the same density as the adjacent surface. The County will determine the area to be corrected and the thickness of new material added.

3.09 REPAIR AND RESTORATION

- A. Replace asphalt pavement or roadway surfaces cut or damaged to equal or better condition than the original, including stabilization, base course, surface course, curb and gutter, and other appurtenances.

3.10 SIGNALIZATION, PAVEMENT STRIPING AND MARKING

- A. The Contractor shall be responsible for coordinating, repairing or replacing all traffic signalization devices and traffic loops damaged during the pavement milling, removal and replacement process.

- B. The Contractor shall be responsible for coordinating, inventorying, and replacing all temporary and permanent pavement striping and markings damaged during the asphalt pavement milling, removal, and replacement process.
- C. Temporary pavement striping and markings shall be paint or reinforced retro-reflective removal tape. Foil back tape is not acceptable. Permanent pavement striping and markings shall be alkyd thermoplastic tape and raised reflective pavement markers.

END OF SECTION

SECTION 02576
CONCRETE SIDEWALKS AND DRIVEWAYS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Constructing new concrete sidewalks, driveways, and curb and gutters as shown on the Drawings.

1.02 QUALITY ASSURANCE

- A. Codes and Standards: Comply with applicable sections of F.D.O.T. Specifications and local governing regulations.
- B. The mixture, placement, and curing of all concrete work shall be in accordance with F.D.O.T. Specifications.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Furnish manufacturer's product data, design mixes, test reports, and materials certifications.

1.04 JOB CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities, as specified under Section 01570 "Maintenance of Traffic."
- B. Utilize flagman, barricades, warning signs, and warning lights as required.

1.05 GUARANTEE

- A. All restored areas within the public right-of-way shall be guaranteed for 1-year after final acceptance. In the event of cracked or broken concrete surfaces, the Contractor shall make the necessary repairs to restore the concrete within 10-calendar days after notification by the County. The cost of such repairs shall be paid by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 CONCRETE MATERIALS

- A. Forms: Steel or wood for each type of use of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - 1. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - 2. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete.
- B. Fibermesh Reinforcement: Fibermesh reinforcement fibers shall be 2-inches to 3-inches collated polypropylene fibers. Fibers shall be in strict accordance with the manufacturer recommendations and within the time as specified in ASTM C94, Type III 4.13 and applicable building codes.
- C. Concrete Materials: Comply with requirements of F.D.O.T. Section 347 for concrete materials, admixtures, bonding materials, curing materials, and others as required.
- D. Epoxy Resin Grout: Type N as specified in F.D.O.T. Section 926.
- E. Aggregate, brick, or other material required to match existing driveway or walk shall be as approved by the County.

2.03 CONCRETE MIX, DESIGN, AND TESTING

- A. Comply with requirements of applicable F.D.O.T. Section 347 for concrete mix design, sampling and testing, and quality control, and as herein specified.
- B. Design the mix to produce standard weight concrete consisting of Portland cement, aggregate, air entraining admixture, and water to produce the following properties.
 - 1. Compressive Strength: Class B, 3,000 psi for walks and curbs.
 - 2. Compressive Strength: Class A, 4,000 psi for driveways.
 - 3. Air Content: 3% to 6% .
- C. Concrete slump shall not exceed plus or minus 1-inch from approved design slump.

PART 3 - EXECUTION

3.01 CONCRETE SIDEWALK, DRIVEWAY, AND CURB AND GUTTER

A. Surface Preparation:

1. Remove loose material from the compacted sub base surface immediately before placing concrete.
2. Proof-roll prepared sub base surface to check for unstable areas and the need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

B. Form Construction:

1. Set forms to the required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of the Work and so that forms can remain in place at least 24-hours after concrete placement.
2. Check completed form work for grade alignment to the following tolerances:
 - a. Top of forms not more than 1/8-inch in 10-feet.
 - b. Vertical face on longitudinal axis, not more than 1/4-inch in 10-feet.
3. Clean forms for reuse immediately after use, and coat with form release agent as often as required to ensure separation from concrete without damage.

C. Concrete Placement:

1. Do not place concrete until sub base and forms have been checked for line and grade. Moisten if required to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are completed to required finish elevation and alignment. Use special colors or aggregate as required to match existing material.
2. Place concrete using methods which prevent segregation of the mix. Consolidate concrete along the face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices. Do not use vibrators to push or move concrete in forms or chute.
3. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a construction joint.
4. An automatic machine may be used for sidewalk or curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed the minimum herein specified. Machine placement must produce sidewalks and/or curbs and gutters to the required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

5. Joints: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of the concrete, unless otherwise indicated. Construct transverse joints at right angles to the centerline, unless otherwise indicated. When joining existing structures place transverse joints to align with previously placed joints, unless otherwise indicated.
 - a. Weakened-Plane Joints: Provide weakened-plane (contraction) joints sectioning concrete into areas as shown on the Drawings. Construct weakened plane joints for a depth equal to at least 1/4 concrete thickness, by sawing within 24-hours of placement or formed during finishing operations. Place joints at intervals not to exceed 10-feet if not otherwise indicated.
 - b. Construction Joints: Place construction joints at the end of all pours and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints. Construction joints shall be as shown or, if not shown, use standard metal keyway-section form of appropriate height.
 - c. Expansion Joints:
 - (1) Provide premolded joint filler for expansion joints abutting concrete curbs, catch basin, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.
 - (2) Locate expansion joints at 12-feet on center for concrete walks unless otherwise indicated.
 - (3) Extend joint fillers full-width and depth of joint, and not less than 1/2-inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
 - (4) Furnish joint fillers in one-piece lengths for the full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler sections together. Pieces shorter than 4-inches shall not be used unless specifically shown as such.
 - (5) Protect the top edge of the joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.
 - (6) Fillers and Sealants: Comply with the requirements of these specifications for preparation of joints, materials installation, and performance, and as herein specified.

D. Concrete Finishing:

1. After striking-off and consolidating concrete, smooth the surface by screening and floating. Use hand methods only where mechanical floating is not possible. Adjust the floating to compact the surface and produce a uniform texture.
2. After floating, test surface for trueness with a 20-foot straightedge. Variations exceeding 1/3-inch for any two points within 10-feet shall not be acceptable. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.
3. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round 10-1/2-inch radius, unless otherwise indicated. Eliminate any tool marks on concrete surface.

4. After completion of floating and when excess moisture or surface sheen has disappeared, broom finish sidewalks by drawing a fine-hair broom across concrete surface, perpendicular to a line of pedestrian traffic. If the existing material has another finish, match existing finish.
5. Do not remove forms for 24-hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas.

E. Curing:

Protect and cure finished concrete paving and walks, complying with applicable requirements of F.D.O.T. Section 350. Use moist-curing methods for initial curing of approved concrete curing compounds whenever possible.

F. Repairs and Protections:

1. Repair or replace broken or defective concrete, as directed by the County.
2. Drill test cores where directed by the County, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy resin grout.
3. Protect concrete from damage until acceptance of work. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
4. Sweep concrete pavement and wash free of stains and discolorations, dirt, and other foreign material just prior to final inspection.

3.02 FIELD QUALITY CONTROL

- A. General: Repair or remove and replace unacceptable concrete sidewalk, driveways, or curb and gutter as directed by the County.
- B. Surface Elevation: Actual surface elevations shall be within ± 0.05 feet of specified or indicated elevations at any given point. Surface elevations between any 2 given points shall be interpolated from a direct line between the 2 points. Surfaces exceeding actual elevation tolerances of more than ± 0.05 feet at any 2 points within a distance of 15-feet will not be acceptable.

END OF SECTION

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SECTION 02578
SOLID SODDING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Establishing a stand of grass by furnishing and placing grass sod. Included are fertilizing, watering, and maintenance as required to assure a healthy stand of grass. Solid sodding shall be placed on all slopes greater than 4:1, within 10-feet of all proposed structures, and in all areas where existing grass or sod (regardless of it's condition) is removed or disturbed by Contractor's operation unless otherwise specified or shown on the Drawings.

1.02 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
 - 1. A certification of sod quality by the producer shall be delivered to the County ten days prior to use.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 GRASS SOD

- A. Grass sod for the road rights-of-way shall be of variety to match the existing adjacent area and shall be well matted with grass roots. The sod shall be taken up in rectangles, preferably 12-inch by 24-inch, shall be a minimum of 2-inches in thickness, and shall be live, fresh, and uninjured at the time of planting.
- B. Grass sod for restoration of new construction sites and/or areas disturbed by construction on existing sites shall be St. Augustine well matted with grass roots. The sod shall be taken up in rectangles, preferably 12-inch by 24-inch, shall be a minimum of 2-inches in thickness, and shall be live, fresh, and uninjured at the time of planting.

- C. It shall be reasonably free of weeds and other grasses and shall have a soil mat of sufficient thickness adhering firmly to the roots to withstand all necessary handling. The sod shall be planted as soon as possible after being dug and shall be shaded and kept moist until it is planted.

2.03 FERTILIZER

- A. Commercial fertilizers shall comply with the state fertilizer laws.
- B. The numerical designations for fertilizer indicate the minimum percentages (respectively) of (1) total nitrogen, (2) available phosphoric acid, and (3) water-soluble potash contained in the fertilizer.
- C. The chemical designation of the fertilizer shall be 6-6-6. At least 50% of the nitrogen shall be derived from organic sources. At least 50 % of the phosphoric acid shall be from normal super phosphate or an equivalent source, which will provide a minimum of two units of sulfur. The amount of sulfur shall be indicated on the quantitative analysis card attached to each bag or other container.

2.04 WATER FOR GRASSING

- A. The water used in the sodding operations shall be by the Contractor as approved by the County.

PART 3 - EXECUTION

3.01 PREPARATION OF GROUND

- A. The area over which the sod is to be placed shall be scarified or loosened to a depth and then raked smooth and free from debris. Where the soil is sufficiently loose and clean, the County, at its discretion, may authorize the elimination of ground preparation.

3.02 APPLICATION OF FERTILIZER

- A. Before applying fertilizer, the soil pH shall be brought to a range of 6.0 - 7.0.
- B. The fertilizer shall be spread uniformly over the area to be sodded at the rate of 700-pounds per acre, or 16-pounds per 1,000 square feet, by a spreading device capable of uniformly distributing the material at the specified rate. Immediately after spreading, the fertilizer shall be mixed with the soil to a depth of approximately 4-inches.
- C. On steep slopes, where the use of a machine for spreading or mixing is not practicable, the fertilizer shall be spread by hand and raked in and thoroughly mixed with the soil to a depth of approximately 2-inches.

3.03 PLACING SOD

- A. The sod shall be placed on the prepared surface, with edges in close contact and shall be firmly and smoothly embedded by light tamping with appropriate tools.
- B. Where sodding is used in drainage ditches, or on slopes of 4:1 or greater, the setting of the pieces shall be staggered to avoid a continuous seam along the line of flow. Along the edges of such staggered areas, the offsets of individual strips shall not exceed 6-inches. In order to prevent erosion caused by vertical edges at the outer limits, the outer pieces of sod shall be tamped so as to produce a featheredge effect.
- C. On slopes greater than 2:1, the Contractor shall, if necessary, prevent the sod from sliding by means of wooden pegs driven through the sod blocks into firm earth at suitable intervals.
- D. Sod which has been cut for more than 72-hours shall not be used unless specifically authorized by the County after the inspection thereof. Sod which is not planted within 24-hours after cutting shall be stacked in an approved manner, maintained, and properly moistened. Any pieces of sod that, after placing, show an appearance of extreme dryness shall be removed and replaced by fresh, uninjured pieces.
- E. Sodding shall not be performed when weather and soil conditions are, in the County's opinion, unsuitable for proper results.

3.04 WATERING

- A. The areas on which the sod is to be placed shall contain sufficient moisture, as determined by the County, for optimum results. After being placed, the sod shall be kept in a moist condition to the full depth of the rooting zone for at least 2-weeks. Thereafter, the Contractor shall apply water as needed until the sod roots and starts to grow for a minimum of 60-days (or until final acceptance, whichever is latest).

3.05 MAINTENANCE

- A. The Contractor shall maintain, at his expense, the sodded areas in a satisfactory condition until final acceptance of the Project. Such maintenance shall include repairing of any damaged areas and replacing areas in which the establishment of the grass stand does not appear to be developing satisfactorily.
- B. Replanting or repair necessary due to the Contractor's negligence, carelessness, or failure to provide routine maintenance shall be at the Contractor's expense.

END OF SECTION

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SECTION 02774
WASTEWATER GRAVITY COLLECTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Construction of sanitary sewers, sewer connections and appurtenances as shown on the Drawings or specified herein.

1.02 QUALITY ASSURANCE

- A. Storage: PVC pipe shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the PVC pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- B. Tests: Certified records of tests made by the manufacturer or by a reliable commercial laboratory shall be submitted with each shipment of pipe. All pipe shall be inspected upon delivery and that which does not conform to the requirements of these specifications shall be rejected and must be immediately removed by the Contractor. The Contractor shall furnish and provide samples of pipe for the performance of such additional tests as the County may deem necessary.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
 - 1. Precast manholes
 - 2. Manhole frames, covers, and other castings
 - 3. Manufacturer's certified test report on castings
 - 4. Certification of admix installation from pre-caster
 - 5. Certified test records for polyvinyl chloride pipe
 - 6. Mill Test Certificates on ductile iron pipe
 - 7. Manhole pipe connections
 - 8. Coal tar epoxy
 - 9. Special interior linings
- B. Record Information: The Contractor shall submit to the County the elevations of the center of the manhole covers and inverts of all pipes in the manholes.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

- A. Ductile Iron Pipe and Fittings: Ductile iron pipe shall meet the requirements of Section 15062 "Ductile Iron Pipe and Fittings."
- B. Polyvinyl Chloride Pipe and Fittings: Polyvinyl Chloride (PVC) Pipe shall meet the requirements of Section 15064 "Polyvinyl Chloride Pipe and Fittings."
- C. Precast Concrete Manholes
 - 1. Precast manholes shall conform to the requirements of ASTM Designation C 478.
 - a. The minimum shell thickness shall be 5-inches.
 - b. Lifting holes through the structures are not permitted.
 - c. The design of the structure shall include a precast base of not less than 8-inches in thickness poured monolithically with the bottom section of the manhole walls.
 - d. Where drop structures are required, the design of the structure shall include a precast base, for the drop structure, of not less than 8-inches in thickness poured monolithically with the bottom section of the manhole walls.
 - e. New manholes shall contain a crystalline waterproofing concrete admix. Crystalline waterproofing concrete admix shall be added to the concrete during the batching operation. Admix concentration shall be added based upon manufacturer design percent concentration of admixture to the required weight of cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the admix was added to the concrete for all precast manholes. Colorant shall be added and provided at the admix manufacturing facility, not at the concrete batch plant. Contractor shall provide certification from the pre-caster that the admix was installed in accordance with the manufacturers recommendations.
 - 2. Top sections shall be eccentric, except that concrete top slab shall be used where shallow cover requires a top section less than 3-feet deep.
- D. Concrete and Reinforcing Steel: Concrete and reinforcing steel shall conform to the requirements of Division 3 - Concrete. Concrete classes for the various purposes shall be as follows:
 - 1. Manhole bottoms, Class A
 - 2. Precast manholes, Class A (4,000-psi)
 - 3. Pipe and riser encasement, Class C
 - 4. Protective slabs, Class C

- E. Castings: Gray iron castings for manhole frames, covers, adjustment rings, and other items shall conform to the ASTM Designation A 48, Class 30. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects in positions which would impair their strength, or otherwise make them unfit for the service intended. No plugging or filling will be allowed. Lifting or "pick" holes shall be provided, but shall not penetrate the cover. Casting patterns shall conform to those shown or indicated on the Drawings. The words SANITARY and ORANGE COUNTY, FLORIDA shall be cast in all manhole covers as shown on the Drawings. All manhole frames and covers shall be traffic bearing to meet AASHTO H-20 loadings unless otherwise specified.
- F. Brick: Brick for manhole construction shall be dense, hard burned, shale, or clay brick conforming to ASTM Designation C 32, Grade MM or C 62, Grade MW, except that brick absorption shall be between 5 and 25-grams of water absorbed in 1-minute by dried brick, set flat face down, in 1/8-inch of water.
- G. Cement Mortar: Cement mortar for manhole construction shall comply with ASTM Designation C 270, Type M, except that the cement shall be Portland Type II only. No mortars that have stood for more than 1-hour shall be used.
- H. Pipe Adapter: Connection of PVC gravity sewer lines to precast manholes and wetwells shall be made by using a flexible boot type manhole coupling adapter.
- I. Special Interior Linings (existing structures): Interior surfaces of manholes and wetwells shall be coated or lined to resist corrosion. Coatings or liners shall be applied in accordance with the manufacturer's recommendations. Surface preparation (cleaning, sandblasting, or acid etching), material application, and curing shall be performed in accordance with the manufacturer's recommendations.
- J. Special Interior Linings (proposed structures): Interior surfaces of manholes and wetwells shall be lined at the precast factory with a high-density polyethylene (HDPE) or polypropylene random copolymer (PP-R) lining system. All HDPE liner sheets shall be extruded with a minimum of 420 anchoring studs per square meter (39/square feet), manufactured during the extrusion process in 1-piece with the sheet so there is no welding and no mechanical finishing work to attach the studs to the sheet. The liner shall have a pull out strength of 112.5 lbs. /anchoring stud. Minimum distance between studs shall be no less than 2-1/8-inches.

Non-anchored flat liner sheet shall be used for overlapping joints and shall have a minimum thickness of 3-mm. All joints shall be sealed by means of thermal welding performed by lining manufacturer's certified welders.
- K. Joint Sealer: Joint sealer material for precast manhole structures shall be pre-formed flexible plastic conforming to Federal Specification SS-S-00210 (GSA-FSS). Seal all exterior joints with Portland Type II cement after setting of joint sealer and placement of manhole section to form a watertight joint.
- L. Non-Shrink Mortar: Non-shrink mortar shall be used for filling annular spaces and holes in precast manholes and wetwells.

- M. Manhole Encapsulation: Manhole cones, riser rings, iron frame, cover, and all joints shall be encapsulated with a heat shrink-wrap with a minimum thickness of 98-mils (2.5-mm).
1. Wrap shall have a cross-linked polyolefin backing coated with a protective heat activated adhesive. The wrap shall effectively bond to the substrate via primer provided by the manufacturer. The wrap shall be applied with a high intensity propane torch.
 2. Heat shrink-wrap for all barrel section joints of manholes shall be a minimum 9-inch width. Corbel section, riser rings, and ring and cover shall have a minimum 12-inch width wrap.
 3. Adhesive tap materials shall not be allowed.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Upon satisfactory excavation of the pipe trench, as specified in Section 02220 "Excavating, Backfilling and Compacting" a continuous trough for the pipe barrel and recesses for the pipe bells shall be excavated by hand digging so that, when the pipe is laid in the trench, true to line and grade, the pipe barrel will receive continuous uniform support and the bell will receive no pressure from the trench bottom.
- B. The interior of all pipe shall be thoroughly cleaned of all foreign material before being lowered in the trench and shall be kept clean during laying operations by means of plugs or other approved methods.

3.02 INSTALLATION

A. Sewer Pipe

1. General

- a. Laying of pipe shall proceed upgrade with spigot ends pointing in the direction of flow. Before pipe is joined, gaskets shall be cleaned of all dirt, stones, and other foreign material. The spigot ends of the pipe and/or pipe gaskets shall be lubricated lightly with a lubricant as specified by the pipe manufacturer and approved by the County. Sufficient pressure shall be applied to the pipe so as to properly seat the socket into the bell of the pipe. Any damage to the pipe due to over-exertion shall be replaced at the Contractor's expense. All pipe shall be laid straight, true to the lines and grades shown on the Drawings.
- b. Variance from established line and grade, at any point along the length of the pipe, shall not be greater than 1/32-inch per inch of pipe diameter and not to exceed 1/2-inch, provided that any such variation does not result in a level or reverse sloping invert.
- c. Any pipe, which is disturbed or found to be defective after installation, shall be taken up and relayed or replaced at the Contractor's expense.
- d. Approved utility crossing signs shall be placed on the pipe alignment at each side of any waterway crossing.

2. PVC Pipe
 - a. Handling PVC pipe: The handling of PVC pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Sections of pipe with deep cuts and gouges shall be removed and discarded at no expense to the County.
 - b. Lowering pipe into trench: Care shall be exercised when lowering pipe into the trench to prevent damage to or twisting of the pipe.
3. Building Laterals/Service Connections
 - a. Service connections shall be constructed in accordance with the details as indicated on the Drawings.
 - b. Sewer lateral pipe shall be extended to the right-of-way and plugged at the right-of-way line to avoid leakage (unless otherwise indicated on the Drawings). All connections and changes of direction shall be made using standard fittings designed for that purpose.
 - c. Locator balls shall be placed under all sanitary sewer service cleanouts.
 - d. On curbed streets, the exact location for each service connection shall be marked by etching or cutting an "S" in the concrete curb. Where no curb exists or is planned, locations shall be marked by a method approved by the County.
4. PVC C-900 DR 14 Pipe Section: PVC C-900 DR 14 pipe shall be substituted for the specified PVC pipe where:
 - a. The sewer or service pipe is to be constructed with less than 30-inches of cover between the top of the pipe and the final top of pavement or ground line.
 - b. The PVC sewer main crosses over a water main, or is at a depth which results in less than 18-inches clear distance between pipes when crossing under a water main. The DR 14 pipe shall extend a minimum of 10-feet on each side of the point of crossing.
 - c. The lateral separation of the sewer pipe and potable water piping is less than 10-feet.

B. Manholes:

1. Manhole excavation and bedding at manhole junctions shall be performed in accordance with the provisions of Section 02220 "Excavating, Backfilling and Compacting" of these specifications.
2. The invert channels shall be smooth and accurately shaped to a semicircular bottom conforming to the inside of the adjacent sewer section using 2,500-psi concrete. Steep slopes outside the invert channels shall be avoided. Changes in size and grade shall be made gradually and evenly. Changes in the direction of the sewer or entering branch shall be a smooth curve with radius as long as practicable. Invert channels shall also be formed for pipe stubouts.
3. The first pipe joint outside the manhole shall be located a minimum distance of 24-inches from the outside surface of the manhole.
4. Precast manhole tops shall terminate at such elevations to permit laying brick courses under the manhole frame to make allowance for future street grade adjustments.
5. Frames and covers shall be set accurately to conform to the finished grade.
6. Outside drop connections shall be made in accordance with the details shown on the Drawings.

7. Drop connection base slab extensions on precast manholes shall be manufactured monolithically with the manhole elements at the casting yard. The manufacturer shall submit for approval the method of drop manhole construction.
 8. Where additional pipe connections or modifications of existing factory made openings are required on new or existing precast concrete manholes or wetwells, all cutting relative thereto shall be performed only by a power driven abrasive wheel or saw. It is specifically noted that such connections to existing manholes or wetwells shall be installed in accordance with the details for new units shown on the Drawings, and shall be caulked watertight with non-shrink grout.
 9. The exterior surfaces of all precast manholes shall be factory coated with coal tar epoxy, 9-mils DFT applied in 2 coats. The interior of precast manholes shall receive the specified protective lining in the factory as specified in the Materials portion of this section.
 10. Connection of the pipe entering the manhole shall be made by using a flexible boot type manhole coupling adapter. At the entry into the manhole, no part of the horizontal pipe shall rest against the concrete.
 11. Manholes shall be completed as the work progresses so that testing may be conducted as prescribed in paragraph 3.03 Field Quality Control.
- C. Concrete encasement: Class C concrete encasement shall be constructed in accordance with details shown on the Drawings.
1. The County may order the line encased when:
 - a. The sewer main crosses over a water main, or is at a depth which results in less than 18-inches clear distance between pipes when crossing under a water main. Encasement shall extend a minimum of 10-feet on each side of the point of crossing. In lieu of encasement, the sewer line may be constructed of PVC DR 14 pipe and shall be laid such that both joints will be a distance of 10-feet from the crossing.
 - b. The maximum width for trench excavations is exceeded. The Contractor shall construct concrete encasement around the pipe for the length of the excessive excavation. No payment will be made for the concrete encasement required due to excessive trench widths.
 2. The points of beginning and ending of pipe encasement shall be not more than 6-inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the effects of superimposed live loads.
- D. Concrete protective slabs: Concrete protective slabs as shown on the Drawings shall be constructed over gravity sewers that have less than 3-feet of cover from finished grade.
- E. Connections to existing structures: Proposed sewer lines shall be connected to the existing manholes by core drilling the proper size opening and installing a flexible boot type manhole adapter as specified in paragraph 2.01.H of this Section.
- F. Invert channels (benching) shall be provided for all new manholes and existing manholes which are connected into. No brick shall be allowed in construction of the manhole invert. Inverts shall be poured using 2,500-psi concrete.

3.03 FIELD QUALITY CONTROL

- A. Workmanship: Sewers and appurtenances shall be built watertight. The sewage must be pumped for disposal and special care and attention must be paid to securing watertight construction. Upon completion, the sewers, or sections thereof, will be tested and gauged and if leakage is above the allowable limits specified, the sewer will be rejected.

- B. Inspection: On completion of each block or section of sewer, or such other times as the County may direct, the block or section of sewer shall be cleaned, tested, and inspected.
 - 1. Each section of the sewer shall show, on examination from either end, a full circle of light between manholes.
 - 2. Each manhole or other appurtenance to the system shall be of the specified size and form, be watertight (no leakage allowed by visual inspection), and be constructed with the top set permanently to specified position and grade. All repairs shown necessary by the inspection shall be made; broken or cracked pipe replaced; all deposits removed and the sewer left true to line and grade, entirely clean and ready for use.
 - 3. No pipe shall exceed a deflection of 5%. After the final backfill has been in place at least 30-days, the Contractor shall perform deflection testing using a rigid ball or mandrel with a diameter of not less than 95% of the base inside diameter or average inside diameter of the pipe, depending which is specified in the ASTM standard to which the pipe is manufactured. If the mandrel does not pass the completed section of sewer, the entire section of sewer will be rejected.

- C. Closed Circuit Television Inspection:
 - 1. Internal gravity sewer video inspection shall be performed by the Contractor to check for alignment and deflection. The television inspection shall also be used to check for cracked, broken, or otherwise defective pipe and overall pipe integrity.
 - 2. The video internal inspection will be performed in 2 stages. The first inspection shall be within 30-days after the installation of the gravity sewer pipe provided the road base is in place and the manhole rings and covers are to grade. The second inspection of the gravity sewer pipe shall be before the end of the 1-year warranty period.
 - 3. If the first or second video inspection reveals cracked, broken, or defective pipe, or pipe misalignment resulting in vertical sags in excess of 1-1/2-inch or a ring deflection in excess of 5%, the Contractor shall be required to repair or replace the pipeline. Successful passage of both the low-pressure air exfiltration test and video inspection is required before acceptance by the County.
 - 4. Prior to repair or replacement of failed sewer pipe, the method of repair or replacement shall be submitted to the County for approval. Pressure grouting of pipe or manholes shall not be considered as an acceptable method of repair.

- D. Low Pressure Air Exfiltration Testing:
 - 1. The Contractor shall provide all labor, equipment, and materials and shall conduct all testing required under the direction of the County
 - 2. Low pressure air testing shall conform to the requirements of UNI-B6-79 "Recommend Practice for Low-Pressure Air Testing of Installed Sewer Pipe", as published by UNI-Bell Plastic Pipe Association.

3. During sewer Construction, all service laterals, stubs, and fittings into the sewer test section shall be properly capped or plugged so as not to allow for air loss that could cause an erroneous air test result. Where necessary, the Contractor shall restrain caps, plugs, or short pipe lengths such that blowouts are prevented.
4. Each test section shall not exceed 400-feet in length and shall be tested between adjacent manholes.
5. Before testing, Contractor shall install monitoring wells at each manhole to determine groundwater level and adjust test pressure accordingly. In no case shall the test pressure exceed 9.0-psig. All pressurizing equipment shall include a regulator or relief valve set no higher than 9.0-psig to avoid over-pressurizing.
6. Low-pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0-psig greater than the average backpressure of any groundwater above the invert of the pipe, but not greater than 9.0-psig.
7. When temperatures have been equalized and pressure stabilized at 4.0-psig greater than the average groundwater backpressure, the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5-psig greater than the average groundwater backpressure. At a reading of 3.5-psig greater than the average groundwater backpressure, timing shall commence with a stopwatch or other timing device that is at least 99.8% accurate.
8. If the time shown in the table, for the designated pipe size and length, elapses before the air pressure drops 1-psig; the section under-going test shall have passed. The test may be discontinued once the prescribed time has elapsed.
9. If the pressure drops 1-psig before the appropriate time shown in the table has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.
10. Should the section fail to meet test requirements, the Contractor shall determine the source or sources of leakage, and make all necessary repairs and shall repeat the test until the test section is within established limits. All corrective work shall be at the Contractor's expense.

E. Correction of Non-Conforming work:

1. All non-conforming work shall be repaired or replaced by the Contractor at no additional expense to the County. Non-conforming work shall be defined as failure to adhere to any specified or implied directive of these technical special provisions and/or the Drawings, including but not limited to pipe not laid straight, true to the lines and grades as shown on the Drawings, damaged or unacceptable materials, misalignment or diameter ring deflection in pipe due to bedding or backfilling, water standing in any pipe segment or structure, visible or detectable leakage, and failure to pass any specified test or inspection.

**Table 02774-1
Test Time Table**

TEST TIME:											
For sewer diameter between 8 inches and 36 inches inclusive, the pipe shall be tested between adjacent manholes. The test time for the air pressure to drop the specified one pound shall be as listed below:											
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP											
1 Pipe Dia. (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Feet							
				100	150	200	250	300	350	400	450
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.148 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:26	71:13	89:02	106:50	124:38	142:26	160:15
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

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SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies all labor, materials and equipment necessary for providing and installing formwork for concrete.
- B. Related Work Described Elsewhere:
 - 1. Section 03200 "Concrete Reinforcement"
 - 2. Section 03300 "Cast-in-Place Concrete"
- C. General Design: The Contractor shall be responsible for the design of all formwork and for safety in its construction, use and removal.

1.02 QUALITY ASSURANCE

- A. Qualifications: Formwork shall be constructed in accordance with the specified standards, as well as all pertinent codes and regulations. In cases where requirements of pertinent codes conflict with the requirements of these specifications, the more stringent shall govern.
- B. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:
 - 1. Standard Building Code
 - 2. ACI 347 "Recommended Practice for Concrete Formwork"
 - 3. Local codes and regulations

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County/Professional for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Materials: Submit manufacturer's literature on form ties, spreaders, corner formers, form coatings and bond breakers.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

- A. Form Lumber: Use form lumber when in contact with exposed concrete, conforming to the following or acceptable equivalent.
- B. Lumber: Douglas Fir/Larch No. 2 grade, seasoned, surfaced on four sides.
- C. Plywood: "Plyform", Class I or II, bearing the label of the Douglas Plywood Association. (Minimum 3/4-inch thickness).
- D. Form Ties: Use form ties which do not leave an open hole through the concrete and which permit neat and solid patching at every hole. Use embedded rods with integral waterstops and cones to provide a 1-inch breakback. Wire ties and wood spreaders will not be permitted.
- E. Form Coatings: Form release coating shall be a paraffin base oil or mineral oil coating which effectively prevents absorption of moisture; prevents bonding with concrete; is non-staining to concrete; and leaves the concrete with a paintable surface.
- F. Chamfer Strips: Chamfer strips shall be polyvinyl strips or acceptable equal, designed to be nailed in the forms to provide a 3/4-inch chamfer (unless indicated otherwise) at exposed edges of concrete members.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Construction of Formwork: Forms shall be sufficiently strong to withstand the pressure resulting from the placement and vibration of concrete and shall be sufficiently rigid to maintain specified tolerances. Forms shall be sufficiently tight to prevent loss of mortar, and shall be adequately braced against lateral, upward or downward movement.
- B. Coating of Forms: Apply form coating to board forms prior to placing reinforcing. Keep form coatings off steel reinforcing, items to be embedded, and previously placed concrete.
- C. Form Erection:
 - 1. Provide a means of holding adjacent edges, ends of panels, and ends of sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects of the finished concrete. Insure that forms may be removed without damage to the surface of the finished concrete.
 - 2. Provide a positive means of adjustment of shores and struts. Insure that all settlement is taken up during concrete placing.
 - 3. Temporary openings shall be provided in wall forms to limit the free fall of concrete to a maximum of 6-feet unless an elephant trunk is used. Such openings shall be located to facilitate placing and consolidation and shall be spaced no more than 8-feet apart. Temporary openings shall also be provided in the bottom of the wall, column forms, and elsewhere as necessary to facilitate cleaning and observation immediately prior to placing.

4. Do not embed any form-tying device or part thereof other than metal in concrete.
5. Form surfaces of concrete members except where placement of the concrete is against the ground. The dimensions of concrete members shown on the Drawings apply to formed surfaces, except where otherwise indicated.

D. Form Reuse: Reuse only forms which maintain a uniform surface texture on exposed concrete surfaces. Apply light sanding between uses to obtain such a uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side of the plug.

E. Removal of Forms

1. Forms and shoring for elevated structural slabs, girders, and/or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and re-shore. The following table indicates the minimum allowable time after the last concrete is placed before forms, shoring, and/or bracing may be removed.

Structural Item	Minimum Allowable Time
Bottom side of slabs, girders, beams	When concrete reaches specified 28-day compressive strength
Vertical sides of girders, beams	48-hours
Walls not supporting vertical or horizontal loads	48-hours
Walls supporting vertical or horizontal loads	When concrete reaches specified 28-day compressive strength
Footings, pipe encasements, pipe supports	24-hours

2. Do not remove forms from concrete which has been placed with outside air temperature below 50° F without first determining if the concrete has properly set regardless of the minimum times specified in the table above. Do not apply heavy loading on recently poured concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

F. Formed Openings: Openings shall be of sufficient size to permit final equipment alignment without deflection or offsets of any kind. Where the items pass through the wall, allow space for packing to ensure watertightness. Provide openings with continuous keyways with waterstops where required. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide reinforcement as indicated and specified. Reinforcing steel shall be at least 2-inches clear from the opening.

G. Embedded Items: Set anchor bolts and other embedded items accurately and hold securely in position in the forms until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concrete pour. Check all nailing, blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to concrete pour.

H. Pipes and Wall Spools Cast in Concrete

1. Install wall spools, wall flanges, and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools to the reinforcing steel.
2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will be possible during Construction.

I. Form Tolerances

1. Failure of the forms to produce the specified concrete surface tolerance shall be grounds for rejection of the concrete work. Rejected Work shall be repaired or replaced at no cost to the County.
2. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

	Maximum Tolerance
Sleeves and inserts	+1/4-inch to -1/4-inch
Projected ends of anchors	+1/4-inch to -0.0-inch
Anchor bolt setting	+1/4-inch to -1/4-inch
Finished concrete	+ 1/4-inch to -1/4-inch in 10 feet of length

The planes or axes from which the above tolerances are to be measured shall be as follows:

Sleeves and inserts	Centerline of sleeve or insert
Projected ends of anchors	Plane perpendicular to the end of the anchor as located on the Drawings
Anchor bolt setting	Centerline of anchor bolts
Finished concrete	The concrete surface as located on the Drawings

3. Where equipment is to be installed, comply with manufacturer's tolerances if more stringent than above.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies reinforcing steel and welded wire mesh for cast-in-place or precast concrete structures.
- B. Related Work:
 - 1. Section 03100 "Concrete Formwork"
 - 2. Section 03300 "Cast-in-Place Concrete"
 - 3. Section 03410 "Precast Concrete Structures"

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship, and practices shall meet all requirements of the current editions of the following standards:
 - 1. Standard Building Code
 - 2. ACI 318 Building Code Requirements for Reinforced Concrete
 - 3. ACI 315 Details and Detailing of Concrete Reinforcement
 - 4. CRSI Manual of Standard Practice, MSP-2

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County/Professional for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Complete shop drawings shall be submitted for comment, including bar lists and placing drawings. Drawings shall show the type, spacing, and location of metal bar supports, the grade of the reinforcing and the name of the manufacturer. The type of coupler splice devices shall be designated.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed billet steel bars of a USA manufacturer.
- B. Welded Wire Fabric: ASTM A185, galvanized.
- C. Metal Bar Supports: CRSI MSP-2, Chapter 3, Class 2, Type B, Stainless Steel Protected Bar Supports.
- D. Coupler Splice Devices: Cadweld tension couplers capable of developing the ultimate strength of the bar, as manufactured by Erico Products, Incorporated, Solon, Ohio, or equal where acceptable to the County.

2.03 FABRICATION

- A. Fabrication shall meet all requirements of the specified standards. Unless otherwise indicated, the following shall apply:
 - 1. Hooks shall be standard hooks.
 - 2. Bottom bars shall extend a minimum of 6-inches into supporting members.
 - 3. Minimum cover shall be measured to the outermost stirrup, tie or bar.
 - 4. Splices are permitted only where indicated on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Supporting Reinforcing: Bar supports shall be provided as required by CRSI MSP-2 and AC1315. Top and bottom bars in slabs formed on earth shall be supported on precast concrete block supports except where such bars are properly supported from formwork. Precast concrete block supports are not required in slabs formed on tremie concrete but may be used at the Contractor's option.
- B. Placing Reinforcing: Placing of reinforcing steel and welded wire fabric shall conform to CRSI MSP-2, ACI 315, and the Drawings. Reinforcing shall be securely tied and supported to prevent displacement during concrete placement.
- C. Welded Wire Fabric: Splices in welded wire fabric shall be such that the overlap between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires, plus 2-inches. Fabric shall not be extended through expansion joints or construction joints in slabs on grade except as otherwise indicated on the Drawings.
- D. Coupler Splice: Unless indicated on the Drawings or where conventional lap splices cannot be achieved, full positive tension connections shall be provided. Such devices shall be installed in accordance with the recommendations of the manufacturer.

- E. Dowels: Dowels shall be wired in position prior to placing concrete.
- F. Field Bending: Heat shall not be used to bend bars. Bars shall not be bent after being embedded in concrete.
- G. Welding: Welding of reinforcing will not be permitted.
- H. Place reinforcement a minimum of 2-inches clear of any metal pipe or fittings.

END OF SECTION

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SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies cast-in-place concrete including all materials, mixing and transport, and performing all labor for the proportioning, mixing, transporting, placing, consolidating, finishing, and curing of concrete.
- B. Related Work Described Elsewhere:
 - 1. Section 03100 "Concrete Formwork"
 - 2. Section 03200 "Concrete Reinforcement"

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the requirements of the following standards:
 - 1. Standard Building Code
 - 2. Local Codes and Regulations
 - 3. ACI 318-83, Building Code Requirements for Reinforced Concrete
- B. Plant Qualification: Plant equipment and facilities shall meet all requirements of the checklist for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association and ASTM C 94.
- C. Evaluation and Acceptance of Concrete: Evaluation and acceptance of concrete will be in accordance with ACI-318, Chapter 4.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Materials and Shop Drawings: The following information shall be submitted for review. No concrete shall be furnished until the County has reviewed submittal and no exceptions taken or other favorable response has been returned.
 - 1. Plant Qualification: Satisfactory evidence shall be submitted indicating that the plant and operators have sufficient experience in providing the applicable design mix.

2. Materials: Satisfactory evidence shall be submitted indicating those materials to be used (including cement, aggregates and admixtures) meet the specified requirements.
3. Design Mix: The design mix to be used shall be prepared by qualified persons and submitted for review. Submit affidavit as to design mix performance over the preceding 6-months. The design of the mix is the responsibility of the Contractor subject to the limitations of the Specifications. Acceptance of this submission will be required only as minimum requirements of the Specifications have been met. Such acceptance will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the Specifications relative to strength and slump.
4. Ready Mix Concrete: Provide delivery tickets or weigh master's certificate per ASTM C 94, including weights of cement and each size aggregate, amount of water in the aggregate, and amount of water added at the plant. The amount of water added on the job shall be written on the ticket.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Cement

1. Cement for all concrete shall be domestic Portland cement that conforms to the requirements of ASTM Designation C 150 Type I, Type II or Type III. All sanitary sewer manholes, wetwells, pumping stations, tanks and structures exposed to wastewater shall be constructed with Type II cement. Type III cement for high early strength concrete shall be used only for special locations and only with the review and acceptance of the County. Type I cement may be used for buildings and tremie concrete.
2. Only 1 brand of cement shall be used in any individual structure unless acceptable by the County. Cement that has become damaged, partially set, lumpy or caked shall not be used and the entire contents of the sack or container that contains such cement will be rejected. No salvaged or reclaimed cement shall be used.
3. Fly ash shall not be used in either Class A or Class B concrete.

B. Aggregates:

1. ASTM C 33. Coarse aggregates shall be size No. 57. Block cell fill shall be size No. 89.
2. In addition to requirements of ASTM C 33 for structures exposed to wastewater, the following shall apply:
 - a. Soft particles: 2% (2.0 percent)
 - b. Chert as a soft impurity (defined in Table 3 of ASTM C 33): 1% (1.0 percent)
 - c. Total of soft particles and chert as a soft impurity: 2% (2.0 percent)
 - d. Flat and elongated particles (long dimension > 5 times short dimension): 15%.

- C. Water: Clean and free from injurious amounts of deleterious materials.
- D. Air Entraining Admixture: ASTM C 260.
- E. Water Reducing and Retarding Admixture: ASTM C 494, Type D. Admixture shall not contain calcium chloride.
- F. Epoxy Bonding Agent: Sikastix 370, Sikadur Hi Mod, Concrevice 1001-LPL or acceptable equal.
- G. Waterproofing Material: Concrete admixture shall be manufactured and supplied by an approved manufacturer as shown in the Appendix D "List of Approved Products."

2.03 MIXES

A. General Requirements

1. Mix Design: Proportioning shall be on the basis of field experience and/or trial mixtures as specified in ACI 318, Section 4.3. Data on consecutive compression tests and standard deviation shall be submitted. Proportioning for small structures may be by the water/cement ratio under special review and acceptance by the County. Concrete mix design shall comply with the Standard Building Code requirements.
2. Air Content: 5% plus or minus (\pm) 1% (Class A and B).
3. Slump: 4-inches plus or minus (\pm) 1-inch. 8-inches plus or minus (\pm) 1-inch for tremie concrete.
4. Water/cement ratio = 0.45 maximum (all concrete exposed to hydrostatic loading), 0.50 maximum (all other concrete).
5. Minimum Compressive Strength at 28-days
 - a. Class A, 4,000-psi: Water and wastewater structures inclusive of tanks, ditches, pumping stations, tremie concrete and other structures in contact with process water.
 - b. Class B, 3,000-psi: Building structures, curb and gutters, slabs, walks, encasements, thrust blocks, and pipe supports, etc. not in contact with process water.
 - c. Class C, 2,500-psi: Mix wherever specified in the standard drawings such as A103, A112, A303, A406 and A407-2.

B. Production of Concrete

1. General: Concrete shall be ready mixed and shall be batched, mixed and transported in accordance with ASTM C 94, except as otherwise indicated.
2. Air Entraining Admixture: Air entraining admixture shall be charged into the mixture as a solution and shall be measured by means of an acceptable mechanical dispensing device. The liquid shall be considered a part of the mixing water.

3. Waterproofing admixture: New concrete structures shall contain a crystalline waterproofing concrete admixture. Crystalline waterproofing concrete admixture shall be added to the concrete during the batching operation. The admixture concentration shall be added based upon manufacturer design percent concentration of admixture to the required weight of cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the admixture was added to the concrete for all precast structures. Colorant shall be added and provided at the admixture manufacturing facility, not at the concrete batch plant. It is recommended that the admixture be added first to the rock and sand and blended thoroughly before adding cement and water or per the manufacturer's recommendations. Concrete structures without crystalline waterproofing admixture or admixture without colorant for field verification shall be rejected. Contractor shall provide certification the admixture was installed in accordance with the manufacturer's recommendations.
 4. Water Reducing and Retarding Admixture: Water reducing and retarding admixture shall be added and measured as recommended by the manufacturer. The addition of the admixture shall be completed within 1-minute after addition of water to the cement has been completed, or prior to the beginning of the last 3/4 of the required mixing, whichever occurs first. Admixtures shall be stored, handled and batched in accordance with the recommendations of ACI 68.
- C. Delivery Tickets: In addition to the information required by ASTM C 94, delivery tickets shall indicate the cement content and the water/cement ratio.
- D. Temperatures: The temperature of the concrete upon delivery from the truck shall not exceed 90° F.
- E. Modifications to the Mix: No modifications to the mix shall be made in the plant or on the job which will decrease the cement content or increase the water/cement ratio beyond that specified.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Preparations before Placing: No concrete shall be placed until the review and acceptance of the County has been received. Acceptance will not be granted until forms are clean and reinforcing and all other items required to be set in concrete have been placed and thoroughly secured. The County shall be notified a minimum of 24-hours before concrete is placed.
- B. Conveying:
1. General: Concrete shall be handled from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete. No concrete shall be placed more than 90-minutes after mixing has begun for that particular batch.

2. Buckets and Hoppers: Buckets and hoppers shall have discharge gates with a clear opening equal to no less than 1/3 of the maximum interior horizontal area, or 5 times the maximum aggregate size being used. Side slopes shall be no less than 60° (degrees). Controls on gates shall permit opening and closing during the discharge cycle.
3. Runways: Extreme care shall be exercised to avoid displacement of reinforcing during the placing of concrete.
4. Elephant Trunks: Hoppers and elephant trunks shall be used to prevent the free fall of concrete of more than 6-feet.
5. Chutes: Chutes shall be metal or metal lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-feet long and chutes not meeting the slope requirements may be used only if they discharge into a hopper before distribution.
6. Pumping Equipment: Pumping equipment and procedures shall conform to the recommendations contained in the report of ACI Committee 304 on "Placing Concrete by Pumping Methods," ACI 304.2R-71. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1-1/2-inches.
7. Conveying equipment Construction: Aluminum or aluminum alloy pipe for tremies or pump lines and chutes, except for short lengths at the truck mixer shall not be permitted.
8. Cleaning: Conveying equipment shall be cleaned at the end of each concrete operation.

3.02 APPLICATION

A. Placing:

1. General: Concrete shall be deposited continuously, or in layers of such thickness (not exceeding 2-feet in depth) that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness.
2. Supported Elements: At least 2-hours shall elapse after depositing concrete in columns or walls before depositing in beams, girders, or slabs supported thereon.
3. Segregation: Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to procedures that will cause segregation.
4. Concrete Underwater: All concrete, except that indicated on the Drawings as tremie concrete, shall be placed in the dry.

B. Seals and Tremie Concrete

1. General

- a. Wherever practicable, all foundation excavations shall be dewatered and the concrete deposited in the dry. Where conditions are encountered which render it impracticable to dewater the foundation before placing concrete, a concrete foundation seal shall be placed. The foundation shall then be dewatered, and the balance of the concrete placed in the dry.

- b. When seal concrete is required to be placed, the satisfactory performance of the seal in providing a watertight excavation for placing structural concrete shall be the responsibility of the Contractor. Seal concrete placed by the Contractor, which subsequently fails to perform properly, shall be repaired as necessary to perform its required function, at the expense of the Contractor.
 2. Method of Placing: Concrete deposited underwater shall be carefully placed in the space in which it is to remain by means of a tremie, a closed-bottom dump bucket of not less than 1-cubic yard capacity, or other approved method, and shall not be disturbed after it is deposited. All seal concrete shall be deposited in 1 continuous pour. No concrete shall be placed in running water. All formwork designed to retain concrete underwater shall be watertight, and the design of the formwork and excavation sheeting shall be by a Professional Engineer, registered in the State of Florida.
 3. Use of Tremie: The tremie shall consist of a tube having a minimum inside diameter of 10-inches, and shall be constructed in sections having tight joints. No aluminum parts that have contact with the concrete will be permitted. The discharge end shall be entirely seated at all times, and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised (but not out of the concrete at the bottom) until the batch discharges to the bottom of the hopper, after which the flow shall be stopped by lowering the tremie. The means of supporting the tremie shall be such as to permit the free movement of the discharge end over the entire top surface of the Work, and shall permit it being lowered rapidly when necessary to choke off or retard the flow. The flow shall preferably be continuous, and in no case shall be interrupted until the Work is completed. Special care shall be exercised to maintain still water at the point of deposit.
 4. Use of Bottom-dump Bucket: When the concrete is placed by means of a bottom-dump bucket, the bucket shall be lowered gradually and carefully until it rests upon the concrete already placed. The bucket shall then be raised very slowly during the discharge travel; the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture. Aluminum buckets will not be permitted.
 5. Time of Beginning Pumping: Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure, and in no case earlier than 72-hours after placement of the concrete.
- C. Consolidating Concrete:
1. General: Concrete shall be consolidated by means of internal vibrators operated by competent workmen.
 2. Vibrators: Vibrators shall have a minimum head diameter of at least 2-inches, a minimum centrifugal force of 700-pounds and a minimum frequency of 8,000 vibrations per second.
 3. Vibrators for Confined Areas: In confined areas, the specified vibrators shall be supplemented by others having a minimum head diameter of 1-1/2-inches, a minimum centrifugal force of 300-pounds and a minimum frequency of 9,000 vibrations per second.

4. Spare Vibrator: One (1) spare vibrator for each 3 in use shall be kept on the site during all concrete placing operations.
 5. Use of Vibrators: Vibrators shall be inserted and withdrawn at points approximately 18-inches apart. The duration of each insertion shall be from 5 to 15-seconds. Concrete shall not be transported in the forms by means of vibrators.
- D. Protection: Rainwater shall not be allowed to increase the amount of mixing water, or to damage the surface finish. Concrete shall be protected from construction over-loads. Design loads shall not be applied until the specified strength has been attained.

3.03 CONCRETE FINISHING AND CURING

- A. All slabs exposed to view shall receive a steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.
- B. All other slabs and footings shall receive a smooth steel trowel finish.
- C. All walls of structures or parts of buildings exposed to view shall receive the following:
 1. Repair defective concrete, remove fins, fill depressions 1/4-inch or deeper, and fill tie holes.
 2. Any surface not receiving a special applied finish, shall receive a slurry finish consisting of 1 part cement and 1-1/2 parts sand by damp loose volume. Dampen surfaces and then apply the slurry with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.
 3. Surfaces that will receive a special applied finish shall be of even color, have no pits, pockets, holes, or sharp changes of surface elevation. Scrubbing with a stiff bristle fiber brush shall produce no dusting or dislodging of cement or sand.
- D. All concrete shall be wet cured a minimum of 7-days; or if not to receive special finishes, coatings or concrete toppings, an acceptable curing compound may be utilized.
- E. All surface defects shall be repaired by removing defective concrete down to sound concrete and repairing with patching mortar. Finished repair shall match adjacent concrete and be cured as specified.

3.04 TESTING

- A. A testing laboratory, acceptable by the County, shall perform required testing. The Contractor shall pay for all tests indicating a failure to comply with the Specifications. The Contractor shall keep the laboratory informed of his schedule.

- B. Standard laboratory compressive test cylinders shall be obtained by the laboratory when concrete is discharged at the point of placing (i.e., discharge end of pumping equipment), and cylinders shall be made and cured in accordance with the requirements of ASTM Designation C 31. A set of 4 cylinders shall be obtained for each 50-cubic yards, or fraction thereof, placed each day for each type of concrete. The cylinders shall be cured under laboratory conditions and shall be tested at 7 and 28-days of age in accordance with the requirements of ASTM Designation C 39.

- C. The testing laboratory shall make slump tests of Class A and Class B concrete as it is discharged from the mixer at the point of placing. Slump tests shall be made for each 25-cubic yards or "pour" of concrete placed. Slump tests may be made on any batch, and failure to meet specified slump requirements shall be sufficient cause for rejection of that batch.

END OF SECTION

SECTION 03410
PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies the materials, labor and equipment required to construct manholes, wetwells, valve vaults, mitered end sections, meter boxes and all other precast concrete structures, as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards.
 - 1. Standard Building Code
 - 2. Local Codes and Regulations
 - 3. ACI Building Code Requirements for Reinforced Concrete
 - 4. American Society for Testing and Materials (ASTM)
 - 5. American Concrete Institute (ACI)
- B. The forms, dimensions, concrete, and construction methods shall be acceptable to the County in advance of construction.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. The Contractor shall submit Shop Drawings to the County, showing all details of construction, reinforcing and joints.
- C. Submit manufacturer's data on certifications and testing for concrete waterproofing additive, joint mastic, gaskets and grout material to be used.

1.04 INSPECTION

- A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and acceptance by the County. Such inspection may be made at the place of manufacture or at the site after delivery, or at both places, and the sections shall be subject to rejection at any time due to failure to meet any of the specification requirements; even though sample sections may have been acceptable as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All damaged sections will be rejected. If damaged sections have already been installed; they shall be acceptably repaired if authorized by the County, or removed and replaced at the Contractor's expense.
- B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified and the acceptable manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch strength", blisters, cracks, roughness, and soundness. The surface shall be dense and close textured.
- C. Imperfections may be repaired subject to the review and acceptance of the County after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final review and acceptance. Cement mortar used for repairs shall have a minimum compressive strength of 4,000-psi at the end of 7-days and 5,000-psi at the end of 28-days, when tested in 3-inch by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the review and acceptance of the County.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 PRECAST CONCRETE SECTIONS

- A. Precast concrete wetwell sections, manhole barrel and eccentric top sections shall conform to specifications for precast reinforced concrete manhole sections, ASTM Designation C478, except as otherwise specified below or as shown on the Drawings. Details of precast sections shown on the Drawings, including thickness and reinforcing, shall supersede ASTM C-478 when such details are more stringent than ASTM C-478. The method of construction shall conform to the detailed Drawings appended to these specifications and the following additional requirements:
 - 1. The minimum wall thickness for the various size barrel sections shall be 5-inches, or as indicated in the Drawings.
 - 2. Barrel sections shall have tongue and groove joints. Joints shall be sealed with cold adhesive preformed plastic gaskets set in double rows on the tongue and in the groove prior to setting the next section. Gaskets shall be K.T. Snyder "Ram-Nek", Conseal "CS-102" or acceptable equal. All extension joints shall be sealed with Portland Type II cement after setting of gasket and placement of manhole section into a watertight joint.

3. Type II cement shall be used except as otherwise accepted.
4. New concrete structures shall contain a crystalline waterproofing concrete admix for all new concrete structures including but not limited to manholes, ARV vaults, wetwells, and wetwell top slabs. Crystalline waterproofing concrete admix shall be added to the concrete during the batching operation. Admixture concentration shall be added based upon manufacturer's design percent concentration of admixture to the required weight of cement. The amount of cement shall remain the same and not be reduced. A colorant shall be added to verify the admixture was added to the concrete. Colorant shall be added and provided at the admixture manufacturing facility, not at the concrete batch plant. It is recommended that the admixture be added first to the rock and sand and blended thoroughly before adding cement and water or per the manufacturer's recommendations. Concrete structures without crystalline waterproofing admixture or admixture without colorant for field verification shall be rejected. Contractor shall provide certification from the pre-caster that the admixture was added in accordance with the manufacturer's recommendations. Concrete admixture shall be manufactured and supplied by an approved manufacturer as shown in Appendix D "List of Approved Products."
5. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section. Each section must be inspected and stamped by an accredited testing laboratory.
6. Sections shall be cured by an acceptable method for at least 28-days.
7. Manhole top sections shall be eccentric except that precast concrete slabs shall be used where cover over the top of the pipe is less than 4-feet for all manholes. Lift rings or non-penetrating lift holes shall be provided for handling precast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation of the manhole sections.
8. Precast concrete slabs over top section, where required, shall be capable of supporting the overburden plus a live load equivalent to ASHTO H 20 loading.
9. The tops of bases shall be suitably shaped to mate with the adjoining precast section.
10. Precast leveling rings for setting cast iron frames over manholes shall be 2-inch thick and have 1 (one) Number 2 continuous reinforcing steel bar.
11. Concrete surfaces shall have form oil, curing compounds, dust, dirt, and other interfering materials removed by brush sand blasting and shall be fully cured prior to delivery.
12. Interior surfaces of manholes, wetwells and valve vaults shall be lined in accordance with Appendix D "List of Approved Products."
13. Manholes to be installed around existing gravity sewers shall consist of a cast-in-place concrete base slab and precast concrete barrel and top sections; lined per Section 3410 – 2.01.11. The base slab shall be as shown on the Drawings and include a joint which is compatible with the bottom barrel section and acceptable to the County. The bottom barrel section shall include an inverted "U-shaped" slot to allow installation of the section over existing pipes. Flow channels shall be provided within the manholes as shown on the Drawings. Annular space between the existing pipe and slot shall be made watertight with non-shrink grout. Existing pipes shall be removed within the manhole and outlets plugged watertight with non-shrink grout as shown on the Drawings.

14. The manholes shall have an invert channel shaped to correspond with the lower half of the pipe. The top of the shelf shall be at the elevation indicated and shall be sloped to drain toward the flowing through channel. Every effort shall be made by the Contractor to construct watertight structures.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All manholes and other precast structures shall be set in the dry.
- B. Manholes and other precast structures shall be constructed to the dimensions as shown on the Drawings and as specified herein.
- C. The base structure may be cast-in-place concrete as specified in Division 3. The concrete structure shall be placed on the required crushed stone base as shown in the Drawings over a dry sub base of structural fill that has been compacted to 95% (percent) of the maximum dry density as determined by the modified proctor test, ASTM D1557. The tops of the cast in place bases shall be shaped to mate with the precast barrel section and shall be adjusted in grade so that the top of the dome section is at the correct elevation.
- D. Precast bases conforming to all requirements of ASTM C478 and other requirements for precast sections may be used and shall be set on a sub base as described above.
- E. Precast concrete structure sections shall be set vertically with sections in true alignment with a 1/4-inch maximum tolerance per 5-feet of depth. The outside and inside joint shall be filled with a non-shrink mortar and finished flush with the adjoining surfaces. Allow joints to set for 24-hours before backfilling. Backfilling shall be accomplished bringing the fill up evenly on all sides. If leaks appear in the structures, the inside joints shall be caulked with non-shrink grout to the satisfaction of the County. The Contractor shall install the precast sections in a manner that will result in a watertight joint.
- F. Lift rings or non-penetrating lift holes shall be provided for handling pre-cast manhole sections. Non-penetrating lift holes shall be filled with non-shrink grout after installation.
- G. Where holes must be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints.
- H. Cast iron frames shall be placed over precast concrete leveling rings, shimmed and set in cement mortar to the required grade. No more than 3 courses of leveling rings shall be used.

END OF SECTION

SECTION 03600

GROUTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: This Section specifies the grouting of the annular space between the host pipe and the new liner and the grouting of the space left void in the abandonment of the existing pipelines and structures. The Work consists of furnishing all labor, equipment and materials, and performing all Work connected with the placement of the cementaceous grout to fill the void.

1.02 QUALITY ASSURANCE

- A. Grouting shall be performed by a crew under the direct supervision of a superintendent that has experience in grouting of this nature.
- B. Storage, mixing, handling and placement shall be in accordance with manufacturer's instructions and specifications.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. In addition, the following shall be submitted to the County for review and acceptance prior to construction.
 - 1. A detailed description of equipment and operational procedures to accomplish the grouting operation.
 - 2. Grout mixture design data, grout mixer type, grout samples, and test data.
 - 3. A detailed description of the grouting time schedule.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 GROUT MATERIAL

- A. The grout shall be a "flowable fill" consisting of a mixture of Type 1 Portland Cement, Type "F" Flyash (ASTM 618), sand and water.

The following is a suggested trial grout mixture for a 1-cubic yard yield:

Cement: 500-pounds
Fly Ash: 500-pounds
Water: 350-pounds (42-gallons)
Sand: 2,248-pounds
Darex (W.R. Grace): 3-ounces (Air Entrainment Additive or equivalent)

The actual grout mixture to be used shall meet the minimum requirements specified below.

- B. The mixture shall contain a minimum of 500-pounds cement and minimum of 400-pounds flyash per cubic yard of grout.
- C. Samples of the grout mixture when set aside in a standard concrete test mold shall show less than 1% of the mixture height of free water on the surface after standing not less than 12-hours.
- D. One (1) set of 3 (three) 3-inch by 6-inch sample test cubes shall be made for each mix preparation. The minimum 28-day strength shall be no less than 1,000-psi. The minimum required slump is 5-inches. The maximum allowable slump is 9-inches. Slump should be as low as practical to maintain viscosity, proper flow, and still retain the ability to pump.

2.03 EQUIPMENT

- A. All grout shall be mixed with a high shear, high-energy colloidal type mixer to achieve the best uniform density.
- B. The grout shall be pumped with a non-pulsating centrifugal or tri-plex pump.
- C. The mixer shall be capable of continuous mixing. Batch mixing shall not be permitted.

PART 3 - EXECUTION

3.01 GROUTING OF ABANDONED PIPE

- A. Where utility pipes are to remain in place (inactive) they shall be filled with a sand/cement grout as specified herein.
- B. The grouting program shall consist of pumping sand-cement grout with suitable chemical additives at pressures necessary to fill the pipe sections in order to prevent the potential for future collapse.

- C. Grouting of pipes shall be in sections not exceeding 300 linear feet.
- D. Grout shall be placed in a maximum of 3 stages, with the initial stage volume equal to or greater than 50% of the total volume for that section of pipe being grouted. The maximum time wait between grouting stages shall be 24-hours.
- E. For each stage, mix and pump the material in one continuous process so as to avoid partial setting of some grout material during that stage; thus, eliminating voids and possible subsequent surface damage due to cave-ins.
- F. Each section shall be grouted by injecting grout from the lowest point and allowing it to flow toward the highest point to displace water from the annulus and assure complete void-free coverage. Grout shall be placed through tubes installed in the bulkheads at the insertion pits or manholes. Grout tubes shall be at least 2-inch nominal diameter.
- G. After the ends of each section of pipe are exposed, the entire space, not to exceed 300 linear feet end to end, shall be sealed by controlled pumping of grout until it flows from the pipe at the opposite end of the grouting. Grouting shall be carried out until the entire space is filled. The ends of these sections shall be capped and/or plugged.
- H. Grout pressure in the void space is not to exceed 5-psi above maximum hydrostatic groundwater level. An open ended, highpoint tap or equivalent vent must be provided and monitored at the bulkhead opposite to the bulkhead through which grout is injected. This bulkhead will be blocked closed as grout escapes to allow the pressuring of the annular space.

3.02 FIELD QUALITY CONTROL

- A. The quality of the grout, application of the equipment, and installation techniques are the responsibility of the Contractor. The review and acceptance or approval of specific mix design, equipment, or installation procedures shall in no way relieve the Contractor of his obligation to provide the final product as specified herein.
- B. The County may stop the grouting operations at any time if the operation does not comply with these Specifications.

END OF SECTION

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SECTION 05500
MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section specifies the labor, materials, equipment, and incidentals required and installation of covers, grates, frames, hatches, manhole rungs, catch basin castings, and other miscellaneous metals as shown on the Drawings and specified herein.

1.02 QUALITY ASSURANCE

- A. The work in this section shall be coordinated with the work of other Sections. Verify at the site both the dimensions and work of other trades that adjoin items of work in this Section before fabrication and installation of items herein specified.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.
- C. Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

1.03 SHOP DRAWINGS AND SAMPLES

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Submit detail drawings showing sizes of members, method of assembly, anchorage, and connection to other members for all products provided under this section to the County for approval before fabrication.
- C. One (1) product sample of each type of product shall be submitted to the County upon request. Samples shall be submitted for concurrent review with Shop Drawings.

1.04 REFERENCE STANDARDS

A. Unless otherwise specified, materials shall conform to the following:

Structural Steel	ASTM A36
Welded and Seamless Steel Pipe	ASTM A53
Gray Iron Castings	ASTM A48, Class 30
Galvanizing, general	ASTM A123
Galvanizing, hardware	ASTM A153
Galvanizing, assemblies	ASTM A386
Aluminum (Extruded Shapes) 6061 T6 (Alum. alloy)	
Aluminum (Extruded Pipe)	6063 T6 (Alum. alloy)
Aluminum Bar Structural	6061 T6 (Alum. alloy)
Bolts and Nuts ASTM, A307	
Stainless Steel Bolts, Fasteners	AISI, Type 316
Stainless Steel Plate and Sheet, Wire	AISI, Type 316
Welding Rods for Steel	AWS Spec. for Arc Welding

PART 2 - PRODUCTS

2.01 GENERAL

A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 ANCHORS, BOLTS, AND FASTENING DEVICES

- A. Anchors, bolts, and other fastening devices shall be furnished as necessary for installation of the work of this Section.
- B. Compound masonry anchors shall be of the type shown or required and shall be Star Slug compounded masonry anchors manufactured by Star Expansion Industries, by Phillips Drill Co., Rahplug, or acceptable equal. Anchors shall be minimum "2-unit" type.
- C. The bolts used to attach the various members to the anchors shall be the sizes shown or required. Stainless steel shall be attached to concrete or masonry by means of stainless steel machine bolts and iron or steel shall be attached with steel machine bolts unless otherwise specifically noted.
- D. For structural purposes, unless otherwise noted, expansion bolts shall be Wej it "Ankr Tite", Phillips Drill Co. "Wedge Anchors", Hilti "Kwik Bolt", or acceptable equal. When length of bolt is not called for on the Drawings, the length of bolt provided shall be sufficient to place the wedge portion of the bolt a minimum of 1-inch behind the reinforcing steel within the concrete.

- E. Materials for anchor or expansion bolts shall be as noted on the Drawings. If no specific material is listed, hot dipped galvanized steel shall be used. All hardware inside wetwells, manholes, or other wetted areas shall be 316 Stainless Steel.

2.03 ALUMINUM ITEMS

- A. Prefabricated checker plate aluminum hatches shall be Type "JD", or "KD" as manufactured by Bilco Co., equal type by Babcock Davis Associates, Inc.; or acceptable equal, sized as shown. Hatches with any single dimension over 3-feet 6-inches shall be double leaf type. Hatches shall be designed for a live load of 300-pounds per square foot. Hatches shall be watertight.
- B. Check plate aluminum cover plates shall be fabricated to the details shown and installed at the locations shown.
- C. Miscellaneous aluminum shapes and plates shall be fabricated as shown. Angle frames for hatches, beams, grates, etc., shall be furnished complete with welded strap anchors attached. Furnish all miscellaneous aluminum shown but not otherwise detailed. Structural shapes and extruded items shall conform to the detail dimensions or the plans within the tolerances published by the American Aluminum Association.

2.04 STEEL ITEMS

- A. Sleeves shall be steel or cast iron pipe in walls and floors with end joints as shown on the Drawings. All pipe sleeves shall have anchors centered on the circumference as shown.
- B. Miscellaneous steel pipe for sleeves, lifting attachments, and other uses as required shall be Schedule 40 pipe fabricated according to the details as shown on the Drawings.

2.05 CAST IRON ITEMS

- A. Outside pipe clean out frames and covers shall be heavy duty, R 6013 R 6099 series as manufactured by Neenah Foundry Co., or acceptable equal. All outside pipe cleanouts shall be 6-inch diameter.
- B. Trench drain shall be of length shown on the Drawings and shall be heavy duty, cast iron, open grate lid type, Series R 4990 Type A as manufactured by Neenah Foundry Co., or acceptable equal.

- C. Gray iron castings for manhole frames, covers, adjustment rings, and other items shall conform to ASTM A48, Class 30B. Castings shall be true to pattern in form and dimensions and free of pouring faults and other defects which would impair their strength or otherwise make them unfit for the service intended. The seating surfaces between frames and covers shall be machined to fit true. No plugging or filling will be allowed. Lifting or "pick" holes shall be provided, but shall not penetrate the cover. Casting patterns shall conform to those shown or indicated on the Drawings. All manhole frames and covers shall be traffic bearing to meet AASHTO H 20 loadings. Frames shall be suitable for the future addition of a cast iron ring for upward adjustment of top elevation.

PART 3 - EXECUTION

3.01 FABRICATION

- A. All miscellaneous metalwork shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability.
- B. Connections and accessories shall be of sufficient strength to safely withstand stresses and strains to which they will be subjected. Steel accessories and connections to steel or cast iron shall be steel, unless otherwise specified. Threaded connections shall be made so that the threads are concealed by the fitting.
- C. Welded joints shall be rigid and continuously welded or spot-welded as specified or shown. The face of welds shall be dressed flush and smooth. Exposed joints shall be close fitting and jointed where least conspicuous.
- D. Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown, specified, or permitted by the County. All welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS code. Component parts of built up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.
- E. Welding of aluminum work shall be on the unexposed side as much as possible in order to prevent pitting or discoloration.
- F. All aluminum finish exposed surfaces, except as specified below, shall have manufacturers' standard mill finish. Aluminum handrails shall be given an anodic oxide treatment in accordance with the Aluminum Association Specification AA C22 A41. A coating of methacrylate lacquer shall be applied to all aluminum before shipment from the factory.

- G. Castings shall be of good quality, strong, tough, even grained, smooth, free from scale, lumps, blisters, sand holes, and defects of any kind which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field by the County. All finished surfaces shown on the Drawings and/or specified shall be machined to a true plane surface and shall be true and seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified or shown shall not be reduced in obtaining finished surfaces. Castings will not be acceptable if the actual weight is less than 95% (percent) of the theoretical weight computed from the dimensions shown. The Contractor shall provide facilities for weighing castings in the presence of the County showing true weights, certified by the supplier.
- H. All steel finish work shall be thoroughly cleaned of all loose mill scale, rust, and foreign matter before shipment and shall be given 1 shop coat of primer in accordance with Section 09865 "Surface Preparation and Shop Prime Painting." Abrasions in the field shall be touched up with primer immediately after erection. Final painting shall be in accordance with Section 09900 "Painting."
- I. Galvanizing shall be the hot dip zinc process after fabrication. Following all manufacturing operations, all items to be galvanized shall be thoroughly cleaned, pickled, fluxed, and completely immersed in a bath of molten zinc. The resulting coating shall be adherent and shall be the normal coating to be obtained by immersing the items in a bath of molten zinc and allowing them to remain in the batch until their temperature becomes the same as the bath. Coating shall be not less than 2-ounces per square foot of surface.

3.02 INSTALLATION

- A. Install all items furnished except items to be imbedded in concrete or masonry, which shall be installed under Division 3 or Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted. All dimensions shall be verified at the site before fabrication is started.
- B. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- C. Where aluminum is embedded in concrete, apply a heavy coat of approved bitumastic troweling mastic in accordance with the manufacturer's instructions prior to installation.
- D. Where aluminum contacts masonry or concrete, provide a 1/32-inch neoprene gasket between the aluminum and the concrete or masonry.
- E. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc chromate primer and provide a 1/32-inch neoprene gasket between the aluminum and the dissimilar metal.

- F. Where aluminum contacts wood, apply 2 coats of aluminum metal and masonry paint to the wood.

END OF SECTION

SECTION 09901
COATINGS AND LININGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This specification pertains to the coating and lining including but not limited to manholes and lift stations as well as the coating of above ground assets including but not limited to: steel, ductile iron pipe, ductile iron fittings, valves, hydrants, hardware and all appurtenances. Brass, bronze and 316 Stainless Steel shall not be coated.
- B. Precast concrete rehabilitation and new structures: The Work shall include the furnishing and installation of an interior protective lining/coating corrosion protection system including all necessary materials, equipment and tools as required for a complete installation in accordance with the manufacturers recommendations. The completed system shall provide a waterproof, corrosion protection system to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater and to prevent infiltration. To ensure total unit responsibility, all materials and installation thereof shall be furnished by, and coordinated with, 1 supplier/manufacturer.

1.02 QUALITY ASSURANCE

- A. All work shall be proved to be in first class condition and constructed in accordance with the Drawings and specifications. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor at no expense to the County.
- B. Fiberglass liner manufacturers shall certify that the liner has been manufactured, sampled, tested, and inspected in accordance with ASTM D 3753.
- C. Polyethylene liner manufacturers shall certify that the liner has been designed and manufactured in accordance with ASTM F 1759 and these specifications.
- D. Holiday Testing: Each coat shall be holiday tested at the recommended 100-125 volts DC per mil in accordance with the latest edition of the following standards: NACE SP0188-2006, NACE Standard RP0490, ASTM G62

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."

1.04 COVERAGE

- A. The protective lining/coating corrosion protection shall cover all concrete surfaces within the wetwell or manhole including the adjustment ring area.
- B. Coatings and lining surfaces shall be holiday free and all defects shall be repaired in accordance with the manufacturer's recommendations prior to the next coat being applied.

1.05 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C1244: Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
 - 2. ASTM D3299: Filament-Wound Glass-Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks
 - 3. ASTM D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - 4. ASTM D3753: Glass-Fiber-Reinforced Polyester Manholes and Wetwells
 - 5. ASTM D6365: Nondestructive Testing of Geomembrane Seams using the Spark Test.
 - 6. ASTM F1759: Design of High-Density Polyethylene (HDPE) Manholes for Sub-surface Applications
 - 7. ASTM F1869: Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - 8. ASTM G62: Standard Test Methods for Holiday Detection in Pipeline Coatings.
- B. NACE INTERNATIONAL (Formerly The National Association of Corrosion Engineers)
 - 1. NACE SP0188-2006 (formerly RP0188): Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
 - 2. NACE Standard SP0490-2007 (formerly RP0490): Holiday Detection of Fusion-Bonded Epoxy External Pipeline Coating of 250 to 760 μm (10 to 30-mils).
 - 3. NACE Standard SP0178-2007 (formerly RP0178): Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 HDPE LINERS

- A. The Work shall include the furnishing and installation of an interior protective liner system including all necessary labor, materials, equipment and tools as required for a complete installation. Liner shall be high-density polyethylene (HDPE). This liner shall provide a waterproof, corrosion resistant liner to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater and to prevent infiltration. To ensure total unit responsibility, all materials and installation thereof shall be furnished by, and coordinated with, 1 supplier/manufacturer.
- B. Manhole HDPE Liner shall have a minimum thickness of 2-mm (78-mil) and wetwell HDPE shall have a minimum thickness of 5-mm (195-mil). All HDPE liner sheets shall be extruded with a large number of anchoring studs, a minimum of (420/m², 39/ft²), manufactured during the extrusion process in 1-piece with the sheet so there is no welding and no mechanical finishing work to attach the studs to the sheet. The liner shall have a pull out of 112.5-lbs/anchoring stud. A manufacturer certified fabricator shall custom fit the liner to the formwork in order to protect the concrete surfaces from sewer gases.
- C. All welding shall be performed in accordance with the published directives and procedures of the manufacturer and by welders certified by the manufacturer and documentation shall be provided to the County prior to the Work. Completion of welding will provide a 1-piece monolithic HDPE protective liner system that will provide excellent resistance to hydrogen sulfide attack and will not pull off the wall in the event that infiltration occurs. Flat liner sheet, not anchored, used for overlapping joints, shall have a minimum thickness of 3-mm for manholes or 5-mm for wetwells and shall contain a co-extruded bottom surface layer of conductive polyethylene. Conductive cap strip material shall have a free path from the back side of the sheet to a portion of the concrete surface.
- D. Field welding of the liner at the riser joints shall be completed only after vacuum testing (ASTM C1244) of the new structure has been completed and any concrete joint deficiencies have been rectified. Vacuum testing is not required on rehabilitation of existing structures.
- E. Testing and supervision of the installation and welding shall be performed by qualified staff only and must be checked when completed by visually checking and by Spark Testing all welded joints per ASTM D6365. Holiday testing 20,000 to 35,000 volts. All high voltage discontinuity (spark) testing shall be performed using a Tinker & Rasor model AP/W Holiday Detector or equal.
- F. Penetrations (Forcemain, conduit, etc) shall have an internal boot comprising of minimum of 3/8-inch 316SS band clamp compressing a 2-inch wide neoprene with full circumferential welded boot around each penetration in accordance with the manufacturer's details.

2.03 PREFORMED POLYPROPYLENE (PP) LINERS

- A. The Work shall include the furnishing and installation of an interior protective liner system including all necessary labor, materials, equipment and tools as required for a complete installation. This liner shall provide a waterproof, corrosion resistant liner to prevent any deterioration of concrete surfaces from hydrogen sulfide and other corrosive gases/acids produced by wastewater and to prevent infiltration. To ensure total unit responsibility, all materials and installation thereof shall be furnished by, and coordinated with, 1 supplier/manufacturer.
- B. All joints shall be field welded by hot air extrusion welding with PP welding bead. Field welding of the PP liner at the riser joints shall be completed only after vacuum testing (ASTM C1244) of the new structure has been completed and any concrete joint deficiencies have been rectified. Vacuum testing is not required on rehabilitation of existing structures.
- C. Testing and supervision of the installation and welding shall be performed by qualified staff only and must be checked when completed by visually checking and by Spark Testing all welded joints per ASTM D6365. Holiday testing 20,000 to 35,000 volts. All high voltage discontinuity (spark) testing shall be performed using a Tinker & Rasor model AP/W Holiday Detector or equal.
- D. Penetrations (Forcemain, conduit, etc) shall be gasketed PP pipe bell connectors or PP sleeves for boot type connectors and shall be attached to the PP liner by hot air extrusion welding with PP welding bead in accordance with the manufacturer's details.

2.04 FIBERGLASS LINERS

- A. Fiberglass liners shall be used for new or existing precast manholes and wetwells. Fiberglass liners shall meet or exceed ASTM D 3753 and shall withstand ASSHTO H-20 Loading.
- B. FRP liner shall be 1-piece with no vertical or horizontal seams allowed. The FRP shall be fabricated in accordance with NBS PS 15-69, and shall consist of commercial grade polyester resin, UV inhibitor, chopped strand, woven roving, and continuous reinforcement. Minimum liner thickness shall be 1/2-inch for all diameter wells, and shall not have external ribs. Liner size shall be field verified by liner manufacturer's representative. Tolerance of the inside diameter shall be +/- 1% of the required liner diameter.
- C. Exterior Surface: The exterior surface shall be relatively smooth with no sharp projections and shall be free of blisters larger than 1/2-inch in diameter, delamination and fiber show. Hand work finish is acceptable if enough resin is present to eliminate fiber show.

D. Interior Surface: The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, and blisters larger than 1/2-inch in diameter, and wrinkles of 1/8-inch or greater in depth. Surface pits shall be permitted up to 6 per square feet if they are less than 3/4-inch in diameter and less than 1/16-inch deep. Voids that cannot be broken with finger pressure and that are entirely below the resin surface shall be permitted if they are less than 1/2-inch in diameter and less than 1/16-inch thick.

E. Physical Properties:

Property	Hoop Direction	Axial Direction
a. Tensile Strength (psi)	18,000	5,000
b. Tensile Modules (psi)	0.6 x 10e	0.7 x 10e
c. Flexural Strength (psi)	26,000	4,500
d. Flexural Modules (psi)	1.4 x 10e	0.7 x 10e
e. Compressive Strength (psi)	18,000	12,000

F. Stiffness

Liner Length in FT.	PSI
3 – 6.5	0.75
7 – 12.5	1.26
13 – 20.5	2.01
21 – 25.5	3.02
26 – 35	5.24

G. Testing: All tests shall be performed as specified in ASTM D3753 latest edition, Section 8. Test method D-790 (note 5) and test method D695. Each completed liner shall be examined for dimensional requirements, hardness and workmanship. All required ASTM D3753 testing shall be completed and records of all testing provided to the County. As a basis of acceptance, the manufacturer shall provide an independent certification which shall consist of a copy of the manufacturer's test report, and be accompanied by a copy of the test results that the liner has been sampled, tested and inspected in accordance with the provisions of this specification and meets all its requirements. The independent certification and manufacturer's test report shall be provided to the County prior to delivery of the Liner.

H. Connections: Openings for pipe connections will be core drilled in the field. Pipes shall be placed through concrete wetwell and fiberglass liner in the locations indicated on the Drawings. Pipes shall then be grouted in place with the grout filling the entire void and being as thick as the concrete wetwell. The pipe on the interior of the wetwell shall be fiberglassed to the fiberglass liner. To fiberglass the PVC or Ductile Iron pipe to the fiberglass liner, the surface to be fiberglassed must first be sanded. In the case of Ductile Iron pipe, the protective coating on the exterior of the pipe must be removed and then the pipe sanded. After sanding and cleaning the area to be fiberglassed, apply a coat of primer resin. When the resin becomes tacky, begin normal installation of the fiberglass, taking care to roll out all of the air pockets. All field fiberglassing must be accomplished by a manufacturer certified installer. Submit certification to the County.

- I. **Fiberglass Reinforced Top:** The fiberglass manhole liner top shall be fabricated using fiberglass material as above. Material and installation to meet all physical requirements as above. Top to be attached to wetwell liner pipe with fiberglass layup to comply with ASTM D3299. When reinforcement is necessary for strength, the reinforcement shall be fiberglass channel laminated to the inside of the liner top and shall comply with ASTM D3299. 4,000-psi concrete shall be poured around the entire manhole fiberglass cone section. Lift station top slabs shall be re-poured with HDPE interior liner. Contractor shall ensure an airtight connect between the Pump Station HDPE lined top slab and interior wetwell liner.
- J. PVC stub-outs shall be factory installed for new installations to accept approved boots for gravity lines or compression seals for force mains.

2.05 FERROUS METAL SURFACES (INCLUSIVE OF STEEL AND DIP, HYDRANTS, FITTINGS AND APPURTENANCES)

Cleaning, surface preparation, coating application, and thickness shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the manufacturer's minimum recommendations. All cleaning, surface preparation, coating application, thickness, testing, and coating materials (where available) shall be in accordance with the referenced standards of AWWA, ANSI, NACE, SSPC, NSF, and ASTM. Color-coding shall be Safety Blue, Safety Green and Pantone Purple 522-C for water, wastewater and reclaimed water respectively. Surfaces shall be holiday detected in accordance with ASTM G 62. Areas found to have holidays shall be marked and repaired in accordance with the paint manufacturer's instructions. The County shall be notified of time of testing so that he might be present to witness testing.

- A. **Procedures for Coating Exterior of DIP, Hydrants, Fittings and Appurtenances**
 1. **Surface Preparation:** Do not abrasive blast or prepare more surface area than can be coated in the same day; prepare surfaces and apply prime coatings within an 8-hour period.
 - a. **Steel:** Shall require NACE-1/SSPC-SP5 White Metal Blast Cleaning minimum angular anchor profile of 1.5-mils. White metal blast cleaning removes all of the coating, mill scale, rust, oxides, staining, corrosion products, and other foreign matter from the surface.
 - b. **DIP:** DIP with asphaltic seal coat, Hydrants, FBE (Valves and appurtenances), Shall require NACE-3/SSPC-SP6 Commercial Blast Cleaning minimum angular anchor profile of 1.5-mils. Commercial blast cleaning removes all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter from all surfaces and allows stains to remain on 33% (percent) of each unit area of surface.

- c. Note: Primer Option - Hydrants, FBE (Valves and appurtenances), existing factory coatings: Where specifically called out in the Coating System Table below, NACE-4/SSPC-SP7 may be substituted for the commercial blast for hydrants and factory applied FBE (Valves and appurtenances) where the coating manufacturer has specifically provided compatible coatings with existing coatings including urethane, epoxy, alkyd and water-based coatings. Under no circumstances shall DIP with asphaltic seal coat be over-coated. NACE-4/SSPC-SP7 Brush-Off Blast Cleaning shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. Tightly adherent mill scale, rust, and coating may remain on the surface. Mill scale, rust, and coating are considered tightly adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed.
2. Contaminants: Remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating in accordance with SSPC-SP1 for the substrate and between each coating layer.
3. Temperature: Surface temperature of substrate shall be a minimum of 5°F above the dew point and rising and generally between 40°F to 100°F. Temperatures shall not exceed manufacturer's recommendations.
4. Stripping: Edges, corners, crevices, welds, and bolts shall be given a brush coat/stripe coat for each material/layer. The stripe coat shall be applied by a brush and worked in both directions.
5. Coatings Systems: Two (2) options for coating systems are provided. Each coat shall be a distinctive color or shade to verify each coating in the system.
6. Prime coat: DIP, DIP with asphaltic seal coat, Hydrants, FBE (Valves and appurtenances) prime coat shall be zinc-rich. Zinc-rich shall only be used on bare metal. Factory applied FBE/Asphaltic/Mastic coatings on valves and appurtenances shall be completely removed per NACE 3 / SSPC-SP6.
7. Note: Where specifically called out in the Coating System Table for factory applied FBE (Valves and appurtenances) surface preparation may be NACE-4/SSPC-SP7 and the prime coat shall be an Inorganic water based epoxy. Asphaltic seal coats and mastics shall not be overcoated with Inorganic water based epoxy.
8. Intermediate coat: Varies per coating system.
9. Final Coat: Varies per coating system.
10. Holiday Testing: Each coating layer shall be holiday tested at the recommended 100-125 volts DC per mil in accordance with the latest edition of the following standards: NACE SP0188-2006, NACE Standard RP0490, ASTM G62 and per the manufacturers recommendations. All low voltage holiday testing shall be performed using a Tinker & Razor model M-1 Holiday Detector or equal.
11. Coating Systems: Either System 1 or System 2 shall be used for above ground, non-immersion ferrous metal surfaces (Inclusive of Steel, DIP, Hydrants, Fittings and Appurtenances).

Color Codes

Generic Name	Application	Tnemec	Carboline	PPG / Ameron
Safety Blue	Water Master Meters	True Blue / Safety 11SF	9122	BL Safety Blue
Safety Green	Pump Station Piping	Hunter Green 08SF	V358	GN Safety Green
Pantone Purple 522C	Reclaimed Master Meters	Purple Rain / Safety 14 SF	7528	PL Safety Purple
Safety Green	Hydrant Bonnet & Caps	Hunter Green 08SF	V358	GN Safety Green
Safety Orange	Hydrant Bonnet & Caps	Tangerine Orange / Safety 04 SF	1420	OR 2Safety Orange
Safety Red	Hydrant Bonnet & Caps	Candy Apple Red / Safety 06SF	7573	RD 2 Safety Red
Safety Silver	Hydrant Barrel	Aluminum 57GR	J766	SL Safety Silver

System 1 - Zinc / Urethane / Fluoropolymer

Description	Generic Coating Name	Tnemec	DFT mils	Carboline	DFT mils
Prime Coat all materials. Surface Prep NACE 1 or NACE 3	Zinc-Rich	Zinc Series 90-97	2.5 - 3.5	Carbozinc 621	3.0 - 8.0
Prime Coat - option for FBE or Hydrants only. Surface Prep NACE 4	Inorganic water based epoxy – overcoat existing coatings	Typoxy Series 27WB	4.0 - 14.0	NA	NA
Intermediate Coat.	Aliphatic Acrylic Polyurethane	Endura-Shield Series 73	2.0 - 3.0	Carbothane 133 HB	3.0 - 5.0
Final Coat.	Advanced Thermoset Fluoropolymer Polyurethane	Hydroflon Series 700	2.0 - 3.0	Carboxane 950	2.0- 3.0

System 2 - Zinc / Epoxy / Urethane

Description	Generic Coating Name	Tnemec	DFT mils	Carboline	DFT mils	PPG / Ameron	DFT mils
Prime Coat all materials. Surface Prep NACE 1 or NACE 3	Aromatic Urethane, Zinc-Rich	Zinc Series 90-97	2.5 - 3.5	Carbozinc 621	3.0 - 8.0	Amercoat 68HS	3
Prime Coat option for FBE, Hydrants. Surface Prep NACE 4	Inorganic water based epoxy – overcoat existing coatings	Typoxy Series 27WB	4.0 - 14.0	NA	NA	NA	NA
Intermediate Coat.	Polyamidoamine Epoxy	Color Hi-Build Epoxoline II Series N69	4.0 - 10.0	Carboguard 60	4.0 - 6.0	Amerlock 2/400	4.0 - 6.0
Final Coat.	Aliphatic Acrylic Polyurethane	Endura-Shield Series 73	2.0 - 3.0	Carboxane 950	2.0 - 3.0	Amercoat 450H	2.0 - 3.0

2.06 SPECIALTY COATINGS

- A. The Specialty Coatings are for rehabilitation of existing precast concrete manholes. New precast structures shall be lined only. All specialty coatings applicators shall follow the procedure as outlined below:
1. Pre-Inspection: Applicator shall take appropriate action to comply with all local, state and federal regulations including those set forth by OSHA, EPA, the County and any other applicable authorities. Prior to conducting any work, perform inspection of structure to determine need for protection against hazardous gases or oxygen-depleted atmosphere and the need for flow control or flow diversion.
 2. Bypass plan: Bypass plan for flow control or bypass shall be submitted to the County for approval prior to conducting the work. Any active flows shall be dammed, plugged, or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated until final applications are cured as recommended by the corrosion protection system manufacturer.
 3. Surface Preparation: NACE 6/SSPC-SP13 "Surface Preparation of Concrete." Dry abrasive blasting, wet abrasive blasting, vacuum-assisted abrasive blasting, and centrifugal shot blasting, high pressure water cleaning (5,000 to 10,000-psig), water jetting (10,000 to 30,000-psig) or combination of methods to remove deteriorated concrete, brick or mortar, laitance, hard contaminants, existing coatings, localized micro-organisms and gas contaminants from the concrete walls, floor, ceiling, and other concrete surfaces and shall display a surface profile suitable for application of the system. Minimum surface profile shall be ICRI CSP-5 or greater. Containment shall be provided to capture spent abrasive material and deteriorated concrete for removal by the Contractor.
 4. Substrate Inspection: After completion of surface preparation, the Contractor shall inspect for: Leaks, Cracks, Holes, Exposed Rebar, Ring and Cover Condition, Invert Condition, Inlet and Outlet Pipe Condition. After the defects in the structure have been identified, repair with a manufacturer approved underlayment or material to assure proper rehabilitation of the surface defect and compatibility with the specialty coating system product to be applied. Repairs to exposed rebar, defective pipe penetrations or inverts, shall be recommended by the specialty coating manufacturer and approved by the County prior to proceeding with the repair. Final preparation and cleaning of repaired surfaces is required prior to application of the coating and shall comply with the corrosion protection system manufacturer's recommendations.
 5. Manufacturer's certification: Applicators, installers, welders and application equipment shall be certified by the manufacturer of the corrosion protection system and documentation shall be provided to the County prior to the work.
 6. Area to be coated: All exposed concrete of the entire interior surface of precast structure including but not limited to benching, pipe penetrations, walls, bottom of top slab, chimney, etc. Flow channel inverts are not necessary to coat. Corrosion protection system shall interface with adjoining construction materials/components throughout the manhole structure to effectively seal and protect substrates from attack by corrosive elements and to ensure the effective elimination of infiltration into the sewer system.

7. Application: Application of specialty coating system shall be in strict accordance with manufacturer's recommendation. Specified surfaces should be shielded to avoid exposure of direct sunlight, other intense heat source or, where cementitious products are employed, excessive ventilation. Where varying surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising. Verification of the corrosion protection system thickness shall be verified during application via wet gauge methods or following cure of the system using appropriate non-destructive or destructive methods.
 8. Holiday Testing: Cure time shall be in accordance with the Manufacturers product data sheet. Final concrete structure corrosion protection system shall be completely free of holidays, pinholes or voids. High voltage Holiday testing shall be required and holidays marked and repaired with same material and to same thickness as required of original installation. All high voltage discontinuity (spark) testing shall be performed using a Tinker & Razor model AP/W Holiday Detector or equal and at 100-125 volts DC per mil or per the manufacturers recommendations.
 9. Destructive Testing: Destructive testing may be performed as directed by the County to verify coating adhesion and coating DFT. Repairs to areas tested by destructive means shall be repaired by the certified applicator at the Contractor's expense.
 10. Reporting: Provide final written report to the County detailing the location, date of report, description of repair or original installation and manufacturer data and cut sheets of the corrosion protection system and applicable testing results as per sections 7, 8 and 9.
 11. Warranty: The report shall contain a copy of the warranty.
- B. System SC-1: Sauereisen Sewergard 210 (Trowelable), 210FS (Trowelable Fast Set), 210S (Sprayable) or 210RS (Rotary Spray) shall be applied and then shall be finished with a coat of Sauereisen Sewergard Glaze 210G. The lining system to be utilized shall be an epoxy mortar or aggregate filled epoxy. Material furnished under this specification shall be a pre-packaged from the manufacturer. Materials shall be trowel applied or sprayed and shall conform to the Manufactures product data sheet as supplied by the manufacturer.
1. Additional Preparation: To ensure a good bond, the newly blasted surface shall be thoroughly vacuumed to remove all sand and debris and surface shall be dry prior to application.
 2. Surfacer for Rehabilitation/repair: Substrate in requiring repairs in excess of 1/8-inch shall be repaired with Sauereisen Underlayment No F-120, F-121 or F-209 Filler prior to application of protective lining/coating corrosion protection system.
 3. Thickness:
 - a. Sewergard 210 / 210FS / 210RS: The material shall be applied in 1 or more layers for a total thickness of minimum of 125-mils DFT (1/8-inch). After application, the material shall be damp rolled with excess water shaken off prior to back rolling.
 - b. Sprayable 210S: The material shall be applied in 1 or more layers for a total thickness of minimum of 60-mils shall be required for the Spray applied 210S.
 4. Finishing Glaze: After application, and curing of either the 210, 210FS, 210RS or 210S, the material shall be coated with a minimum of 20-mils of Sauereisen Sewergard Glaze 210G by roller or spray application in accordance with the manufacturers recommendations.

5. Holiday Testing: The protective lining/coating protection system shall be cured in accordance with the manufacturer's recommendations prior to holiday testing at a minimum of 14,500 volts.

C. System SC-2: Tnemec Perma-Shield Coating System.

1. Additional Preparation: To ensure a good bond, the newly blasted surface shall be thoroughly vacuumed to remove all sand and debris and surface shall be dry prior to application and surface shall be minimum 5°F above the dew point. Moisture content not to exceed 3-pounds per 1,000 square feet in a 24-hour period verify dryness using a "plastic film tape-down test" ASTM D4263 and perform Anhydrous Calcium Chloride ASTM F1869.
2. Surfacer for Rehabilitation/repair: Substrate in requiring repairs in excess of 1/8-inch shall be repaired Series 217 or 218 Filler prior to application of protective lining/coating corrosion protection system. Concrete surface shall be pre-wet or dampened with potable water prior to surfacer application.
3. Thickness: Lining Series 434: The material shall be applied in 1 or more layers for a total thickness of minimum of 125-mils DFT (1/8-inch).
4. Finishing Glaze: After application, and curing, the material shall be coated with 15-20-mils of Series 435 in accordance with the manufacturer's recommendations.
5. Holiday Testing: The protective lining/coating protection system shall be cured in accordance with the manufacturer's recommendations prior to holiday testing at a minimum 14,500 volts.

D. System SC-3: Sewercoat (PG and 2000 HS) Calcium aluminate mortar: The lining system to be utilized shall be 100% calcium aluminate cement with 100% calcium aluminate aggregate. Materials shall be spray applied by either a wet gunning (low-pressure spray) or dry gunning (shotcrete) method and shall conform to the manufacturer's product data sheet as supplied by the manufacturer. The equipment shall be clean and free of any hydrated or un-hydrated Portland Cement.

1. Additional Preparation: To ensure a good bond, the newly blasted surface shall be fully saturated with water prior to application.
2. Thickness: The material shall be applied in 1 or more layers to such total thickness as required. A minimum of 1-inch shall be applied.
3. Finishing: After spraying, the material shall be brushed or trowel finished.
4. Curing: Curing by appropriate methods (curing compound, water mist, etc.) should be implemented as the surface begins to harden and dry (as early as 1-hour after application).

E. System SC-4: Raven 405: System shall be 100% solids epoxy. Thinning with solvents shall not be permitted. Surface preparation, mixing, pot life, ambient conditions, application, film thickness per coat, cure time, and recoat time shall be in accordance the manufacturer's recommendations.

1. Applicator/installer shall be certified by the Manufacturer.
2. Surfacer/Repair: Raven 710, 705CA or Raven 700 shall be spray applied or trowelled to repair/fill minor surface defects or applied as an underlayment.

3. Primer: Concrete exhibiting a moisture vapor emission rate greater than 3-lbs/1,000 square feet/24-hours, when tested according to ASTM F1869, shall be primed with Raven 155. Raven 155 primer (2 component waterborne epoxy) shall be applied at a maximum of 8-mil WFT (3-mil DFT). Recoat window minimum 2-4-hours at 72°F with maximum 72-hours at 72°F.
 4. Top Coat: Raven 405 shall be applied with an approved plural component airless spray system. Coating thickness shall be in relation to the profile of the surface to be coated as recommended by the coating product manufacturer. In all cases the coating shall be applied with minimum of 2 coats applied at 40-80-mils WFT/DFT each for minimum final film thickness at 125-mils DFT. Subsequent top coating or additional coats of the coating product(s) shall occur within the product's recoat window: minimum cure to a tacky state; maximum cure of 18-hrs at 72°F substrate temperature. Additional surface preparation procedures will be required if this recoat window is exceeded including inspection for and removal of amine blush and/or other potential contaminants.
 5. Holiday Testing: The protective lining/coating protection system shall be cured in accordance with the manufacturer's recommendations prior to holiday testing at a minimum of 12,500 volts.
- F. SC-5: Spectrashield Multicomponent Liner System. Spectrashield multi-component stress panel liner system composed of moisture barrier (modified polymer), surfaces (polyurethane/polymeric blend foam) and final barrier coat (modified polymer). The system is applied in three-steps and the applicator/installer shall be certified by the Manufacturer.
1. Application
 - a. Moisture barrier: Silicone Modified Polyurea Minimum 40-mils DFT
 - b. Surfacer: Polyurethane/Polymeric blend foam
 - c. Final corrosion barrier: Silicone Modified Polyurea Minimum 60-mils DFT
 2. Film Thickness: Final installation shall be a minimum of 500-mils. A permanent identification and date of work performed shall be affixed to the structure in a readily visible location.
 3. Holiday Testing: The protective lining/coating protection system shall be cured in accordance with the manufacturer's recommendations prior to holiday testing at a minimum of 50,000 volts.

PART 3 - EXECUTION

3.01 QUALITY ASSURANCE

- A. All materials shall be delivered to the job in original sealed and labeled containers of the coating manufacturer, and shall be subject to inspection by the County. Labels shall show name of manufacturer, type of coating, formulation, date, color and manufacturers recommendations. Coatings manufacturer date shall not exceed the manufacturer's recommendations for storage and useful life and Coatings manufactured in excess of 1-year prior to application shall be rejected.

- B. Oil and grease shall be completely removed in accordance with SSPC-SP1 before beginning any other surface preparation method. Surfaces of welds shall be scraped and ground as necessary to remove all slag and weld spatter.
- C. All components of equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components that will be inaccessible after installation shall have the surfaces prepared and coated before installation.
- D. All ferrous metal surfaces shall be free of all defects and have all sharp edges, welds, slag, defects and weld splatter ground smooth in accordance with NACE Standard RPO178.
- E. Edges, corners, crevices, welds, and bolts shall be given a brush coat (stripe coat) for each coating. The stripe coat shall be applied by a brush and worked in both directions. Special attention shall be given to filling all crevices with coating.
- F. Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be carefully examined and faulty material, poor workmanship, holidays, damaged areas and other imperfections shall be touched up prior to applying succeeding coats. Each coat shall be thoroughly dry and hard before the next coat is applied in accordance with the coating manufacturer's recommendations for drying time between coats. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer. Each coat shall be uniform in coverage and color. Successive coats shall perceptibly vary in color.
- G. Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to holidays, sags, checking, cracking, teardrops, fat edges, fisheyes, or delamination.
- H. Surfaces not required to be coated: Brass, Bronze, Stainless steel (Not including SS bolts and nuts)

3.02 INSPECTION FOR ACCEPTANCE

- A. The quality of materials, the process of manufacture and the finished sections shall be subject to inspection and approval by the County. Such inspection may be made at the place of manufacture, at the site after delivery or at both places and the sections shall be subject to rejection at any time due to failure to meet any of the specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. Sections that have been damaged after delivery will be rejected and if already installed removed and replaced, entirely at the Contractor's expense.

- B. At the time of inspection, the sections will be carefully examined for compliance with the specified ASTM designation and with the approved manufacturer's drawings. Sections shall be inspected for general appearance, dimension, "scratch-strength" blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.
- C. Precast concrete structures shall be inspected by the County and defective materials shall be replaced by the Contractor at the Contractor's expense.
- D. Any repairs made on surfaces shall be holiday detected. Areas found to have holidays shall be marked and repaired in accordance with the coating manufacturer's instructions. The County shall be notified of time of testing so that he might be present to witness testing.

END OF SECTION

SECTION 15064
POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Furnish all labor, materials, equipment and incidentals required and install and test all polyvinyl chloride (PVC) piping, fittings and appurtenances as shown on the Drawings and specified herein.
- B. General Design: The equipment and materials specified herein are intended to be standard types of PVC pipe and ductile iron fittings for use in transporting wastewater, reclaimed water, and water.

1.02 QUALITY ASSURANCE

- A. Qualifications: All of the PVC pipe and ductile iron fittings shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed, installed in accordance with the best practices and methods and shall comply with these specifications as applicable.
- B. Standards:
 - 1. AWWA C900/C905
 - 2. ASTM D1784 / D1785 / D2241 / D2466 / D2564 / D2729 / D2774 / D3034 / D3139 / D3212
 - 3. NSF 14
 - 4. UNI-B-1 through 5
- C. Factory Tests: The manufacturer shall perform the factory tests described in Section 3 - AWWA C900/C905.
- D. Quality Control:
 - 1. The manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with the referenced standards.
 - 2. In addition to the manufacturer's quality control procedures, the County may select an independent testing laboratory to inspect the material at the production facility for compliance with these specifications. The County will pay for the cost of facility inspection requested by the County.

1.03 SHOP DRAWINGS AND SUBMITTALS

- A. Submittals shall be submitted to the County/Professional for review and acceptance prior to construction in accordance with the General Conditions and specifications Section 01300 "Submittals."
- B. Materials and Shop Drawings
- C. Manufacturer's Certification
 - 1. Submit sworn certification of factory tests and their results.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Storage: Delivery and storage of the materials shall be in accordance with the manufacturer's recommendations. PVC pipe shall be covered with black plastic with a minimum thickness of 15-mil. Joint gaskets shall be stored in a clean, dark and dry location until use.
- B. Handling: Care shall be taken in loading, transporting and unloading to prevent damage to the pipe or fittings and their respective coatings. Pipe or fittings shall not be rolled off the carrier or dropped. Pipe shall be unloaded by lifting with a forklift or crane. All pipe or fittings shall be examined before installation and no piece shall be installed which is found to be defective. Pipe shall be handled to prevent damage to the pipe or coating. Accidental damage to pipe or coating shall be repaired to the satisfaction of County or it shall be removed from the job. When not being handled, the pipe shall be supported on timber cradles or on level ground, graded to eliminate all rock points and to provide uniform support along the full pipe length. When being transported, the pipe shall be supported at all times in a manner to prevent distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the County, is damaged beyond repair by the Contractor shall be removed from the site.
- C. The Contractor shall be responsible for all materials furnished and stored until the date of project completion. The Contractor shall replace, at his expense, all materials found to be defective or damaged in handling or storage. The Contractor shall, if requested by the County, furnish certificates, affidavits of compliance, test reports, samples or check analysis for any of the materials specified herein. All pipe delivered to project site for installation is subject to random testing for compliance with the designated specifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material supplied shall be one of the products specified in Appendix D "List of Approved Products" appended to these technical specifications.

2.02 MATERIALS

A. Polyvinyl Chloride (PVC) Pipe

1. Standards: AWWA C900/C905 and ASTM D1784/D3034/F679 (Gravity Sewer)
2. Compounds: Class 12454-A or Class 12454-B
3. PVC Gravity Pipe and Fittings: PVC gravity pipe (6-inch to 15-inch), shall conform to ASTM D3034, maximum SDR 35. PVC gravity pipe (18-inch to 36-inch), shall conform to ASTM F679 and uniform minimum "pipe stiffness" at 5% (percent) deflection shall be 46-psi. The joints shall be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. Applicable UNI Bell Plastic Pipe Association standard is UNI B.
4. PVC Pressure Pipe and Fittings: All PVC pipe of nominal diameter 4 to 12-inches shall be manufactured in accordance with AWWA Standard C900 and greater than 12-inches shall be manufactured in accordance with AWWA Standard C905. The PVC pipe shall have a minimum working pressure rating of 100-psi and shall have a maximum dimension ratio of 18. Pipe shall be the same outside diameter as ductile iron pipe.
5. Dimension Ratio/Thickness: (unless otherwise shown on the Drawings)
 - a. Raw Wastewater:
 - (1) Pressure Systems: DR 18
 - (2) Gravity Systems: DR 35 (ASTM D3034) or PS 46 (ASTM F679)
 - b. Treated Wastewater: DR 18
 - c. Reclaimed Water: DR 18
 - d. Raw Water: DR 18
 - e. Potable Water: DR 18
 - f. Irrigation Piping: Schedule 40 or SDR 21
6. Joints:
 - a. Push-on integral bell elastomeric gasket joints:
 - (1) Standards: ASTM D3212/D3139/F477 and UNI-B-1
 - (2) Gaskets:
 - (a) Potable and Reclaimed Water Service: Styrene Butadiene Rubber (SBR) ring type.
 - (b) Wastewater Service: Neoprene rubber ring type.
 - (3) Pipe Markings: Pipes shall have a manufacturer's home-mark on the spigot. On field cut pipe, the Contractor shall provide home-mark on the spigot in accordance with manufacturer's recommendations.
 - b. Solvent weld (nominal diameter less than 4-inches):
 - (1) Standards: ASTM D2466/D2564
 - (2) Type: Slip Fitting Socket (tapered)
 - (3) Exclusions: Plastic saddle and flange joints will not be used.
 - c. Restrained Joints:
 - (1) Restrained joint devices shall be made specifically for PVC pipe and meet or exceed the requirements in ASTM F-1674.
 - (2) Manufacturers: Uni-flange mechanical joint restraints and bell restraints (for all sizes); Meg-a-lug system as manufactured by EBBA Iron (sizes 12-inches or less), or acceptable equal.
 - (3) Design pressure rating equal to or above test pressure as specified herein.

- d. Pipe Length:
 - (1) Pressure systems: 20-feet maximum nominal length
 - (2) Gravity systems: 13-feet minimum nominal length
- B. Fittings - Pressure Systems (nominal diameter 4-inches and greater):
 - 1. Materials: Ductile iron
 - 2. Joints: Mechanical Joint, Minimum 350-psi pressure rating
 - 3. Gaskets:
 - a. Water and Reclaimed Water Service: Styrene Butadiene Rubber (SBR) ring type
 - b. Wastewater Service: Neoprene rubber ring type
 - 4. Exclusions: Standard double bell couplings will not be acceptable where the pipe will slip completely through the coupling.
 - 5. All fittings shall conform to either ANSI/AWWA C110/A21.10 and/or C153/A21.53, latest revision, and shall be ductile iron.
 - 6. All fittings shall have a date code cast (not printed or labeled), with identification of the date, factory and unit at which it was cast and machined. Fittings shall have distinctly cast on them the pressure rating, nominal diameter of openings, manufacturer's name, the country where cast, and deflection angle. Ductile iron fittings shall have the letters "DI" or "Ductile" cast on them.
 - 7. All potable water main fittings shall have NSF certification and ISO 9001 certification for both the foundry and manufacturer. The NSF 61 certification shall be issued on all coatings and linings, from the said manufacturers that are used for potable water applications.
 - 8. All ductile iron fittings shall have exterior coatings, including markings and colors, and interior linings in conformance with Section 15062 "Ductile Iron Pipe and Fittings."
- C. Fittings - Pressure Systems (nominal diameter less than 4-inches)
 - 1. Material: Polyvinyl Chloride (PVC)
 - 2. Joints: Slip fitting tapered socket with solvent weld
 - 3. Solvent: Sure Guard 12 or acceptable equal
 - 4. Exclusions: Plastic saddle and flange joint fittings shall not be used

2.03 LOCATION MARKERS, LOCATION WIRE AND IDENTIFICATION MARKINGS

- A. Electronic Markers and Locator System (for reclaimed water and wastewater ONLY)
 - 1. Markers: Markers shall consist of a passive device capable of reflecting a specifically designated repulse frequency tuned to the utility (service) being installed. Markers shall be color coded in accordance with the American Public Works Association's "Utility Locating and Coordinating Council Standards." Colors shall be: Wastewater and Reclaimed Water - #1404 Green. Markers shall be full range. Markers shall be installed directly above the centerline of the respective pipeline at intervals not to exceed 100-feet, at each fitting (tees, wyes, crosses, reducers, plugs, caps and bends) or change in horizontal direction and at each valve along the pipeline. Markers shall be hand backfilled to 1-foot above the pad and have a finished depth of burial of not less than 2-feet or more than 6-feet. No separate payment shall be made for furnishing and installing the respective frequency and color-coded electronic pad type marker.

2. Locator System: Marker locator set shall be the 3M Dynatel 1420 or 3M Dynatel 1420E Electronic Marker System Marker Locator, or acceptable equal. The Contractor shall furnish 1 locator set for each type of service piping installed on the Project (i.e.: reclaimed water, wastewater.) to the County. Each unit shall incorporate the following features and accessories:
 - a. Unit(s) shall be tuned to the proper frequency for each type (service) of piping.
 - b. Field strength meter that provides visual indication of the return signal
 - c. Function switch for selection of operation mode
 - d. Sensitivity control to adjust the receiver gain
 - e. Audio speaker for signal response
 - f. Battery access panel containing condensed operating instructions
 - g. Auxiliary headset and heads set jack
 - h. Permanently attached shoulder straps
 - i. Rugged shockproof and weatherproof storage/carrying case
3. Manufacturer: System shall be Scotch Mark Locator System, or acceptable equal.

B. Location Detection Wire

1. Materials: Continuous, insulated 10-gauge copper wire (color to match pipe identification).
2. Installation: Directly above (1-inch maximum) centerline of pipe terminating at top of each valve box collar and be capable of extending 18-inches above top of box (stored inside the 2-inch brass pipe through the valve box collar) in a manner so as not to interfere with valve operation. For direction drilling installations, a minimum of 2 (two) 10-gauge wires shall be pulled along with the pipe.

C. Identification Markings:

1. Pipe furnished in solid color or white with color lettering as indicated below.
 - a. Lettering along top 90° (degrees) of pipe, minimum 3/4-inch in height with appropriate wording appearing 1 or more times every 21-inches along the entire length of the pipeline.
 - (1) Raw Wastewater: Safety Green
 - (2) Reclaimed Water: Purple (Pantone 522C)
 - (3) Potable Water: Safety Blue

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Standards: AWWA C900/C905/UNI-B 3 and 4
- B. Underground Polyvinyl Chloride (PVC) Pipe and Fittings
 1. Bedding: Firm, dry and even bearing of suitable material. Blocking under the pipe will not be permitted.
 2. Placement/Alignment:
 - a. Installation shall be in accordance with lines and grades shown on the Drawings. For pressure systems, deflection of joints shall not exceed 75% of that recommended by the manufacturer.

- b. All pipe and fittings shall be inspected prior to lowering into trench to insure no cracked, broken or otherwise defective materials are being used. All homing marks shall be checked for the proper length so as to not allow a separation or over homing of connected pipe. Homing marks incorrectly marked on pipe shall result in rejection of pipe and removal from site. The Contractor shall clean ends of pipe thoroughly and remove foreign matter and dirt from inside of pipe and keep clean during and after installation.
- c. Proper implements, tools and facilities shall be used for the safe and proper protection of the Work. Pipe shall be lowered into the trench in such a manner as to avoid any physical damage to the pipe. Pipe shall not be dropped or dumped into trenches under any circumstances.
- d. Trench Dewatering and Drainage Control: Contractor shall prevent water from entering trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall not be laid in water.
- e. Pipe Laying in Trench: Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and re-laid. Pigging of pipe may be used to remove foreign materials in lieu of flushing. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the County to ensure absolute cleanliness inside the pipe. The color stripe and pipe text shall be viewed from the top of pipe when installed. When installing PVC pipe, no additional joints will be installed until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.
- f. Locating Wire: Locating wire, for electronically locating pipe after it is buried, or installed by trenchless technology shall be attached along the length of and installed with the pipe. This is applicable to all sizes and types of pressure mains. At a minimum, the tracing wire is to be attached to the pipe with nylon wire ties. The wire itself shall be 10-gauge single strand solid core copper wire with non-metallic insulation. The insulation shall be color coded for the type of pipe being installed. Continuous continuity must be maintained in the wire along the entire length of the pipe run. Permanent splices must be made in the length of the wire using wire connectors approved for underground applications as listed in the uniform electric code handbook. The coiled wire shall extend to a minimum of 12-inches above the surface and be connected to a test station box at valve locations.
- g. PVC Pressure Pipe Installation and Training: PVC pipe shall be installed in accordance with standards set forth in the UNI-BELL "Handbook of PVC Pipe", AWWA C605, and AWWA Manual M-23. The pipe shall be laid by inserting the spigot end into the bell flush with the insertion line or as recommended by the manufacturer. At no time shall the bell spigot end be allowed to go past the "insertion line" or "homing mark" for pressure pipe applications and homing mark shall be visible.

- h. Field Cutting: PVC pipe can be cut with a handsaw or power driven abrasive disc making a square cut. The end shall be beveled with a beveling tool, wood rasp or power sander to the same angle as provided on the factory-finished pipe. The insertion line on the spigot shall be remarked to the same dimensions as the factory-marked spigot.
- i. All Contractor pipe crews utilizing PVC pressure pipe shall be trained on an annual basis by Uni-Bell in coordination with the County and attended by the manufacturer's representative of the respective approved Manufacturers in Appendix D "List of Approved Products." The Uni-Bell PVC training session will consist of proper handling, storage, installation, and compaction as well as County requirements regarding PVC pipe and deflection. Every person handling, installing or backfilling PVC pipe shall not be permitted to install County owned and / or maintained pipe without training.
- j. Approved manufacturers representatives (Appendix D "List of Approved Products"), not present at the hosted Uni-Bell training session or individuals of pipe crews not in attendance shall be trained on every project site. On-site project training shall be for each manufacturer of pipe utilized on-site, per crew and per project. Specifically each crewmember shall be trained on every project by every pipe manufactures representative regardless of previous on-site training. Every person handling, installing or backfilling PVC pipe shall not be permitted to install County owned and / or maintained pipe without training.
- k. PVC Gravity Pipe Installation: Gravity sewer pipe shall be installed to the homing mark, no tolerance. Any noticeable separation shall be removed and reinstalled. The homing mark may be disregarded to meet the maximum of 1-inch separation between bell and spigot requirement. Joints:
 - l. Joint Placement:
 - (1) Push on joints: Pipe shall be laid with the bell ends facing upstream. The gasket shall be inserted and the joint surfaces cleaned and lubricated prior to placement of the pipe. After joining the pipe, a metal feeler shall be used to verify that the gasket is correctly located.
 - (2) Mechanical Joints: Pipe and fittings shall be installed in accordance with the "Notes on Method of Installation" under ANSI A21.11/AWWA C111. The gasket shall be inserted and the joint surfaces cleaned and lubricated with soapy water before tightening the bolts to the specified torque.

C. Thrust Restraint

- 1. Thrust restraint shall be accomplished by the use of mechanical restraining devices unless specifically identified otherwise on the Drawings or herein.
- 2. Length of restrained joints shall be in accordance with the lengths listed in the table as shown on the Drawings.

D. Installation of Pipes on Curves:

- 1. No joint deflection or pipe bending is allowed in PVC pipe. The maximum allowable tolerance in the joint due to variances in installation is 0.75° (degrees) (3-inches per joint per 20-foot stick of pipe). No bending tolerance in the pipe barrel shall be acceptable. Alignment change shall be made only with sleeves and fittings.

3.02 CLEANING AND FIELD TESTING

- A. At the conclusion of the Work, the Contractor shall provide all associated cleaning and field testing as specified in associated sections of these specifications.

END OF SECTION

APPENDIX A

GEOTECHNICAL REPORT

Holden Heights Wastewater Improvements

Dated December, 1996

The attached Geotechnical Engineering Investigation and dewatering ground water sampling was accomplished for the utilization of the Design Engineer during the design phases of this project. The criteria and recommendations stated herein are not to be construed as direction from the Design Engineer to the Contractor and are hereby provided only as general information, furnished as a courtesy to the Contractor.

GEOTECHNICAL INVESTIGATION REPORT
HOLDEN HEIGHTS WASTEWATER IMPROVEMENTS
ORANGE COUNTY, FLORIDA

AEA PROJECT NO. 961027

Antillian Engineering Associates, Inc.
3331 Bartlett Boulevard
Orlando, Florida 32811
(407) 422-1441

December 12, 1996

BFA/WBQ Joint Venture
3655 Maguire Boulevard, Suite 150
Orlando, Florida 32803

Attention: Ron Ferland, P.E.

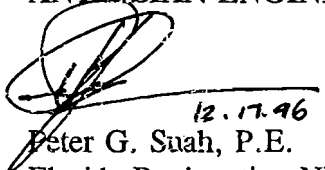
Reference: Geotechnical Investigation Report
Holden Heights Wastewater Improvements
Orange County, Florida
AEA Project No. 961027

Dear Mr. Ferland:

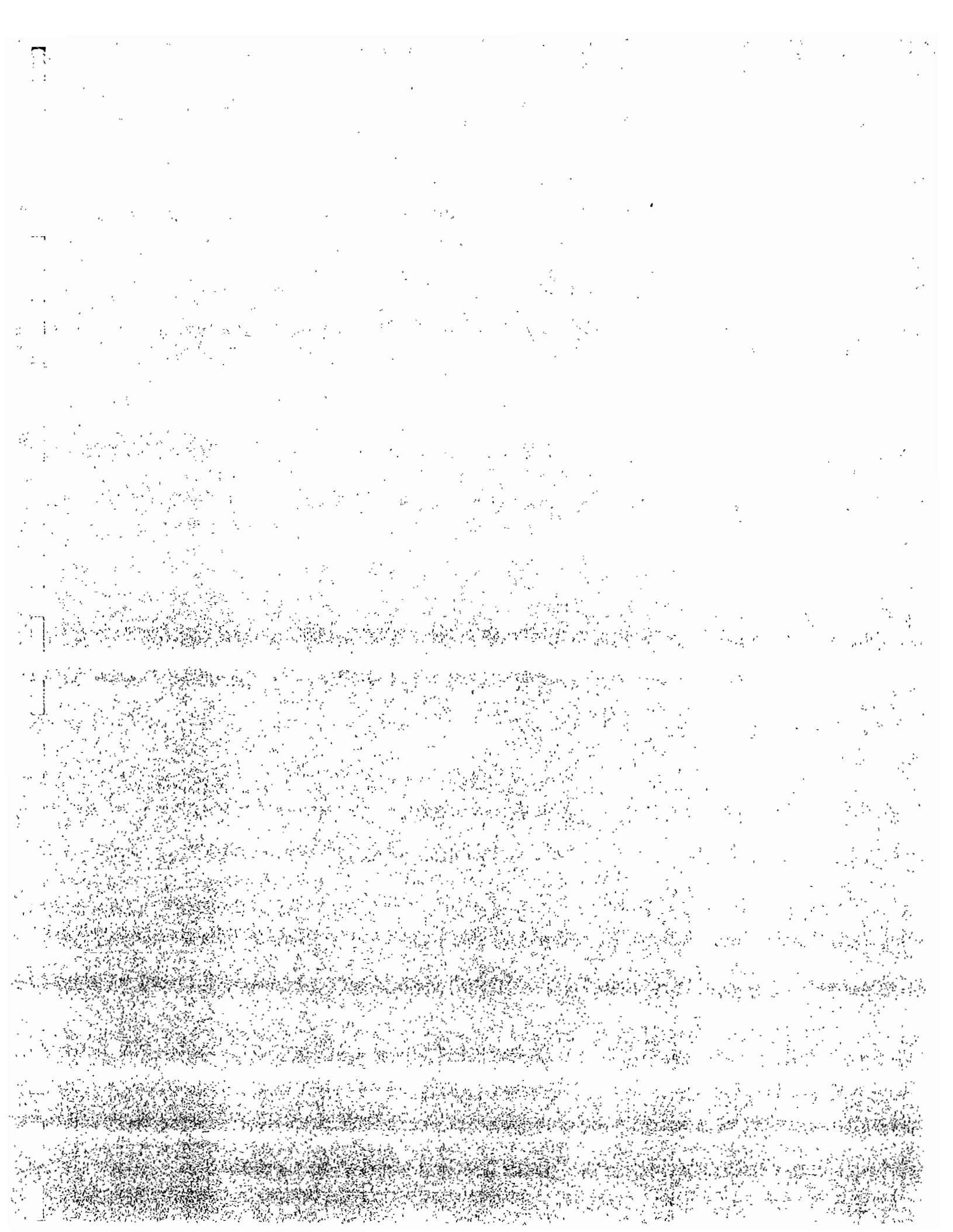
Antillian Engineering Associates, Inc. has completed a geotechnical investigation for the Holden Heights Wastewater Improvements project in Orange County, Florida. The investigation was conducted in accordance with the scope of services presented in our revised proposal dated September 2, 1996. This report contains the results of our investigation, and our recommendations for general earthwork, groundwater control, and other concerns as appropriate.

We appreciate the opportunity to have served you on this project. Please call if you have any questions, or if we may be of further assistance to you as work proceeds.

Very truly yours,
ANTILLIAN ENGINEERING ASSOCIATES, INC.


12.17.96
Peter G. Suah, P.E.
Florida Registration No. 46910
Principal Engineer

Attachments: Figures
Appendix A: Field and Laboratory Investigations
Appendix B: Important Information About Your Geotechnical Engineering Report
Appendix C: Constraints and Restrictions



PROJECT DESCRIPTION

A new wastewater system and other public improvements are planned for the Holden Heights area in central Orange County, Florida. The project area is bounded on the north by Gore Street, on the east by Parramore Avenue, on the south by Interstate Highway 4 (I-4) and on the west by Clear Lake. The total project area is just under two square miles. Civil design and related services for the project are being provided by BFA/WBQ Joint Venture (BFA/WBQ). The sanitary system will consist of collector lines and manholes beneath neighborhood streets, as well as four pump stations with force mains to conduct the wastewater to the existing treatment facilities. Routing of force mains has not yet been finalized. Other improvements planned for later stages of this project include stormwater drains and retention ponds.

AVAILABLE INFORMATION

The United States Geological Survey (USGS) quadrangle topographic map for the area, and the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) Soil Survey for Orange County were reviewed to obtain information about the general vicinity. Conceptual development plans furnished by BFA/WBQ were also examined for more information.

The USGS map depicted the project area as part of a broad plain sloping very gently downwards to the west. A number of low knolls and a few localized depressions and small lakes were also shown within the project area. Ground surface elevations within the project area were shown to range from Elevation 100 NGVD (El.100) to just over El. 110. The map showed a spot at the intersection of Westmoreland Avenue and Grant Avenue at El. 109, and a spot about 3700 feet to the northwest (at the intersection of Rio Grande Avenue and Miller Street at El. 105. The surface of Clear Lake was mapped at El. 92.

The SCS Soils Survey indicated that Lochloosa and Zolfo-Urban soils could be expected over much of the project area. Areas of Millhopper-Urban land complex and Tavares-Urban land complex were mapped on the slightly higher knolls, while Wabasso-Urban soil complex, Basinger fine sand and Hontoon muck were depicted along the shorelines of some of the lakes and in some of the shallow depressions in the terrain.

Urban land consists of soils which have been covered by buildings, asphalt and other impervious surfaces, or otherwise have been modified by grading, to the point that the original soil cannot be identified readily. Urban land complexes are named after the soil unit which was either known or suspected to exist in the locality prior development of the land.

The Lochloosa fine sand and Zolfo fine sand are found on low ridges and knolls on, and adjacent to, the flatwoods. These soils tend to be poorly drained because of the relatively flat slopes, however they are suitable for urban development. Groundwater levels in these soils during the rainy season are reported to be between three and five feet below the ground surface.

Millhopper fine sand and Tavares fine sand are found in the upland areas in central and western Orange County. These soil units are nearly level to gently sloping, and tend to be moderately well drained. They are frequently used for urban development. Groundwater levels in these soils during the rainy season are reported to be between four and seven feet below the ground surface. Wabasso fine sand, Basinger fine sand and Hontoon muck are found on broad flatwoods in Orange County. The latter two soils are found in shallow depressions, freshwater swamps and marshes. They are poorly drained and often submerged for much of the year. For these reasons, these soils are not desirable for urban development, unless site grades are raised by placing fill or the groundwater level is drawn down by artificial means.

REGIONAL GEOLOGY

Orange County is located in the central Florida peninsular zone of the Atlantic Coastal Plain physiographic province. The area is characterized by a series of low ridges running roughly parallel to the existing coastline, and separated by broad plains. In areas of moderate elevation, the plains are referred to as flatwoods, while in the lower areas they would be considered as floodplains, swamps and freshwater marshes.

The geology of the Orange County area can be characterized using three general units or "groups" of sedimentary material. The lowermost unit is a soft, white to cream colored, chalky limestone referred to as the Ocala Group. It is overlain by a layer of interbedded dolomites, clays, sandy clays and clayey sands collectively referred to as the Hawthorn Group. The uppermost unit is a thick stratum (typically more than 40 feet) of undifferentiated sands containing varying amounts of silt. General classification of the near-surface soils is difficult, as their composition at any given location is the result of a complex and often unique combination of depositional and erosional processes. It is not unusual for soil particle gradation, consistency, and color to change significantly within short horizontal and vertical distances.

Central Orange County is located on the Orlando Ridge, a low rise only a few feet higher in elevation than the surrounding flatwoods. The ridge, which is oriented generally in a north-south direction, originates in the general vicinity of Lake Conway. It broadens as it extends northward through downtown Orlando, Winter Park and Maitland into Seminole County. The boundary between the Orlando Ridge and the flatwoods of the Shingle Creek floodplain to the west is mapped just west of US Route 441 (Orange Blossom Trail) for the most part. One notable exception is an area between Kaley Street and State Road 408 (East-West Expressway). Here, the floodplain cuts eastward into the Orlando Ridge, past Interstate Highway 4 (I-4) to the northern end of Lake Holden.

FIELD INVESTIGATION

One hundred forty-one test borings were drilled next to the edge of pavement on the streets where underground sewer lines are planned. The boring locations are shown on Figure 2. The objective of the test borings was to examine the general nature, variability and consistency of the soils and the groundwater conditions at each location. The borings were arranged in 11 groups (designated "A" through "K") using the major north-south streets and other geographic features as a reference.

The borings were advanced by driving split-spoon samplers, and were terminated at a depth of 15 feet each. The Standard Penetration Test (SPT) was conducted in accordance with ASTM D 1586. In some areas, the uppermost four feet of each boring were advanced by hand using a bucket auger, to avoid damage to nearby underground utilities. Wherever possible, the Dynamic Cone Penetrometer (DCP) was used to evaluate soil consistency in the hand augered holes. In most granular soils, DCP penetration resistance values correspond closely with those obtained using the SPT. Testing and sampling were conducted continuously to ten feet, and then at five-foot intervals from ten feet to completion.

The soils encountered during drilling were logged by the field crew. Representative portions of each sample recovered from the split-spoon sampler were sealed in clean, glass jars for transportation to our Orlando office. The depth to groundwater encountered in each boring was measured and recorded on the field logs. At the completion of the drilling program, the borings were backfilled with the drill cuttings.

LABORATORY TESTING

The recovered soil samples were examined in our office by geotechnical engineers who verified the descriptions on the field logs, classified the soils visually and developed a representation of the soil stratigraphy at each boring location. Representative soil samples were selected for laboratory testing which consisted of 225 single-sieve gradation tests. The test results are presented on the boring logs and on the summary sheets in Appendix A.

SURFACE CONDITIONS

The project area is a well-established urban district, consisting mostly of residential and associated commercial properties. Some light industrial operations were observed, and only a few undeveloped parcels of land were noted. Many of the streets and roadways in the area were paved, however very little curb and gutter and few catch basins existed. Most of the streets had open ditches along the sides for stormwater drainage. These ditches, which typically were between two and four feet deep, appeared to be in fair condition for the most part. Standing water was observed in only a few of the ditches.

SUBSURFACE CONDITIONS

Parramore Avenue, 23rd Street to Miller Avenue (Borings A-1 through A-7)

The uppermost material in these borings consisted of a few inches of sandy topsoil, which was underlain by brown to reddish brown and dark brown sand containing varying amounts of silt. The thickness of this material ranged from two to eight feet. SPT N-values in this material ranged from 2 blows per foot (bpf) to 18 bpf, with most less than 10 bpf, indicating a generally very loose to loose consistency. In general, the higher values were observed in the uppermost one to three feet of soil, and are probably indicative of subgrade stabilization for construction of the roadway. The fines content of three samples from this layer ranged from 5 to 12 percent, resulting in the Unified Soil Classification System (USCS) designations of SP, for poorly graded sand, and SP-SM, for sand with silt.

The sand and sand with silt were underlain by sand which appeared to contain more silt. The color of this material ranged from gray and light brown to brown. The encountered thickness in borings A-6 and A-7 was between three and seven feet. In the remaining borings, the overall thickness of the stratum could not be established as the borings were terminated without penetrating it completely. SPT N-values ranged from weight of rods (WOR) to 26 bpf, indicating a variable consistency ranging from very loose to medium dense. The fines content of four samples from this layer ranged from 18 to 25 percent, resulting in the USCS designation of SM, for silty sand.

In borings A-6 and A-7, the silty sand was underlain by gray to brown sand. The thickness of this layer could not be established as both borings were terminated in it. SPT N-values in the sand were 16 bpf and 17 bpf, indicating a generally medium dense consistency. The fines content of a sample from this layer was 4 percent, resulting in the USCS designation of SP, for poorly graded sand.

Groundwater was encountered in the borings at depths between three and seven feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Lee Avenue; 27th Street to Miller Avenue (Borings B-1 through B-11)

The uppermost material in these borings typically consisted of a few inches of sandy topsoil, followed by gray to dark brown sand. In boring B-8, the uppermost soil was orange-brown in color and appeared to contain more silt. Some soil-cement road base was occasionally encountered. The overall thickness of the near-surface layer was between two and seven feet. SPT N-values in the sand were about 6 bpf, indicating a generally loose consistency. Samples of this material were classified visually and given the USCS designation of SP, for poorly graded sand. A sample from boring B-8 had a fines content of 8 percent, resulting in the USCS designation of SP-SM for sand with silt.

The sand was underlain by a layer of sand containing varying amounts of silt. These materials varied in color from light gray to brown. The thickness of these materials could not be established as they extended beyond the boring completion depths. SPT N-values ranged from 2 bpf to 22 bpf, with most between 4 bpf and 12 bpf, indicating a very loose to medium dense consistency. The fines content of 18 samples from this layer ranged from 6 to 29 percent, resulting in the USCS designations of SP-SM, for sand with silt and SM, for silty sand.

A layer of organic material was encountered in boring B-8, at a depth of about five feet below the existing ground surface. The thickness of this material was about three feet. SPT N-values of 1 bpf and 4 bpf were recorded in this layer, indicating a very loose or very soft consistency. Samples of this material were classified visually and given the USCS designation Pt, for peat.

Groundwater was encountered in the borings at depths between three feet and ten feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Westmoreland Drive; 28th Street to Indiana Avenue (Borings C-1 to C-13)

The uppermost material in these borings (except boring C-12) consisted of a few inches of sandy topsoil underlain by light brown and gray to reddish brown sand which contained varying amounts of silt. The encountered thickness of this material ranged from two to about nine feet, except in boring C-9, where the material extended below the completion depth of the boring. SPT N-values in this material ranged from 4 bpf to 12 bpf, with most greater than 5 bpf, indicating a generally loose to medium dense consistency. In general, the higher values were observed in the uppermost two feet of soil. This higher resistance is probably due to compaction of the roadway subgrade during construction. The fines content of three samples from this layer ranged from 5 to 11 percent, resulting in the USCS designation of SP-SM, for sand with silt.

The sand with silt was underlain by a layer of sand containing more silt. This soil was uppermost in boring C-12. The color of this layer ranged from light brown to gray and brown. The thickness of this layer was between three and 15 feet. In borings C-1, C-2, C-5, C-6 and C-9, the thickness of the layer could not be established, as it extended below the completion depth of these borings. SPT N-values ranged from WOR to 33 bpf, indicating a highly variable

consistency ranging from very loose to dense. The fines content of 13 samples from this layer ranged from 15 to 31 percent, resulting in the USCS designations of SM, for silty sand.

In borings C-3, C-4, C-8, C-10, C-11 and C-13, the silty sand was underlain by light gray to grayish brown sand. The thickness of the sand could not be established, as these borings were terminated without completely penetrating it. SPT N-values in the sand were 2 bpf and 30 bpf, indicating a highly variable consistency ranging from very loose to dense. The fines content of three samples of this soil ranged from 5 to 8 percent, resulting in the USCS designation of SP-SM, for sand with silt.

Groundwater was encountered in the borings at depths between four and seven feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Woods Street; Miller Avenue to 29th Street (Borings D-1 through D-12)

The uppermost material beneath the sandy topsoil in these borings typically was a grayish brown to brown sand containing some silt. The thickness of this layer varied from two to 15 feet. SPT N-values in the sand ranged from 1 bpf to 14 bpf, indicating a very loose to medium dense consistency. The fines content of three samples from this layer ranged from 10 percent to 11 percent, resulting in the USCS designation of SP-SM for sand with silt.

In boring D-1, the surficial sand with silt was underlain by organic materials. This layer was encountered at a depth of about three feet below the existing ground surface, and it was about two feet thick. The single SPT value in this material was 4 bpf, indicating a very loose or soft consistency. Based on visual classification of the sample obtained from this layer, the organic soil was given the USCS designation Pt, for peat.

The sand with silt was underlain by sand which appeared to contain more silt. These materials varied in color from pale brown and orange brown to gray. In most of the borings, the thickness of this stratum could not be established, as it extended below the boring completion depths. SPT N-values ranged from 1 bpf to 22 bpf, with most less than 11 bpf indicating a very loose to loose consistency. The fines content of nine samples of this material ranged from 18 percent to 25 percent, resulting in the USCS designation of SM, for silty sand.

In boring D-3, the silty sand was underlain by light gray sand. The thickness of this material could not be established, as it extended below the termination depth of the boring. The SPT N-value in the sand was 10 bpf, indicating a generally loose consistency. The fines content of a sample from this stratum was 4 percent, resulting in the USCS designation SP, for poorly graded sand.

Groundwater was encountered in the borings at depths between three feet and seven feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Orange Blossom Trail; Grand Avenue to 30th Street (Borings E-1 to E-28)

The uppermost material in these borings consisted of a few inches of sandy topsoil underlain by light brown and gray to dark brown sand containing varying amounts of silt. In borings E-2, E-11, E-13, E-15, E-16, E-19, E-21 and E-27, the uppermost materials contained more silt than in the other borings. The thickness of this material ranged from three to 15 feet. SPT N-values in this material ranged from WOR to 53 bpf, with most less than 11 bpf, indicating a generally loose consistency. In general, the higher N-values were observed in the uppermost two feet of soil which were most likely compacted during roadway construction. High N-values were also recorded in the partially cemented soils which occasionally were encountered. The fines content of 14 samples from this layer ranged from 4 to 12 percent, resulting in the USCS designations of SP, for poorly graded sand, and SP-SM, for sand with silt.

The sand and sand with silt were underlain by a layer of sand containing more silt. The color of this layer ranged from light brown to dark gray and dark brown. These soils were uppermost in borings E-2, E-11, E-13, E-15, E-16, E-19, E-21 and E-27. The thickness of this layer ranged from three to 15 feet. In the latter case, the actual thickness of the layer could not be established, as it extended below the completion depth of the borings. SPT N-values ranged from 1 bpf to 120 bpf, indicating a highly variable consistency ranging from very loose to very dense. The higher N-values generally were encountered in cemented soils in borings E-1 through E-5, E-8, E-17, E-20 and E-28. The fines content of 23 samples from this layer ranged from 13 to 30 percent, resulting in the USCS designation of SM, for silty sand.

In borings E-2, E-8, E-9, E-16, E-20, E-24 and E-26, the silty sand was underlain by gray to brown sand. The thickness of the sand could not be established, as these borings were terminated without completely penetrating it. SPT N-values in the sand were 16 bpf and 17 bpf, indicating a generally medium dense consistency. The fines content of three samples of this soil ranged from 4 to 11 percent, resulting in the USCS designations of SP, for poorly graded sand, and SP-SM, for sand with silt.

Groundwater was encountered in the borings at depths between three feet and eight feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Nashville Avenue; Miller Avenue to Roscoe Road (Borings F-1 to F-14)

The uppermost material in these borings consisted of a few inches of sandy topsoil underlain by brown to dark gray brown sand containing varying amounts of silt. The thickness of this material ranged from two to seven feet. SPT N-values in this material ranged from 1 bpf to 6 bpf, with most less than 11 bpf, indicating a generally loose consistency. Although not measured, higher N-values can be expected in the uppermost two feet of soil, which were most likely compacted during roadway construction. The fines content of three samples from this layer ranged from 5 to 12 percent, resulting in the USCS designation of SP-SM, for sand with silt.

The sand with silt was underlain by a layer of sand containing more silt. The color of this layer ranged from light gray to reddish brown and dark brown. The thickness of this layer as encountered in borings F-4 and F-5 ranged from less than two to 15 feet. In the latter case, and in the remaining borings, the actual thickness of the layer could not be established, as it extended below the boring completion depth. SPT N-values ranged from WOR to 26 bpf, indicating a consistency ranging from very loose to medium dense. The fines content of 13 samples from this layer ranged from 13 to 33 percent, resulting in the USCS designation of SM, for silty sand.

In borings F-4 and F-5, the silty sand was underlain by brown to dark brown sand. The thickness of the sand could not be established, as these borings were terminated without completely penetrating it. SPT N-values in the sand ranged from 9 bpf to 21 bpf, indicating a generally medium dense consistency. The fines content of two samples of this soil ranged from 4 to 11 percent, resulting in the USCS designation of SP-SM, for sand with silt.

Groundwater was encountered in the borings at depths between three and nine feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Rio Grande Avenue; L.B. McLeod Road to Monte Carlo Trail (Borings G-1 to G-20)

The uppermost material in these borings (except G-14 and G-15) consisted of a few inches of sandy topsoil underlain by light brown and grayish brown to brown sand containing some silt. The thickness of this material ranged from three to 15 feet, as encountered in boring G-13. SPT N-values in this material ranged from 2 bpf to 50 bpf, with most less than 10 bpf, indicating a generally loose consistency. Higher N-values were recorded in the uppermost two feet of soil, which were most likely compacted during roadway construction. The fines content of nine samples from this layer ranged from 3 to 12 percent, resulting in the USCS designations of SP, for poorly graded sand, and SP-SM, for sand with silt.

The sand with silt was underlain by a layer of sand containing more silt. The color of this layer ranged from grayish brown and orange brown to dark brown. The thickness of this layer as encountered in borings G-1, G-5, G-7, G-8, G-16 and G-19 ranged from five to nine feet. In the remaining borings, the actual thickness of the layer could not be established, as it extended below the completion depth of the borings. SPT N-values ranged from 1 bpf to 42 bpf, indicating a highly variable consistency ranging from very loose to dense. The fines content of 16 samples from this layer ranged from 14 to 26 percent, resulting in the USCS designation of SM, for silty sand.

In borings G-1, G-5, G-7, G-8, G-16 and G-19, the silty sand was underlain by light grayish brown to brown sand. The thickness of the sand could not be established, as these borings were terminated without completely penetrating it. SPT N-values in the sand ranged from 10 bpf to 27 bpf, indicating a generally medium dense consistency. The fines content of two samples of this soil ranged from 8 percent to 9 percent, resulting in the USCS designation of SP-SM, for sand with silt.

Groundwater was encountered in the borings at depths between three and seven feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Rio Lane; 24th Street to 29th Street (Borings H-1 to H-7)

The uppermost material in borings H-1 through H-5 consisted of a few inches of sandy topsoil underlain by light grayish brown to dark brown sand containing some silt. The thickness of this material ranged from four to seven feet. SPT N-values in this material ranged from 2 bpf to 6 bpf, indicating a very loose to loose consistency. The fines content of two samples from this layer ranged from 5 percent to 6 percent, resulting in the USCS designation of SP-SM, for sand with silt.

The sand with silt in borings H-1 through H-5 was underlain by a layer of sand containing more silt. The color of this layer ranged from very light gray and pale gray to gray. The thickness of this layer as encountered in borings H-1 through H-3 ranged from four to ten feet. In borings H-4 and H-5, the actual thickness of the layer could not be established, as it extended below the completion depth of the borings. SPT N-values ranged from 4 bpf to 16 bpf, indicating a variable consistency ranging from very loose to medium dense. The fines content of four samples from this layer ranged from 16 percent to 30 percent, resulting in the USCS designation of SM, for silty sand.

In borings H-1 through H-3, the silty sand was underlain by light gray to light brown sand. The thickness of the sand could not be established, as these borings were terminated without completely penetrating it. SPT N-values in the sand ranged from 5 bpf to 10 bpf, indicating a generally loose consistency. The fines content of a sample of this soil was 4 percent, resulting in the USCS designation of SP, for poorly graded sand.

In borings H-6 and H-7, the uppermost material consisted of a few inches of sandy topsoil underlain by brown to dark brown and dark reddish brown sand containing silt. This material extended below the completion depth of the borings, so its thickness could not be established. SPT N-values in this material ranged from 4 bpf to 64 bpf, indicating a highly variable consistency ranging from very loose to very dense. The fines content of three samples from this layer ranged from 13 percent to 23 percent, resulting in the USCS designation of SM, for silty sand.

Groundwater was encountered in the borings at depths between five feet and six feet below the existing ground surface. It could not be measured in borings H-6 and H-7. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Clear Cove Lane, 29th Street to Telstar Avenue (Borings I-1 through I-4)

The uppermost material in these borings consisted of a few inches of sandy topsoil underlain by light grayish brown to dark gray sand containing some silt. The thickness of this layer ranged from two to seven feet. SPT N-values in this material ranged from 6 bpf to 18 bpf, with most less than 10 bpf indicating a generally loose consistency. The fines content of a sample of this soil was found to be 5 percent, resulting in a USCS designation of SP-SM, for sand with silt.

The sand with silt was underlain by light gray to gray and orange sand which appeared to have more silt. The thickness of this layer could not be established since all four borings terminated in this material. SPT N-values in this material ranged from 1 bpf to 11 bpf, with most ranging from 7 bpf to 11 bpf indicating a generally loose consistency. The fines content of three samples of this material ranged from 20 to 27 percent, resulting in a USCS designation of SM, for silty sand.

Groundwater was encountered in the borings at depths between three and five feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Mid-block between Rio Lane & Rio Grande Ave; 23rd St to 29th St (Borings J-1 to J-8)

The uppermost material in these borings consisted of a few inches of sandy topsoil underlain by light brown to reddish brown and dark brown sand containing some silt. This material was also slightly cemented in boring J-1. The thickness of this material ranged from two to nine feet. SPT N-values in this material ranged from 2 bpf to 16 bpf, indicating a very loose to medium dense consistency. The fines content of four samples from this layer ranged from 7 to 10 percent, resulting in the USCS designation of SP-SM, for sand with silt.

The sand with silt was underlain by a layer of sand containing more silt. The color of this layer ranged from light brown to dark reddish brown and dark brown. This material was also slightly cemented in borings J-2 and J-3. The thickness of this layer as encountered in the borings ranged from three to seven feet. The actual thickness of the layer could not be established, as it extended below the completion depth of the borings. SPT N-values ranged from 2 bpf to 88 bpf, indicating a highly variable consistency ranging from very loose to very dense. The fines content of four samples from this layer ranged from 14 to 27 percent, resulting in the USCS designation of SM, for silty sand.

Groundwater was encountered in the borings at depths between three and four feet below the existing ground surface. Groundwater levels could not be measured in borings J-1, J-4 and J-5. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

Northern Project Area; (Borings K-1 to K-18)

The uppermost material in these borings consisted of a few inches of sandy topsoil followed by light brown and grayish brown to dark brown sand containing some silt. The thickness of this material ranged from two to seven feet, except in borings K-11 and K-18, where these soils extended below the completion depth of the borings. SPT N-values in this material ranged from 1 bpf to 22 bpf, indicating a variable consistency ranging from very loose to medium dense. The fines content of eight samples from this layer ranged from 5 to 12 percent, resulting in the USCS designation of SP-SM, for sand with silt.

The sand with silt generally was underlain by sand containing more silt. The color of this material ranged from light gray to dark reddish brown and dark brown. This material was cemented in borings K-5, K-6, K-8 and K-9. The thickness of this stratum could not be established, as it extended below the completion depth of the borings. SPT N-values ranged from WOR to 62 bpf, indicating a highly variable consistency ranging from very loose to very dense. The fines content of 17 samples from this layer ranged from 13 to 37 percent, resulting in the USCS designation of SM, for silty sand.

Groundwater was encountered in these borings at depths between three and nine feet below the existing ground surface. The encountered groundwater levels, as well as details of the subsurface characteristics at each boring location are shown on the boring logs in Appendix A.

RECOMMENDATIONS

GENERAL

The following recommendations are based upon a review of the field and laboratory test data, our understanding of the proposed improvements, and our experience with similar projects and subsurface conditions. If plans for the proposed improvements change from those discussed, we request the opportunity to review these changes and possibly amend our recommendations to accommodate them. In addition, if subsurface conditions encountered during construction differ significantly from those encountered in the borings, those conditions should be reported to us immediately for our observation and recommendations.

EARTHWORK

In general, typical construction equipment should be able to excavate the soils along the proposed utility alignments without difficulty. However, localized areas of dense and/or cemented sands were encountered during this investigation, so these soils should be anticipated. The contractor should be prepared to deal with more difficult excavation conditions should they be encountered during construction.

Grass and other vegetation, roots, and topsoil within the limits of the proposed construction should be removed or "stripped" to a depth of not less than one foot below the existing ground surface. The depth of clearing and grubbing may have to be increased in heavily vegetated areas where large root systems are likely. The stripped material may be stockpiled for use in the future as landscaping material, if needed. Any organic materials beneath the surficial materials should also be removed, and stockpiled or discarded.

Trenches should be excavated to the required depth and to sufficient width to provide adequate working room for proper installation of the pipe and any excavation support. This work should be supervised by a suitably qualified member of the contractor's staff, who should ensure that the trench is not being overexcavated unnecessarily. The supervisor should also check for zones of especially loose or soft soils which were not encountered in the test borings. All below-grade construction activity should be conducted in accordance with the recommendations for groundwater control and excavation safety presented later in this report.

Pipe should be bedded in firm, stable material. If very loose or soft soils are encountered, they should be undercut and replaced with suitable fill, or otherwise treated as recommended by the engineer or the owner's on-site representative. In those areas where the soils are particularly soft or wet and groundwater control proves to be difficult, crushed reclaimed concrete may be placed in the bottom of the trench to serve as a bedding material. The aggregate particle size corresponding to No. 57 stone should be adequate.

Backfill material should be placed as required. It should consist of relatively "clean" fine sand (containing less than 12 percent soil fines). Materials with a greater percentage of soil fines may

be used, however more stringent moisture control may be required in order to achieve satisfactory compaction in an efficient manner.

Backfill material should be free from mud, muck, stumps, roots and other vegetable matter, debris, rubbish or other materials which might decompose or otherwise cause settlement. Fill should be placed in level, uniform lifts approximately one foot in loose thickness. It should be placed on both sides of the pipe simultaneously until the crown of the pipe is covered. Heavy construction equipment should not be routed over the pipe until a minimum of two feet of cover is in place and properly compacted over the crown.

Each lift of trench backfill should be compacted using a medium weight vibrating roller or plate tamper, to achieve a minimum dry density not less than 95 percent of the maximum dry density obtained in the laboratory by the Modified Proctor method (ASTM D-1557). Backfill should be tested for adequate compaction at a frequency of not less than one test per lift per 300 feet of pipeline or per run of pipe between manholes, whichever yields the greater number of tests. Backfill around manholes should be tested at a frequency of one test per vertical foot.

We do not anticipate that using vibratory compaction equipment on this project will affect adjacent structures. However, if any disturbance, degradation of compacted surfaces or other undesirable effects are noted on more than an isolated or random basis, vibratory compaction should be halted immediately, and the Antillian Engineering Associates, Inc. office notified without delay. If necessary, the recommended compaction procedures will be modified so that satisfactory compaction can still be achieved.

We anticipate that off-site material may be required for use as structural backfill, as some of the materials encountered in the borings had fines contents in excess of 12 percent. In addition, the high groundwater levels indicated that excavated materials may be too wet for immediate re-use as backfill. Dewatering in preparation for excavation may reduce in-situ water contents to more acceptable levels. If this is not sufficient, the excavated soils may be stockpiled to drain, spread to dry, or blended with drier materials to achieve a suitable moisture condition.

GROUNDWATER CONTROL

Based upon our review of USGS data and our experience with regional hydrogeology, our best estimate for the seasonal high groundwater level would be about one foot below the existing ground surface. The actual level expected at each boring location is shown on the boring logs in Appendix A. We recommend that all below-grade construction activity be planned assuming seasonal high groundwater conditions.

During below-grade construction activity, the groundwater level should be maintained at least two feet below the bottom of trenches or other excavations. To prevent any instability of the excavations or unnecessary degradation of the trench bottoms, the groundwater should be drawn down before starting the trench excavation. Dewatering should be maintained in operation until the pipe has been placed and backfilled in a satisfactory manner. Water from dewatering pumps

should be discharged as far as practically possible away from the work area, to prevent return flow or erosion near the excavations. The contractor should also have small submersible pumps ready on site to intercept and remove any small, localized inflows. The ground surface around excavations should be graded to minimize the inflow of surface runoff.

The contract documents should require the contractor to verify the groundwater level before starting construction. The contractor should also be responsible for all dewatering, regardless of the groundwater level. The importance of proper groundwater control cannot be over-emphasized.

EXCAVATION SAFETY

As discussed earlier, some trench excavations may be as much as 15 feet deep, and the excavation for the lift station is expected to significantly deeper. As a result, the sides of these excavations must be supported to withstand the lateral forces exerted by the existing soils, possible hydrostatic pressures and surcharge loads. For calculating the lateral loads due to the site soils, we recommend a soil unit weight of 120 pounds per cubic foot (pcf) and a lateral earth pressure coefficient of 0.4. The same coefficient should be applied to loads acting on the ground surface due to construction equipment and other vehicular traffic in the vicinity of the excavations. For purposes of the excavation support design, we recommend representing these traffic loads by a uniformly distributed surcharge of 200 pounds per square foot (psf).

It is expected that the excavation will be kept dry so that work can proceed safely and efficiently. As indicated in the previous section, the groundwater level should be maintained at least two feet below the bottom of any excavations for the duration of below-grade construction activity. However, the possibility does exist that the dewatering system could fail, allowing the groundwater to return to the pre-construction level and fill the excavation. Subsequent rapid removal of the water by pumping out the excavation to resume work could create a "rapid drawdown" condition. Under these circumstances, the hydrostatic pressure in the soil outside the excavation would be at a maximum, and would reduce the soil strength to its minimum. This condition should be analyzed using the anticipated seasonal high groundwater level.

Once the excavation support system design has been finalized, we request the opportunity to review the soil parameters, resulting lateral pressure distributions and stability analyses before the final construction drawings are prepared.

CONSTRUCTION-RELATED SERVICES

A geotechnical engineering firm should be retained during foundation construction to monitor the subsurface conditions and verify that they are consistent with the findings of this investigation. This firm should also conduct the recommended soil testing and related quality assurance functions. Antillian Engineering Associates, Inc. would be pleased to present a proposal to provide these services.

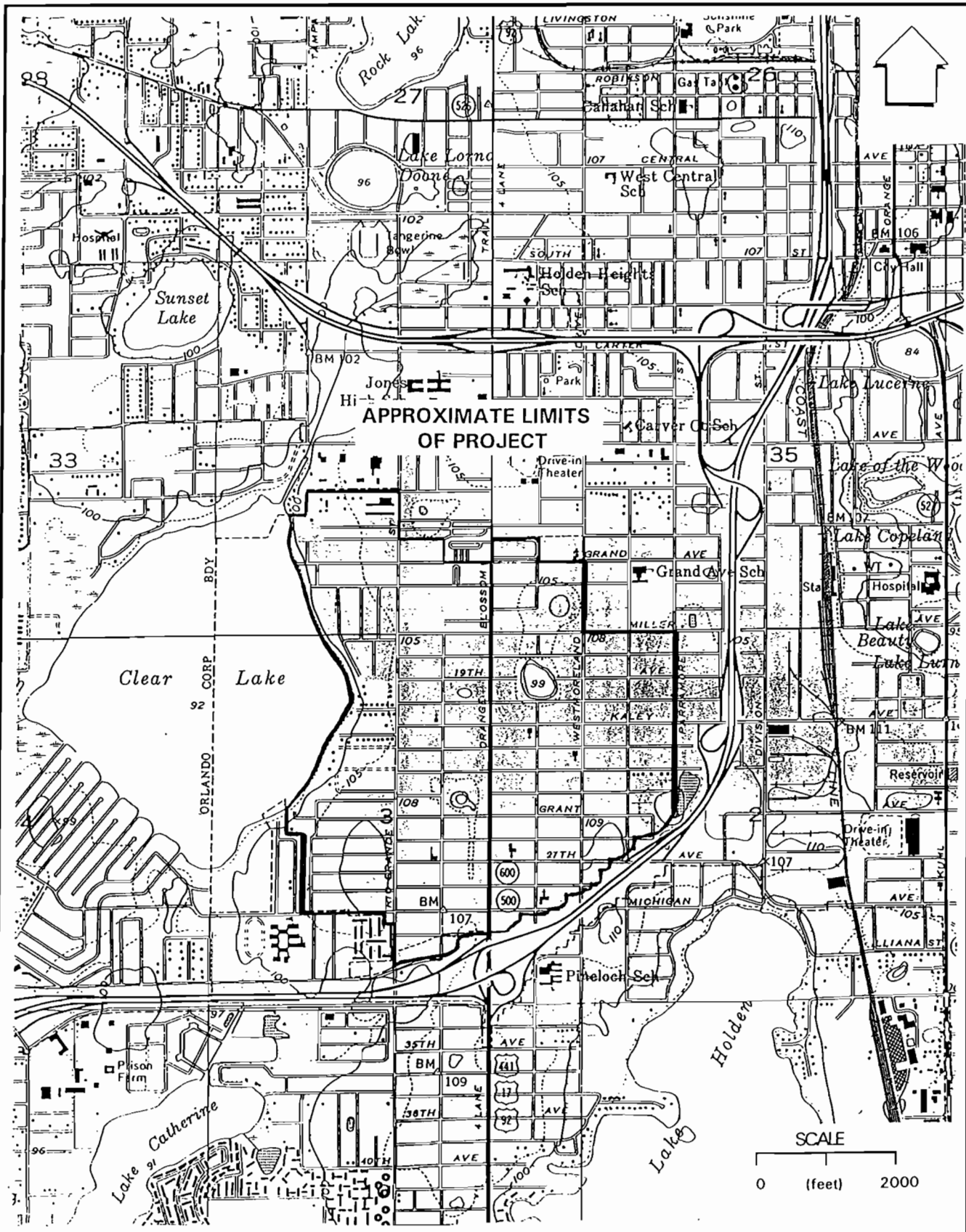
LIMITATIONS

This report presents an evaluation of the subsurface conditions on the basis of accepted geotechnical procedures for site characterization. The recovered soil samples were not examined or tested in any way for chemical composition or environmental hazards.

The investigation was confined to the zone of soil which is likely to be affected by the proposed construction, and did not address the potential of surface expression of deep geologic activity such as sinkholes. This type of evaluation requires a more extensive range of field services than those performed for this study.

Because of the natural limitations inherent in working with the subsurface, it is not possible for a geotechnical engineer to predict and address all possible problems. During the early stages of most construction projects, geotechnical issues not addressed in this report may arise. The bulletin "Important Information About Your Geotechnical Engineering Report" published by the Association of Engineering Firms Practicing in the Geosciences (ASFE) appears in Appendix B. This document will help explain the nature of geotechnical issues. Additional documents in Appendix C to bring to your attention the potential concerns and the basic limitations of a typical geotechnical report.

FIGURES



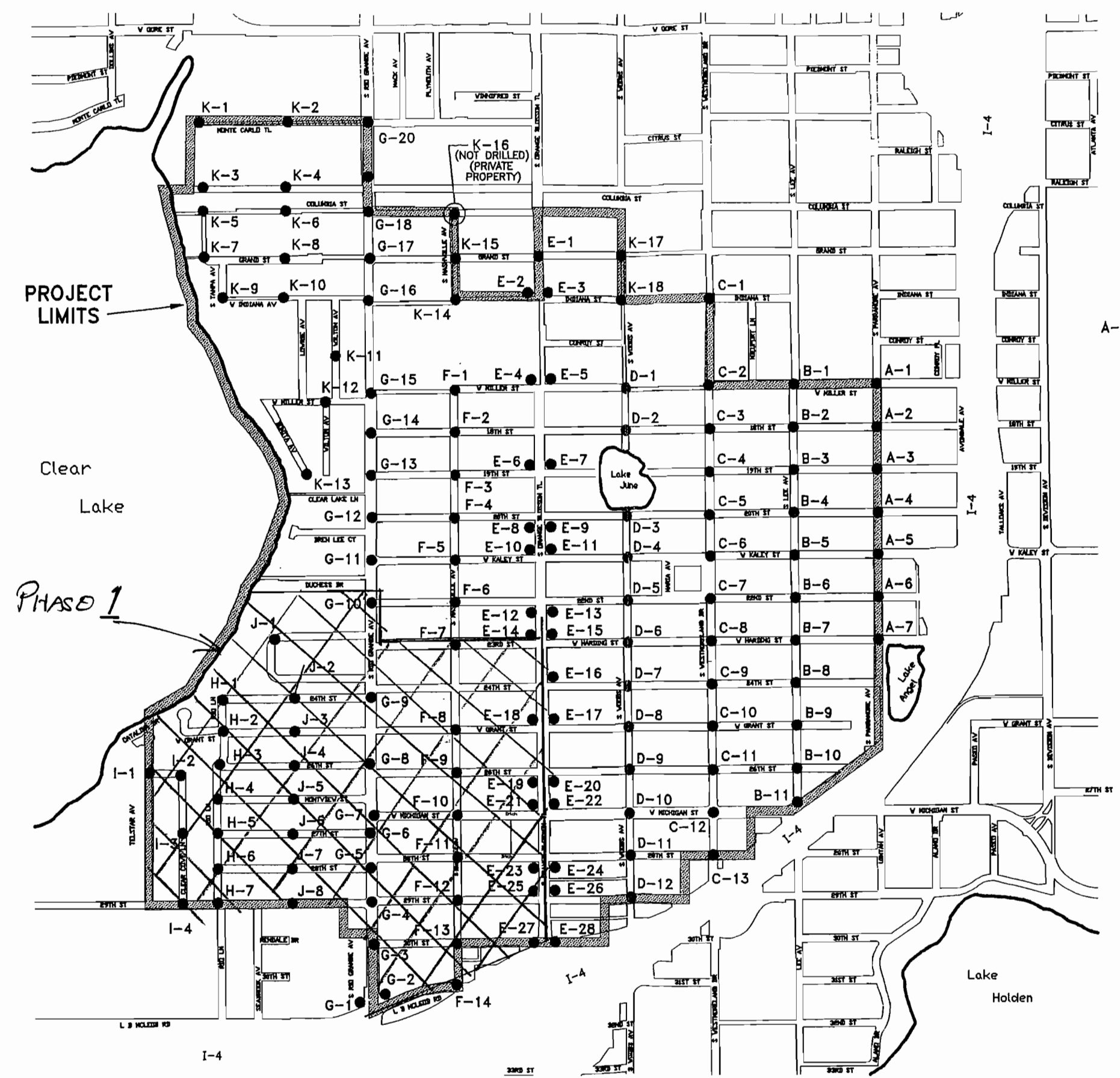
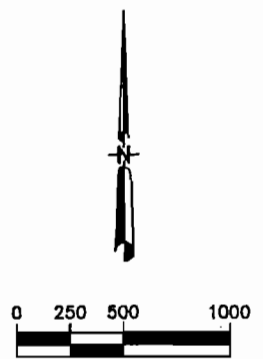
Developed from USGS Quadrangle Map "Orlando West, Florida" photorevised 1980

SITE LOCATION MAP

961027

HOLDEN HEIGHTS WASTEWATER IMPROVEMENTS

FIG. 1



LEGEND

A-1 ● APPROXIMATE LOCATION OF SOIL BORING

FOR:	
DRAWN BY: KS	DATE: 12-12-96
CHECKED BY: PS	DATE: 12-12-96
REPORT NO:	SCALE: NOTED
PROJECT NO: 96-1027	

HOLDEN HEIGHTS UTILITY IMPROVEMENTS
ORANGE COUNTY, FLORIDA

BORING LOCATION PLAN

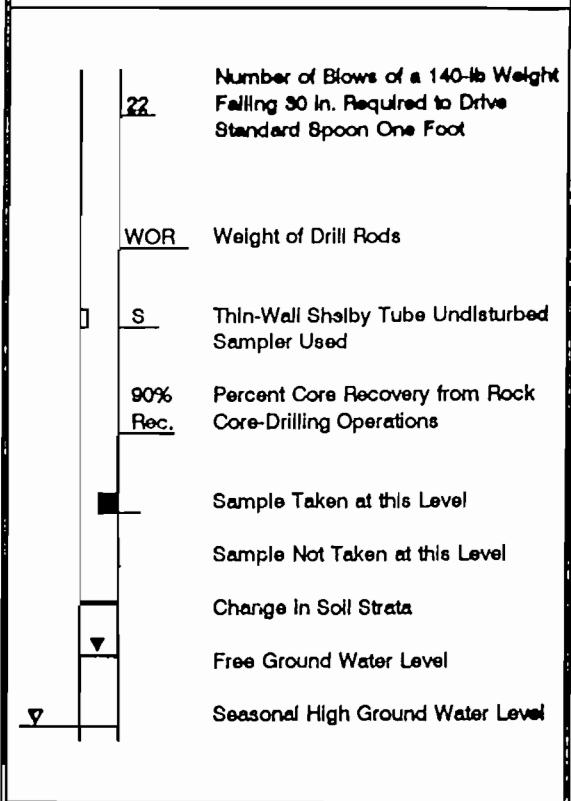


1/20/97

APPENDIX A



SYMBOLS



UNIFIED CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 80% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW Well-graded gravels and gravel-sand mixtures, little or no fines
			GP Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM Silty gravels, gravel-sand-silt mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	GC Clayey gravels, gravel-sand-clay mixtures
			SW Well-graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SP Poorly graded sands and gravelly sands, little or no fines
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less	SC	SM Silty sands, sand-silt mixtures
			SO Clayey sands, sand-clay mixtures
		ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	
	SILTS AND CLAYS Liquid limit greater than 50%	CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		OL Organic silts and organic silty clays of low plasticity	
		MH Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
Highly Organic Soils	CH Inorganic clays of high plasticity, fat clays		
	OH Organic clays of medium to high plasticity		
	PT Peat, muck and other highly organic soils		

* Based on the material passing the 3-in. (75-mm) sieve.

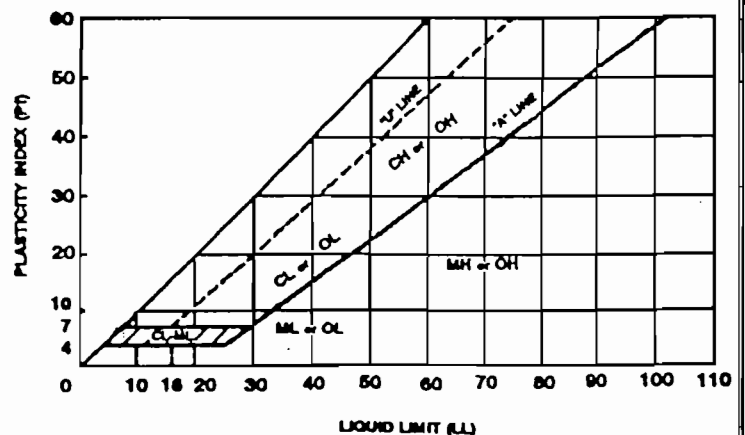
**RELATIVE DENSITY
(sand-silt)**

- Very Loose - Less Than 4 Blows/Ft.
- Loose - 4 - 10 Blows/Ft.
- Medium - 10 to 30 Blows/Ft.
- Dense - 30 to 50 Blows/Ft.
- Very Dense - More Than 50 Blows/Ft.

**CONSISTENCY
(clay)**

- Very Soft - Less Than 2 Blows/Ft.
- Soft - 2 to 4 Blows/Ft.
- Medium - 4 to 8 Blows/Ft.
- Stiff - 8 to 15 Blows/Ft.
- Very Stiff - 15 to 30 Blows/Ft.
- Hard - More Than 30 Blows/Ft.

PLASTICITY CHART





LOG OF BORING C-5

SHEET 1 OF 1

PROJECT NO: 961027
 PROJECT: Holden Heights Wastewater Improvements
 DATE: 11/19/96
 LOCATION: Orange County, Florida

SURFACE ELEVATION: Unknown
 DEPTH TO G.W.T: 5.0
 COMPLETION DEPTH: 15.0
 DRILLING METHOD: Split Spoon Sampler

DEPTH, ft.	SAMPLES	SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	k _v (ft/day)
0				Topsoil, medium dense, brown to dark brown, SAND with silt							
	12		DCP								
	7		DCP	- loose, light brown							
	12		DCP	- medium dense							
	10		DCP								
	12		SS	- light grayish-brown							
5											
	5		SS	- loose							
				- light brown							
	5		SS								
				Loose, dark brown, silty SAND (SM)	7.5						
	2		SS	- very loose, dark brown			21				
10											
	11		SS	- medium dense, grayish-brown							
15					15.0						



LOG OF BORING D-2

SHEET 1 OF 1

PROJECT NO: 961027
 PROJECT: Holden Heights Wastewater Improvements
 DATE: 11/19/96
 LOCATION: Orange County, Florida

SURFACE ELEVATION: Unknown
 DEPTH TO G.W.T: 6.0
 COMPLETION DEPTH: 15.0
 DRILLING METHOD: Split Spoon Sampler

DEPTH, ft.	SAMPLES SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	k _v (ft/day)
0			Topsoil, then, grayish-brown, SAND with silt							
			Light brown, silty SAND (SM)	2.0						
4	4	SS	- very loose, dark brown, with organics			37				
5	1	SS	- very loose, light brown, silty SAND							
	5	SS								
	3	SS				22				
10										
	6	SS	- loose							
15				15.0						



LOG OF BORING D-3

SHEET 1 OF 1

PROJECT NO: 961027
 PROJECT: Holden Heights Wastewater Improvements
 DATE: 11/19/96
 LOCATION: Orange County, Florida

SURFACE ELEVATION: Unknown
 DEPTH TO G.W.T: 5.0
 COMPLETION DEPTH: 15.0
 DRILLING METHOD: Split Spoon Sampler

DEPTH, ft.	SAMPLES SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	k (ft/day)
0			6 inches of light brown soil, 1.5 feet of soil cement							
			Light brown, SAND with silt (SP-SM)	2.0						
1	1	SS	- very loose							
5	3	SS	- brown							
6	6	SS	- loose							
10	10	SS	- light brown			10				
10	10	SS	Loose, very light gray, fine SAND (SP)	13.5		4				
15				15.0						



LOG OF BORING E-7

SHEET 1 OF 1

PROJECT NO: 961027

SURFACE ELEVATION: Unknown

PROJECT: Holden Heights Wastewater Improvements

DEPTH TO G.W.T: 6.0

DATE: 11/26/96

COMPLETION DEPTH: 15.0

LOCATION: Orange County, Florida

DRILLING METHOD: Split Spoon Sampler

DEPTH, ft.	SAMPLES SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	k (ft/day)
0			Topsoil, then loose, light gray, SAND with silt (SP-SM)							
9	9	DCP								
9	9	DCP								
8	8	DCP								
7	7	DCP	- dark brown			8				
5	10	DCP								
	3	SS	- very loose, dark brown							
	4	SS								
	4	SS	Very loose, dark brown, silty SAND (SM)	8.5		22				
10										
	13	SS	- medium dense							
15				15.0						



LOG OF BORING E-9

SHEET 1 OF 1

PROJECT NO: 961027
 PROJECT: Holden Heights Wastewater Improvements
 DATE: 11/26/96
 LOCATION: Orange County, Florida

SURFACE ELEVATION: Unknown
 DEPTH TO G.W.T: 4.0
 COMPLETION DEPTH: 15.0
 DRILLING METHOD: Split Spoon Sampler

DEPTH, ft.	SAMPLES SPT N-VALUE (bpf)	SAMPLE TYPE	DESCRIPTION	STRATUM EL / DEPTH	SYMBOL	- 200	MC %	LL	PI	k (ft/day)
0			Topsoil, then medium dense, brown, SAND with silt (SP-SM)							
13	13	DCP	- loose, light brown			11				
7	7	DCP								
5	5	DCP								
5	5	DCP								
5	4	DCP	- very loose							
	2	SS								
	13	SS	- medium dense							
	13	SS	Medium dense, grayish-green, silty SAND	8.5						
10										
	14	SS	Medium dense, light gray, fine SAND	13.5						
15				15.0						

Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		USCS
	#4	#10	#40	#60	#100								
A-1 2.0	Light brown sand with silt					10.0							
A-2 7.0	Grayish brown silty sand					12.3							
A-3 4.0	Brown silty sand					15.3							
A-3 8.5	Light brown silty sand					26.3							
A-4 1.0	Reddish brown sand with silt					7.6							
A-4 5.5	Gray silty sand					21.2							
A-4 7.0	Gray silty sand					18.2							
A-5 4.0	Light gray sand with silt					7.2							
A-5 7.0	Light gray and orange silty sand					24.7							
A-6 4.0	Light gray fine sand					5.0							
A-6 8.5	Gray silty sand					24.4							
A-7 5.5	Light grayish brown silty sand					12.7							
A-7 8.5	Light gray fine sand					3.7							
B-1 5.0	Light brown to tan silty sand					26.3							
B-1 8.5	Grayish brown silty sand					18.8							
B-10 5.0	Light brown silty sand					21.7							
B-10 7.0	Light gray silty sand					19.9							
B-11 5.0	Light brown and orange sand with silt												
B-11 7.0	Gray and light brown mixed sand with silt					6.8							

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____

Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		USCS
	#4	#10	#40	#60	#100								
B-2 7.0	Gray silty sand					28.6							
B-2 13.5	Pale gray sand with silt					8.9							
B-3 3.0	Light brown sand with silt					9.1							
B-3 13.5	Gray silty sand					21.8							
B-4 2.5	Dark reddish brown sand with silt					10.7							
B-4 7.0	Grayish brown silty sand					25.9							
B-4 13.5	Tan silty sand					13.2							
B-5 3.0	Pale gray sand with silt					5.9							
B-5 5.5	Gray silty sand with organics					27.8							
B-5 8.5	Tan sand with silt					8.0							
B-6 5.0	Light gray silty sand												
B-7 5.0	Pale gray silty sand					21.5							
B-8 1.0	Orange brown sand with silt					8.1							
B-8 5.0	Gray and light brown fine sand					3.5							
B-8 13.5	Dark brown silty sand					12.8							
B-9 5.0	Pale gray sand with silt					7.5							
C-1 3.0	Light reddish brown silty sand					15.0							
C-1 7.0	Dark reddish brown sand with silt					9.4							
C-1 8.5	Grayish brown silty sand					23.8							

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____

Location: Orange County, Florida _____

Boring Depth	Sample Description	Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)					USCS		
								#4	#10	#40	#60		#100	
C-10 7.0	Grayish brown sand with silt	5.6												
C-11 4.0	Grayish brown silty sand	14.3												
C-11 7.0	Light grayish brown sand with silt	5.1												
C-12 3.5	Dark gray and white silty sand	13.1												
C-12 13.5	Light reddish brown silty sand	22.3												
C-13 13.5	Light grayish brown silty sand	13.5												
C-2 4.0	Grayish brown silty sand	16.3												
C-2 5.5	Grayish brown silty sand	31.4												
C-3 2.5	Light brown silty sand	11.0												
C-3 8.5	Light brown silty sand	13.0												
C-4 4.5	Grayish brown silty sand	12.9												
C-4 8.5	Gray silty sand	22.8												
C-5 8.5	Dark gray silty sand	20.7												
C-6 2.5	Light brown silty sand	12.9												
C-6 7.0	Grayish brown silty sand	24.6												
C-8 5.5	Gray silty sand, slightly cemented	22.8												
C-8 7.0	Gray silty sand	28.6												
C-8 13.5	Light gray sand with silt	7.5												
C-9 5.5	Grayish brown sand with silt	11.3												

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		USCS
	#4	#10	#40	#60	#100								
C-9 8.5	Dark brown fine sand					4.9							
D-1 3.0	Dark brown peat												
D-1 8.0	Light brown sand with silt					11.1							
D-12 5.0	Light gray silty sand					16.7							
D-12 10.0	Light gray silty sand, slightly cemented					17.9							
D-2 4.0	Dark brown silty sand with organics					37.0							
D-2 8.0	Light brown silty sand					22.2							
D-3 8.0	Brown sand with silt					10.2							
D-3 13.5	Pale gray fine sand					4.2							
D-5 5.0	Gray silty sand					23.4							
D-6 1.5	Light brown sand with silt					10.9							
D-6 8.0	Grayish brown silty sand					38.2							
D-7 5.0	Pale brown silty sand					14.3							
D-7 9.0	Brown silty sand					12.6							
D-8 7.0	Pale brown silty sand					27.9							
D-9 5.0	Pale gray silty sand												
E-10 4.0	Brown and gray sand with silt					6.8							
E-11 4.0	Pale brown silty sand					12.5							
E-11 13.5	Grayish brown silty sand					24.1							

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description	Fines	Water	LL	PI	Organic	k			USCS
		#4 #10 #40 #60 #100 #200	Content							
E-12 5.5	Brown silty sand	27.4								
E-13 4.0	Brown silty sand	21.2								
E-13 13.5	Brown silty sand	21.5								
E-14 2.5	Brown sand with silt	7.8								
E-14 5.5	Light grayish brown sand with silt	6.7								
E-15 1.0	Dark grayish brown silty sand	13.5								
E-15 8.5	Light grayish brown sand with silt	7.8								
E-16 4.0	Light brown silty sand	16.5								
E-16 8.5	Light brown fine sand	3.9								
E-17 4.0	Orange and gray silty sand	18.2								
E-17 5.5	Orange-brown silty sand	13.7								
E-18 3.0	Dark brown silty sand	20.4								
E-18 7.0	Light brown silty sand	12.8								
E-19 1.0	Brown silty sand	15.7								
E-19 2.0	Grayish brown silty sand	27.0								
E-19 7.0	Light brown sand with silt	9.5								
E-2 4.0	Grayish brown silty sand	12.8								
E-2 13.5	Light brown sand with silt	10.8								
E-20 1.0	Brown sand with silt	8.2								

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		USCS
	#4	#10	#40	#60	#100								
E-20 4.0	Orange and gray silty sand					28.8							
E-21 4.0	Brown silty sand					18.4							
E-21 8.5	Brown silty sand					18.1							
E-22 5.5	Light brown silty sand					13.5							
E-23 8.5	Gray silty sand					26.2							
E-24 4.0	Light brown silty sand					21.7							
E-24 8.5	Light brown fine sand					5.0							
E-25 5.5	Grayish brown silty sand					26.4							
E-26 8.5	Pale brown silty sand					11.7							
E-27 2.5	Light grayish brown sand with silt					6.2							
E-27 13.5	Light brown sand with silt					8.4							
E-28 8.5	Grayish brown silty sand					29.8							
E-3 5.5	Light reddish brown silty sand, cemented					25.8							
E-4 2.5	Grayish brown fine sand					4.4							
E-4 5.5	Brown sand with silt					12.0							
E-5 2.5	Dark brown sand with silt					8.5							
E-5 13.5	Dark brown sand with silt					7.6							
E-6 13.5	Reddish brown sand with silt					10.3							
E-7 4.0	Dark brown sand with silt					8.3							

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description	Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)	USCS											
								#4	#10	#40	#60	#100							
E-7 8.5	Dark brown silty sand	22.3																	
E-8 7.0	Dark brown sand with silt	9.6																	
E-9 2.5	Light brown sand with silt	11.1																	
F-1 2.0	Dark grayish brown sand with silt	9.0																	
F-1 8.5	Light grayish brown sand with silt	6.2																	
F-10 3.0	Grayish brown sand with silt	12.3																	
F-11 3.0	Light brown silty sand	14.1																	
F-11 5.5	Dark reddish brown silty sand	19.4																	
F-12 13.5	Grayish brown silty sand	33.1																	
F-13 4.0	Light brown sand with silt	10.8																	
F-13 8.5	Dark reddish brown silty sand	14.6																	
F-14 2.5	Dark gray sand with silt	9.2																	
F-14 4.0	Pale brown silty sand	13.6																	
F-2 2.5	Grayish brown fine sand	4.8																	
F-2 13.5	Brown sand with silt	11.2																	
F-3 1.5	Light brown sand with silt, mottled	9.1																	
F-3 4.0	Light reddish brown silty sand	21.1																	
F-4 6.0	Light brown sand with silt	6.4																	
F-4 7.0	Brown silty sand	32.2																	

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)	USCS
	#4	#10	#40	#60	#100							
F-4 13.5	Very dark brown sand with silt					8.3						
F-5 5.0	Brown silty sand, cemented					19.7						
F-5 9.0	Dark brown sand with silt					8.7						
F-6 7.0	Light gray sand with silt					9.3						
F-7 5.0	Light gray silty sand					13.1						
F-7 9.0	Brown silty sand					15.3						
F-8 3.0	Light brown silty sand					12.3						
F-8 7.5	Light gray to brown silty sand					18.0						
F-9 3.0	Light brown silty sand, mottled					12.5						
F-9 7.0	Gray silty sand					28.2						
G-1 3.5	Grayish brown silty sand					14.0						
G-10 5.5	Grayish brown sand with silt					7.5						
G-11 7.0	Light grayish brown sand with silt					9.8						
G-12 8.5	Reddish brown silty sand, cemented					14.0						
G-13 5.5	Light grayish brown sand with silt					10.9						
G-14 4.0	Light grayish brown sand with silt					5.1						
G-14 7.0	Orange-brown silty sand					19.9						
G-15 5.5	Light brown fine sand					3.3						
G-15 13.5	Grayish brown silty sand					15.9						

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)	USCS
	#4	#10	#40	#60	#100							
G-16 8.5	REddish brown silty sand, cemented					17.6						
G-16 13.5	Brown sand with silt					8.2						
G-17 2.5	Dark brown sand with silt					9.9						
G-18 4.0	Light brown sand with silt					5.8						
G-19 7.0	Grayish brown sand with silt					15.7						
G-19 13.5	Dark brown sand with silt					8.9						
G-2 4.0	Brown sand with silt					11.1						
G-2 8.5	Grayish brown silty sand					13.7						
G-20 5.5	Gray silty sand					20.7						
G-3 4.0	Light grayish brown silty sand					13.8						
G-4 4.0	Light grayish brown silty sand					15.2						
G-5 5.5	Dark grayish brown silty sand					14.1						
G-5 8.5	REddish brown silty sand, cemented					24.2						
G-6 5.5	Gray and orange silty sand					15.5						
G-6 7.0	REddish brown silty sand					25.0						
G-8 5.5	Gray silty sand					21.3						
G-8 8.5	Gray and orange silty sand					25.8						
G-9 1.0	Grayish brown sand with silt					7.6						
G-9 8.5	Brown silty sand					25.4						

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)		USCS
	#4	#10	#40	#60	#100								
H-1 2.0	Light gray sand with silt					5.6							
H-1 5.5	Pale gray silty sand					27.2							
H-2 1.5	Gray fine sand					4.7							
H-2 5.5	Pale gray silty sand					30.1							
H-3 5.5	Pale gray silty sand					25.5							
H-3 8.5	Light brown sand with silt					8.9							
H-4 8.5	Pale gray silty sand					16.4							
H-5 7.0	Pale gray silty sand					13.6							
H-5 8.5	Light brown silty sand					12.7							
H-6 5.5	Reddish brown silty sand, slightly cemented					16.6							
H-6 8.5	Reddish brown silty sand												
H-6 13.5	Reddish brown silty sand					12.5							
H-7 10.0	Light brown silty sand					22.9							
I-1 5.5	Grayish brown silty sand					19.8							
I-2 4.0	Orange and gray silty sand					26.9							
I-3 1.0	Light gray fine sand					4.5							
I-4 8.5	Light grayish brown silty sand					21.7							
J-1 2.0	Light grayish brown sand with silt					7.5							
J-1 8.5	Light brown silty sand					18.5							

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)	USCS
	#4	#10	#40	#60	#100							
J-3 2.5	Light brown sand with silt					7.2						
J-4 4.0	Dark reddish brown silty sand					23.4						
J-4 13.5	Orange brown silty sand					22.5						
J-5 5.5	Light brown sand with silt					27.1						
J-6 5.5	Brown silty sand					13.6						
J-7 4.0	Brown sand with silt					10.4						
J-8 7.0	Pale gray sand with silt					6.8						
K-1 3.0	Light orange brown silty sand					20.4						
K-1 8.5	Light brown silty sand					21.2						
K-10 5.5	Reddish brown silty sand, cemented					14.7						
K-11 3.5	Light brown fine sand					4.6						
K-11 13.5	Reddish brown sand with silt					7.8						
K-12 5.5	Brown silty sand					21.4						
K-13 4.5	Light brown and orange silty sand					13.2						
K-13 8.5	Light gray fine sand					1.4						
K-14 4.0	Light brown sand					5.1						
K-14 5.5	Brown silty sand					21.7						
K-15 1.5	Brown sand with silt					9.2						
K-15 5.5	Light brown fine sand					3.4						

**Summary Of
Laboratory Test Results**



Manager: _____ Client: _____ Project Description: _____
 Location: Orange County, Florida _____

Boring Depth	Sample Description					Fines #200	Water Content	LL	PI	Organic Content	k (ft/day)	USCS
	#4	#10	#40	#60	#100							
K-17 4.0	Pale brown silty sand					12.9						
K-17 5.5	Light brown sand with silt					9.5						
K-18 2.0	Light brown sand with silt, slightly cemented					12.0						
K-18 4.0	Brown sand with silt					9.6						
K-2 3.0	Light gray silty sand					5.1						
K-2 8.5	Grayish brown silty sand, mottled					36.6						
K-3 4.0	Light brown sand with silt					22.9						
K-3 8.5	Light brown silty sand					17.5						
K-4 4.0	Brown silty sand, cemented					24.5						
K-4 8.5	Reddish brown silty sand, cemented					12.7						
K-5 3.0	Light brown silty sand					12.3						
K-6 5.5	Brown silty sand, cemented					14.7						
K-6 13.5	Light brown silty sand					23.7						
K-7 4.0	Light brown silty sand					14.1						
K-8 8.5	Dark brown silty sand					18.7						
K-9 5.5	Reddish brown silty sand					15.8						

**Summary Of
Laboratory Test Results**



APPENDIX B

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geo-

technical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

APPENDIX C

CONSTRAINTS AND RESTRICTIONS

WARRANTY

Antillian Engineering Associates, Inc. has prepared this report for our client for his exclusive use, in accordance with generally accepted soil and foundation engineering practices, and makes no other warranty either expressed or implied as to the professional advice provided in the report.

UNANTICIPATED SOIL CONDITIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations indicated on the boring Location Plan. This report does not reflect any variations which may occur between these borings.

The nature and extent of variations between borings may not become known until excavation begins. If variations appear, we may have to re-evaluate our recommendations after performing on-site observations and noting the characteristics of any variations.

CHANGED CONDITIONS

We recommend that the specifications for the project require that the contractor immediately notify Antillian Engineering Associates, Inc., as well as the owner, when subsurface conditions are encountered that are different from those present in this report.

No claim by the contractor for any conditions differing from those anticipated in the plans, specifications, and those found in this report, should be allowed unless the contractor notifies the owner and Antillian Engineering Associates, Inc. of such changed conditions. Further, we recommend that all foundation work and site improvements be observed by a representative of Antillian Engineering Associates, Inc. to monitor field conditions and changes, to verify design assumptions, and to evaluate and recommend any appropriate modifications to this report.

MISINTERPRETATION OF SOIL ENGINEERING REPORT

Antillian Engineering Associates, Inc. is responsible for the conclusions and opinions contained within this report based upon the data relating only to the specific project and location discussed herein. If the conclusions or recommendations based upon the data presented are made by others, those conclusions or recommendations are not the responsibility of Antillian Engineering Associates, Inc..

APPENDIX B

ORANGE COUNTY UTILITIES

FORMS

Digital Data Submission

APPENDIX B

FORMS

Digital Data Submission

February 11, 2011

This form is to be utilized for the submittal of digital data in accordance with the requirements outlined in Chapter 2111, “ Project Documents and Submittals”.

Date of Submittal: _____

Project Number: _____

Project Name: _____

Project Manager: _____

Consulting Firm: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____ Email: _____

Type of Submittal: Construction Plans Record Drawings

File Format: _____

APPENDIX C

ORANGE COUNTY UTILITIES

PERMITS OBTAINED BY COUNTY



FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Central District
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

RICK SCOTT
GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

Sent via email: jim.broome@ocfl.net

PERMITTEE:
JIM BROOME PE
ORANGE COUNTY UTILITIES
9150 CURRY FORD RD
ORLANDO FL 32825

PERMIT NUMBER: 0318617-001
COUNTY: Orange
PROJECT: Holden Heights Community Center
GENERATING: 10,987 GPD
CONNECTED TO: OCUD/South WRF
(FLA107972)

Dear Mr. Broome:

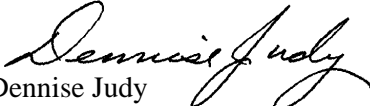
This letter acknowledges receipt of your Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System for the subject project. Our office received the Notice on May 7, 2013.

This is to advise you that the Department does not object to your use of such General Permit.

Please note the attached requirements apply to your use of this General Permit for constructing the proposed domestic wastewater collection/transmission system. In accordance with Rule 62-4.540(13), F.A.C., this authorization shall be good for a period of five years from the date of this letter.

You are further advised that the construction activity must conform to the description contained in your Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System and that any deviation will subject the permittee to enforcement action and possible penalties.

Sincerely,


Dennise Judy
Manager
Wastewater Permitting

Date: May 9, 2013

DJ/cs/ply

cc: Willie Thomas, P.E. (via email: thomas@bfaenvironmental.com)

REQUIREMENTS FOR USE OF THE GENERAL PERMIT FOR DOMESTIC WASTEWATER COLLECTION/TRANSMISSION SYSTEMS:

1. This general permit is subject to the general permit conditions of Rule 62-4.050, F.A.C., as applicable. This rule is available at the Department's Internet site at: <http://www.dep.state.fl.us/water/wastewater/rules.htm#domestic> [62-4.050]
2. This general permit does not relieve the permittee of the responsibility for obtaining a dredge and fill permit where it is required. [62-604.600(6)(b)1, 11-6-03]
3. This general permit cannot be revised, except to transfer the permit. [62-604.600(6)(b)2, 11-6-03]
4. Upon completion of construction of the collection/transmission system project, and before placing the facilities into operation for any purpose other than testing for leaks or testing equipment operation, the permittee shall submit to the Department's Central District Office, Form 62-604.300(8)(b), Request for Approval to Place a Domestic Wastewater Collection/Transmission System into Operation. This form is available at the Department's Internet site at: <http://www.dep.state.fl.us/water/wastewater/forms.htm> [62-604.700(2), 11-6-03]
5. The new or modified collection/transmission facilities shall not be placed into service until the Department clears the project for use. [62-604.700(3), 11-6-03]
6. Abnormal events shall be reported to the Department's Central District Office in accordance with Rule 62-604.550, F.A.C. For unauthorized spills of wastewater in excess of 1000 gallons per incident, or where information indicates that public health or the environment may be endangered, oral reports shall be provided to the STATE WARNING POINT TOLL FREE NUMBER (800) 320-0519 as soon as practical, but no later than 24 hours from the time the permittee or other designee becomes aware of the circumstances. Unauthorized releases or spills less than 1000 gallons per incident are to be reported orally to the Department's Central District Office within 24 hours from the time the permittee, or other designee becomes aware of the circumstances. [62-604.550, 11-6-03]

APPENDIX D

ORANGE COUNTY UTILITIES Standards and Construction Specification Manual LIST OF APPROVED PRODUCTS

APPENDIX D LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Air Release	ARV Enclosure	Water Plus Polyethylene Enclosure	131632 H30-B	Blue 44" Tall	131632 H30-P	Pantone 44"	131632 H30-G	Green 44" Tall
			171730 H40-B	Blue 30" Tall	171730 H40-P	Pantone 30"	171730 H40-G	Green 30" Tall
			AVG2036 Encl	Blue 36" Tall	AVG2036 Encl	Pantone 36" Tall	AVG2036 Encl	Green 36" Tall
			GP3232 Base		GP3232 Base		GP3232 Base	
			AVG2041 Encl	Blue 41" Tall	AVG2041 Encl	Pantone 41" Tall	AVG2041 Encl	Green 41" Tall
			GP3232 Base		GP3232 Base		GP3232 Base	
	Safety-Guard/Hydro Guard		Blue 34" Tall	15100 Encl	Pantone 34" Tall	15100 Encl	Green 34" Tall	
Air Release	Air Release Valves	ARI	Air Release Valves shall be Combination Type, 316 SS					
			D-040SS	Combination	D-040SS	Combination	D-020 (SS)	Combination
			NA	NA	NA	NA	986 (316SS)	Combination
			Series RBX DN50	2"	Series RBX DN50	2"	RGX series	
ARV Valve	Air Release Valve Frame and Cover	US Foundry	NA	NA	NA	NA	USF 7665-HH-HJ	
			Automatic Blow Off Valve					
Blow Off	Auto Blow Off Valve	Hydro Guard	HG-1 Standard Unit	Automatic	NA	NA	NA	NA
			Blow Off Valve - Fits standard 5-1/4 inch Valve Box					
			Truflo Series TF #550		Truflo Series TF #550		NA	NA
Blow Off	Water Plus Corp	Kupferle Foundry Co	The Hydrant Plus Series		The Hydrant Plus Series		NA	NA
			VB 2000B		VB 2000B		NA	NA
			Casing End Seals. Annular space between pipe and steel casing shall be brick and mortar with end seals to secure ends.					
Casing Seals / Spacers	Casing End Seals	Advance Products	Model AC and AW		Model AC and AW		Model AC and AW	
			Model WR and PO		Model WR and PO		Model WR and PO	
			Model CCES		Model CCES		Model CCES	
			Model ESW and ESC		Model ESW and ESC		Model ESW and ESC	
			Model C and W		Model C and W		Model C and W	
			Model 4810ES		Model 4810ES		Model 4810ES	

APPENDIX D LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments		
Casing Seals / Spacers	Casing spacer	Advance Products	SSI8 / SSI12		SSI8 / SSI12		SSI8 / SSI12			
		BWM Company	BWM-SS-8 / SS-12		BWM-SS-8 / SS-12		BWM-SS-8 / SS-12			
		Cascade Water Works	Series CCS 8" / 12"		Series CCS 8" / 12"		Series CCS 8" / 12"			
		CCI Pipeline	Model CCS8 / CSS12		Model CCS8 / CSS12		Model CCS8 / CSS12			
		Pipeline Seal & Insulator, Inc (PSI)	Series S8G-2 / S12G-2		Series S8G-2 / S12G-2		Series S8G-2 / S12G-2			
		Casing spacers shall be a min. 8-inches wide for pipe 12" Dia or less or min. 12-inches wide for pipe 16 or greater, shall have a minimum 14 gauge 304 stainless steel shell/band, minimum 10 gauge 304 reinforced risers; minimum thickness of 0.090 EPDM or PVC interior liners, glass reinforces polymer or ultra high molecular weight polyethylene and 304 stainless bolts, nuts and washers.								
Coatings	Exterior Coatings for Exposed Metal Assets	Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 1 Zinc / Urethane / Fluoropolymer application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.								
		Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils		
			Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils	Carbothane 133 HB	3.0 -5.0 mils		
			Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils		
			Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils		
			Typosy Series 27WB	4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils		
		Tnemec	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils		
			Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils	Hydroflon Series 700	2.0 - 3.0 mils		
		Coatings: Aerial pipe, hydrants, above ground piping, fittings, valves and Appurtenances - System 2 Zinc / Epoxy / Urethane application and color code per Section 3119 Coatings & Linings. Coating shall not be in contact with Potable water unless NSF 61 approved.								
			Carboline	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	Carbozinc 621	3.0 - 8.0 mils	
		Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils	Carboguard 60	4.0 -6.0 mils			
		Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils	Carboxane 950	2.0 - 3.0 mils			
		Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils	Zinc Series 90-97	2.5 - 3.5 mils			
		Typosy Series 27WB	4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils	Typosy Series 27WB	4.0 -14.0 mils			
	Tnemec	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils	Hi-Build Epoxoline II Series N69	4.0 - 10.0 mils			
		EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils	EnduraShield Series73	2.0 - 3.0 mils			
		Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils	Amercoat 68HS	Min 3.0 mils			
	PPG / Ameron	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils	Amercoat 385	4.0 - 6.0 mils			
		Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils	Amercoat 450H	2.0 - 3.0 mils			

APPENDIX D LIST OF APPROVED PRODUCTS - TRANSMISSION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments
Fittings	Ductile Iron Fittings C153 SSB / C110 FLG: (Water & Reclaimed Water fittings shall cement lined or holiday free fusion bonded epoxy lined) (Wastewater fittings interior shall be Protecto 401 and holiday free)	American	30" & up	FBE / Cement	30" & up	FBE / Cement	30" & up	Protecto 401
		Sigma		FBE / Cement		FBE / Cement		Protecto 401
		Star		FBE / Cement		FBE / Cement		Protecto 401
		Tyler Union & Clow		FBE / Cement		FBE / Cement		Protecto 401
Flow	Flow Meters With Replaceable Sensors	EMCO	NA	NA	NA	NA	Unimag 4411E	
Hydrants	Hydrants Shall open left, 1-1/2 Pentagon operating nut, NST hose & pumper thread, rotate 360 degrees, closed drains, epoxy on shoe in & out and 304 SS nuts & bolts below ground.	American Flow Control	B-84-B (6 inch)		NA	NA	NA	NA
		Clow	Medallion 2545		NA	NA	NA	NA
		Mueller	Super Centurion 250		NA	NA	NA	NA
Joint Restraints	Ductile iron pipe Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated Restrain ductile iron pipe to mechanical joint fittings, pipe and appurtenances.	EBAA Iron Inc	Megalug Series 1100		Megalug Series 1100		Megalug Series 1100	
		Ford / Uni-Flange	UFR-1400		UFR-1400		UFR-1400	
		Sigma	OneLok Series SLD/SLDE		OneLok Series SLD/SLDE		OneLok Series SLD/SLDE	
		Smith Blair	Cam Lok Series 111		Cam Lok Series 111		Cam Lok Series 111	
		Star	Star Grip Series 3000		Star Grip Series 3000		Star Grip Series 3000	
		Tyler Union	TufGrip Series TLD		TufGrip Series TLD		TufGrip Series TLD	
Joint Restraints	Bell Joint Restraints for Ductile Iron Pipe (4"-12") (New & Existing) - All restraints split serrated on bell and spigot ends. Pipe 16" and greater shall have restraint gaskets or locking bells. (Wastewater only for restraint of existing DIP FM)	EBAA Iron Inc	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Ford / Uni-Flange	Uni-Flange Series 1390C		Uni-Flange Series 1390C		Uni-Flange Series 1390C	
		Sigma	PV-Lok Series PWP-C		PV-Lok Series PWP-C		PV-Lok Series PWP-C	
		Smith Blair	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
		Star	StarGrip Series 3100S		StarGrip Series 3100S		StarGrip Series 3100S	
		Tyler Union	TufGrip-Series 300C		TufGrip-Series 300C		TufGrip-Series 300C	
DIP Bell Joint Restraints (16" & Greater)	Ductile Iron Pipe Bell Joint Restraints for Ductile Iron Pipe (16" & Greater) - All restraints shall have a split back-up ring for the bell and a serrated or wedge action gland for the spigot end. New installation for water & reclaimed water piping 16" and greater shall have restraint gaskets or locking bells.	EBAA Iron Inc	Series 1100HD	Existing Only	Series 1100HD	Existing Only	Series 1100HD	Existing Only
		Sigma	Series SSLDH	Existing Only	Series SSLDH	Existing Only	Series SSLDH	Existing Only
		Star	Series 3100S	Existing Only	Series 3100S	Existing Only	Series 3100S	Existing Only

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Cat.	Desc	Manufacturer	Water Model #	Comments	Reclaimed Water Model #	Comments	Wastewater Model #	Comments
	Ductile iron pipe Bell Joint Restraint Gaskets and Locking Bell (4" & Above)	American	Fast Grip Gasket	Gasket	Fast Grip Gasket	Gasket	NA	NA
		Griffin	Flex-Ring Joint	Bell Lock	Flex-Ring Joint	Bell Lock	NA	NA
			Lok-Ring Joint	Bell Lock	Lok-Ring Joint	Bell Lock	NA	NA
		McWane Inc. DI Pipe Group	Talon RJ Gasket	Gasket	Talon RJ Gasket	Gasket	NA	NA
			Snap-Lok	Bell Lock	Snap-Lok	Bell Lock	NA	NA
			Sure Stop 350 Gasket	Gasket	Sure Stop 350 Gasket	Gasket	NA	NA
			Thrust-Lock	Bell Lock	Thrust-Lock	Bell Lock	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			Super-Lok	Bell Lock	Super-Lok	Bell Lock	NA	NA
		US Pipe	Field Lok 350 Gasket	Gasket	Field Lok 350 Gasket	Gasket	NA	NA
			Field Lok Gasket	Gasket	Field Lok Gasket	Gasket	NA	NA
			TR-Flex	Bell Lock	TR-Flex	Bell Lock	NA	NA
			HP Lok Restraint Joint	Bell Lock	HP Lok Restraint Joint	Bell Lock	NA	NA
	SS to DIP Transition Restraint	EBAA Iron Inc	NA	NA	NA	NA	Megaflange 2100	(epoxy coated, SS hardware) Fig x PE RJ.
		Sigma	NA	NA	NA	NA	SigmaFlange with One Lock SLDE	
		Smith Blair	NA	NA	NA	NA	911 Flange - Lock Restrained FCA	
	Mechanical Joint Wedge-action Restraining Gland, Epoxy Coated							and appurtenances.
	PVC Pipe MJ Restraints	EBAA Iron Inc	Mega-lug Series 2000PV		Mega-lug Series 2000PV		Mega-lug Series 2000PV	
		Ford / Uni-Flange	NA	NA	NA	NA	Megalug Series 2200 (42"-48")	
		Sigma	UFR 1500 Series		UFR 1500 Series		UFR 1500 Series	
		Smith Blair	One Lok Series SLC/SLCE		One Lok Series SLC/SLCE		One Lok Series SLC/SLCE	
		Star	Cam Lok Series 120		Cam Lok Series 120		Cam Lok Series 120	
		Tyler Union	Star Grip Series 4000		Star Grip Series 4000		Star Grip Series 4000	
			TufGrip Series TLP		TufGrip Series TLP		TufGrip Series TLP	
	PVC Bell Joint Restraints (4" - 12") (New & Existing)	EBAA Iron Inc						
		Ford / Uni-Flange	Tru-Dual Series 1500TD		Tru-Dual Series 1500TD		Tru-Dual Series 1500TD	
		Sigma	Uni-Flange Series 1390		Uni-Flange Series 1390		Uni-Flange Series 1390	
		Smith Blair	PV-Lok Series PWP		PV-Lok Series PWP		PV-Lok Series PWP	
		Star	Bell-Lock Series 165		Bell-Lock Series 165		Bell-Lock Series 165	
			Series 1100C		Series 1100C		Series 1100C	
		Tyler Union	TufGrip 300C		TufGrip 300C		TufGrip 300C	

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Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments			
Joint Restraints	PVC Bell Joint Restraints (16" & Greater)	Ford / Uni-Flange	Series 1390	Existing Only	Series 1390	Existing Only	Series 1390				
			JCM	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621	Existing Only	Sur-Grip Series 621			
			Sigma	PV-Lok PWP	Existing Only	PV-Lok PWP	Existing Only	PV-Lok PWP			
			Smith Blair	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165	Existing Only	Bell-Lock Series 165			
			Star	Series 1100C	Existing Only	Series 1100C	Existing Only	Series 1100C			
Pipe	PVC Bell & Spigot Restraints (4" - 12")	Certainteed 4" to 12"	Certa-Lok C900/RJ	Blue	Certa-Lok C900/RJ	Pantone Purple	Certa-Lok C900/RJ	Green			
			Diamond Plastics Corp	C-900	Blue	C-900	Pantone Purple	Diamond C900	Green		
			Ipex Inc	C-900 Blue Brute	Blue	C-900	Pantone Purple	C900 Blue Brute	Green		
			JM Eagle	C-900	Blue	C-900	Pantone Purple	C-900	Green		
			National Pipe & Plastics Inc	C-900 Dura- Blue	Blue	C-900	Pantone Purple	C-900 Pipe	Green		
			North American Pipe Corp (NAPCO)	C-900	Blue	C-900	Pantone Purple	C-900	Green		
			Sanderson Pipe Corp	C-900	Blue	C-900	Pantone Purple	C-900	Green		
			PVC C905 DR 18 Bell & Spigot Restraints	Certainteed 16" and Larger	Diamond Plastics Corp	NA	NA	NA	NA	Certa-Lok C905/RJ	NA
						NA	NA	NA	NA	Trans-21 DR18	Green
						NA	NA	NA	NA	IPEX Centurion	Green
NA	NA	NA				NA	C905 Big Blue	Green			
NA	NA	NA				NA	C905	Green			
HDPE C906 DR11	JM Eagle	Performance Pipe(Chevron)	HDPE	DR11 Blue	HDPE	DR11 Pantone	HDPE	DR11Green			
			Driscoplex 4000	DR11 Blue	Driscoplex 4000	DR11 Pantone	Driscoplex 4300	DR11 Green			
			EHMW Poly Pipe	DR11 Blue	EHMW	DR11 Pantone	EHMW	DR11Green			

PVC Bell Joint Restraints: (16" & Greater) PVC pipe Split Serrated on Bell End and Spigot End. Water & Reclaimed Water Existing pipe only. Wastewater shall be new and existing pipe.

C900 Bell & Spigot PVC Pipe: 4 to 12-inch - AWWA C-900, Minimum DR18 for Water, Reclaimed and Wastewater. DR14 for Fire Lines. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.

C905 Bell & Spigot PVC Pipe 16" and Larger: AWWA C-905, Minimum DR18 for all Force Mains up to 24". Minimum DR21/DR25 for 30" and greater. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.

HDPE Pipe DR11 AWWA C906 shall be Ductile Iron Pipe Size, PE 3408/3608/4710 DIPS manufactured in accordance with ASTM F-714 and listed with NSF. Pipe shall be marked in accordance with either AWWA C901,AWWA C906. Compression type connections are not acceptable in new installations. Pipe joints shall be butt fusion or electro-fusion with flange or adapter. All HDPE shall be color coded to the Utility. Color identifications are in accordance with the APWA/ULCC Uniform Color Code. Manufacturers shall be members in good standing with PPI to maintain approval status.

Cat.	Desc	Manufacturer	Model #	Water	Comments	Reclaimed Water	Model #	Comments	Wastewater	Model #	Comments	
Pipe	Ductile Iron Pipe	American	Cement Lined	Blue		Cement Lined		Pantone Purple	Protecto 401		Pump Station	
		Griffin	Cement Lined	Blue		Cement Lined		Pantone Purple	Protecto 401		Pump Station	
		McWane Inc. DI Pipe Group	Cement Lined	Blue		Cement Lined		Pantone Purple	Protecto 401		Pump Station	
		US Pipe	Cement Lined	Blue		Cement Lined		Pantone Purple	Protecto 401		Pump Station	
Sample	Sample Station	Sample Stations - Bacteriological Sample Station with built in flush system, all internal piping to be 2", brass and includes lockable green enclosures.										
		Safety-Guard	SG-BSS-05 pedestal #77	green enclosure		NA		NA		NA		NA
		Water Plus Corp	Model 5000	green		NA		NA		NA		NA
Services	Brass Service Saddles	Brass Service Saddles for 1" & 2" water & reclaimed water services on 4" through 12" Mains - Service saddles can be hinge or bolt controlled OD saddles to be used on C-900 and existing IPS OD PVC pipe.										
		Ford	Series S-70, S-90	4"-12"		Series S-70, S-90		4"-12"		NA		NA
		AY McDonald	Model 3891 / 3895,3801 / 3805	4"-12"		Model 3891 / 3895,3801 / 3805		4"-12"		NA		NA
Services	Service Saddles	Mueller	Series S-13000/H-13000	4"-12"		Series S-13000/H-13000		4"-12"		NA		NA
		Service Saddles for 1" (CC) & 2" (Iron pipe threads) Water & Reclaimed Water services on mains greater than 12". Service saddles for 2" taps (iron pipe threads) on 4" mains and greater for Waste Water. : Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on C-900 / C905 or DI for all 1-in and -2in taps on pipes over 12in.										
		Ford	Series FC202	16" & greater		Series FC202		16" & greater		Series FC202		4" & greater
		JCM	Series 406	16" & greater		Series 406		16" & greater		Series 406		4" & greater
		Mueller	DR2S	16" & greater		DR2S		16" & greater		DR2S		4" & greater
		Romac	Series 202NS	16" & greater		Series 202NS		16" & greater		Series 202NS		4" & greater
Service Saddles for HDPE	Service Saddles for HDPE	Smith Blair	Series 317	16" & greater		Series 317		16" & greater		Series 317		4" & greater
		Service Saddles for 1" (CC) & 2" (Iron Pipe threads) Water and Reclaimed Water Services: Epoxy or nylon coated stainless steel 18-8-type 304 double straps, controlled O.D. saddles to be used on HDPE for all 1-in and -2in taps. Taps to HDPE pipe shall be approved on a case by case basis.										
		Ford	Series FCP202			Series FCP202				Series FCP202		
		Romac	Series 202N-H			Series 202N-H				Series 202N-H		
Corporation Stops Ball Type	Corporation Stops Ball Type	Smith Blair	Series 317-1 for HDPE			Series 317-1 for HDPE			Series 317-1 for HDPE			
		Corporation Stops Ball Type (1-inch with AWWA taper C threads only/pack joint outlet for CTS) 2" Corporation Stop Ball Type shall be 2" MIP X FIP threads.										
		Ford	FB1000, FB1700-7			FB1000, FB1700-7				FB1700-7		2" ARV
Corporation Stops Ball Type	Corporation Stops Ball Type	AY McDonald	4701B-22, 3149B2			4701B-22, 3149B2			3149B2		2" ARV	
		Mueller	P25008, B-20046			P25008, B-20046			B-20046		2" ARV	

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Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments	
Services	Curb Stops	Ford	B41-777W	Ball type compression 2" cts O.D. tubing by 2" FIP	B41-777W		NA	NA	
			6102W-22		6102W-22		NA	NA	
			P25172		P25172		NA	NA	
	Curb Stops	Ford	B44-444W	ball type compression x compression	B44-444W		NA	NA	
			6100W-22		6100W-22		NA	NA	
			P25146		P25146		NA	NA	
	PE tubing	Charter Plastics	Blue Ice	Polyethylene tubing: AWWA C901. UV protection (SDR-9) 1-inch and 2-inch only. PE 3408 / PE 4710	Lav Ice		NA	NA	
			Endopure Blue		Endocore Lavender		NA	NA	
			Pure-Core		NA		NA	NA	
	Line Stops	JCM							
Romac									
Smith Blair									
Tapping Sleeves and Valves	Tapping Sleeves	American Flow Control	Series 2800	(Mechanical joint for taps on cast iron, ductile iron, PVC & AC pipe, including size on size) with stainless steel nuts and bolts.	Series 2800		Series 2800		
			Series 1004		Series 1004		Series 1004		
			Series F-5205		DIP/PVC		Series F-5205		DIP/PVC
			Series F-5207		A/C Pipe		Series F-5207		A/C Pipe
			Series 414		FBE		Series 414		FBE
			Series H-615		DIP/PVC		Series H-615		DIP/PVC
			Series H-619		A/C Pipe		Series H-619		A/C Pipe
			Style 623		FBE		Style 623		FBE
Tapping Valves: 12" and smaller	American Flow Control	Series 2500	Tapping Valves: 12" and smaller - Tapping Valves shall be furnished with an alignment lip and installed in the vertical position for Water and Reclaim Water. Wastewater shall be installed horizontally and abandoned in the open position. Tapping valves shall be resilient seated only and meet the requirements of AWWA C509 or C515	Series 2500		Series 2500		Series 2500	Alignment Lip
		Series F-6114		Series F-6114		Series F-6114		Alignment Lip	
		Series T2360 (4"-12")		Series T2360 (4"-12")		Series T2360 (4"-12")		Alignment Lip	

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Cat.	Desc	Manufacturer	Model #	Water Comments	Reclaimed Water Model #	Comments	Wastewater Model #	Comments
Tapping Sleeves and Valves	Tapping Valves: 16" and Larger	American Flow Control	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port	Series 2500	Alignment Lip & flushing port
		Clow	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port	Series F-6114	Alignment Lip & flushing port
		Mueller	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port	Series T2361 (14"&up)	Alignment Lip & flushing port
Valves	Butterfly Valve 42" and Above	Butterfly Valves 42" and above, AWWA C504. Actuators input torques based on 150 psi valve pressure and 16 fps velocity with a maximum input of 80 ft-lb on 2" nuts and shall withstand 250 ft-lbs. Valve seats shall be leak-tight in both directions at 150 psi.						
		Clow	Style #1450		Style #1450		NA	NA
		Dezurik	BAW		BAW		NA	NA
Valves	Check Valves 4" - 12"	Mueller / Pratt	LINSEAL III / Groundhog		LINSEAL III / Groundhog		NA	NA
		Valves (Check) 4-inch and Larger (8 mil epoxy lined)						
		American Flow Control	NA		NA		Series 600 or 50 line	
Valves	Gate Valves 16" and Larger	Clow / M&H / Kennedy	NA		NA		106	
		Mueller	NA		NA		Series 2600	
		Gate Valves 12" and smaller - resilient seated only AWWA C509 or C515. Valve seat shall be leak-tight in both directions at 150 psi.						
Valves	Gate Valves 4" - 12"	American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
		Mueller	Series A-2360		Series A-2360		NA	NA
Valves	Gate Valves (Vertical) 16" and Up	Gate Valves 16" and larger (Vertical Installation) AWWA C515 resilient seated only (16" and 24" no gearing required) above 24" shall be installed vertically with a gear actuator unless noted by the engineer. Valve seat shall be leak-tight in both directions at 150 psi.						
		American Flow Control	Series 2500		Series 2500		NA	NA
		Clow	Series F-6100		Series F-6100		NA	NA
Valves	Gate Valves (Vertical) 16" and Up	Mueller	Series A-2361		Series A-2361		NA	NA

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Cat.	Desc	Manufacturer	Water Model #	Water Comments	Reclaimed Water Model #	Reclaimed Water Comments	Wastewater Model #	Wastewater Comments				
Valves	Plug Valves	Clow Dezurik Millikan / Pratt Val-Matic	NA	NA	NA	NA	F-5412 FLG	4" & up				
			NA	NA	NA	NA	F-5413 MJ	4" & up				
			NA	NA	NA	NA	Series PEF or PEC	4" & up				
			NA	NA	NA	NA	Eccentric / Ballcentric	4" & up				
			NA	NA	NA	NA	5600 or 5800 (FLG)	4" & up				
			NA	NA	NA	NA	5700 or 5900 (MJ)	4" & up				
Valve Boxes	Valve Boxes with Locking Lids (Cast Iron)	Bingham/Taylor Sigma Star Tyler Union	Two piece standard screw type Heavy Duty Valve Boxes with Locking Lids (Cast Iron) and type of service cast in heavy duty traffic lid (H20 loading) ASTM A48									
			Series 4905	Box	NA	NA	Series 4905	Box				
			4905-X	Extension	NA	NA	4905-X	Extension				
			4904-L	Blue Water Locking Lid	NA	NA	4904-L	Green Sewer locking Lid				
			Series VB 261X-267X	Box	VB-25031LK-VB-2612	Box	Series VB 261X-267X	Box				
			VB 6302	Extension	VB-6302	Extension	VB 6302	Extension				
			VB 4650W	Blue Water Locking Lid	VB2503LK	Purple Square Locking Lid	VB 4650S	Green Sewer locking Lid				
			Series VB-0002	Box	NA	NA	Series VB-0002	Box				
			VBEX 12-24S	Extension	NA	NA	VBEX 12-24S	Extension				
			VBLIDLOCK	Blue Water Locking Lid	NA	NA	VBLIDLOCK	Green Sewer locking Lid				
			Series 6850	Box	NA	NA	Series 6850	Box				
			58, 59, 60	Extension	NA	NA	58, 59, 60	Extension				
			Locking Lid	Blue Water Locking Lid	NA	NA	Locking Lid	Green Sewer locking Lid				
			Valve Box		American Flow Control Mueller Company	For mains equal to, or greater than, 16" diameter or equal to greater than 6' feet deep						
						# 2A - 9A Retrofit Valve	Fit inside std valve boxes	NA	NA	2A - 9A Retrofit Valve	Green Sewer locking Lid	
Box Insert		NA				NA	Box Insert	Green Sewer locking Lid				
MVB050C thru MVB130C with Extension Stem	Blue Water Locking Lid	MVB050CR thru MVB130CR with Extension Stem				Purple Square Locking Reclaim Lid	MVB050C thru MVB130C with Extension Stem	Green Sewer locking Lid				
		MVB875 Guide Plate		MVB875 Guide Plate		MVB875 Guide Plate						

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Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model #	Comments		
Coatings	Anti-Graffiti Paint	Block Walls-Anti-Graffiti Paint per Section 3119 Coatings & Linings						
		American Building Restoration Products	NA	NA	NA	NA	Polyshield Graffiti Preventer for Unpainted Masonry Type B	
		Themec / Chemprobe	NA	NA	NA	NA	626 DUR A PEL	
		Professional Products of Kansas, Inc	NA	NA	NA	NA	Professional Water Seal & Anti-Graffiti (PWS-15 Super Strength)	
	Coatings for Existing Manholes	Rehabilitation corrosion protection system per Section 3119 Coatings & Linings. Interior coating for force main connections to existing concrete manholes only. New precast structures and existing pump stations shall be lined.						
		CCI Spectrum, Inc	NA	NA	NA	NA	Spectrashield	
		Kerneos Aluminate Technologies	NA	NA	NA	NA	Sewpercoat	
		Raven Lining System	NA	NA	NA	NA	Raven 155 Primer Raven 405	
		Sauereisen	NA	NA	NA	NA	210 Series Topcoat Glaze 210G	
		Themec	NA	NA	NA	NA	Series 434 Topcoat Glaze 435	
PVC Pipe and fittings	Pipe SDR 35 Gravity Mains	PVC Pipe for Gravity SDR26/SDR 35 (Green in color) ASTM-D034. Manufacturers shall be members in good standing with Uni-Bell to maintain approval status.						
		Certainteed	NA	NA	NA	NA	Gravity Sewer Pipe	
		Diamond Plastics Corp	NA	NA	NA	NA	Sani-21 SDR-35	
		JM Eagle	NA	NA	NA	NA	Gravity Sewer	
		National Pipe & Plastics, Inc.	NA	NA	NA	NA	Ever-Green Sewer Pipe	
		North American Pipe Corp (NAPCO)	NA	NA	NA	NA	Gravity Sewer	
		Sanderson Pipe Corp	NA	NA	NA	NA	Gravity Sewer	
		Locate Balls	Locating Marker Systems - Wastewater Locator balls placed at all sanitary sewer cleanouts					
			3M	NA	NA	NA	NA	3M™ EMS 4" Extended Range 5' Ball Marker 1404-XR
			Fittings, Adapters and Plugs - Gravity PVC ASTM-D3034, Min SDR26/SDR 35					
Fittings SDR 35	GPk Products, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings		
	Harrington Corporation (HARCO)	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings		
	Multi Fittings Corp.	NA	NA	NA	NA	SDR26/SDR 35 Trench Tough Sewer Fittings		
	JM Eagle	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings		
	Plastic Trends Inc	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings		
	TIGRE USA, Inc.	NA	NA	NA	NA	SDR26/SDR35 Gasketed sewer fittings		

APPENDIX D LIST OF APPROVED PRODUCTS - GRAVITY SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model #	Comments	
PVC Pipe a	Flexible Pipe Connectors	Fernco	NA NA	NA NA	1002, 1051, 1056 Series		
		Indiana Seal	NA NA	NA NA	102, 151, 156 Series		
		Mission Rubber	NA NA	NA NA	MR02, MR51, MR 56 Series		
MH Lids	Frame and Cover	USF Fabrication Inc.	NA NA	NA NA	USF 225-AS		
		Top Adjusting Rings - HDPE with heavy duty loading (H-20)	NA NA	NA NA	24R, 24S with Rope Sealant CS2455		
Hatches		Ladtech, Inc	NA NA	NA NA		Wet Well and Valve Vault Access Frames and Covers (Include the term "Confined Space" etched or cast into the cover with recessed lock & hasp. Frames and covers per manufacturers specifications.	
Precast Concrete Structures	Precast Concrete Structures	Halliday Products	NA NA	NA NA	SIR or S2R Series		
		USF Fabrication Inc.	NA NA	NA NA	APS or APD Series		
		Precast Manhole and Wetwell Structures ASTM C478. Precast concrete shall be batched with concrete dyed crystalline waterproofing admixture with corrosion protection. Concrete without admixture or without color tint /tracer shall be rejected.					
		Allied Precast	NA NA	NA NA		Dyed Admix	
		Atlantic Concrete Products, Inc.	NA NA	NA NA		Dyed Admix	
		Delzotto Products, Inc.	NA NA	NA NA		Dyed Admix	
		Dura Stress Underground Inc.	NA NA	NA NA		Dyed Admix	
		Hanson Pipe & Product	NA NA	NA NA		Dyed Admix	
		Mack Concrete	NA NA	NA NA		Dyed Admix	
		Oldcastle Precast	NA NA	NA NA		Dyed Admix	
Standard Precast Inc.	NA NA	NA NA		Dyed Admix			
Concrete Admix	Crystalline Waterproofing Concrete Admix with color dye shall be added to all concrete structures (precast and cast-in-place) to provide waterproofing and corrosion resistance. Concrete without admixture or without color tint / tracer shall be rejected. % concentration of admix with colored dye added to the mix shall be based on weight of cement.	Kryton International	NA NA	NA NA	KIM K-301R (with red dye)	2%	
		Xypex Chemical Corp	NA NA	NA NA	Xypex Admix C-1000Red (with red dye)	3.0 - 3.5%	
		Interior Liner for New or existing Precast Manhole and Precast Wetwell Structures per Section 3119 Coatings & Linings					
Liners	AFE	AFE	NA NA	NA NA	Fiberglass Liner		
		AGRU Liner	NA NA	NA NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)		
		Containment Solutions Inc. (Flowtite)	NA NA	NA NA	Fiberglass Liner		
		GSE Studliner	NA NA	NA NA	HDPE Liner (Min 2 mm for Manhole / Min 5 mm for Pump Station)		
		GU Liner	NA NA	NA NA	Reinforced Plastic Liner		
		L & F Manufacturing	NA NA	NA NA	Fiberglass Liner		

APPENDIX D LIST OF APPROVED PRODUCTS - GRAVITY SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	Comments	
Precast Concrete Structures	Heat Shrink Seal	Canusa-CPS	NA	NA	NA	NA	Wrapid Seal with WrapidSeal Primer (Canusa G Primer)		
	Jointing Material	Pipeline Seal & Insulator, Inc (PSI)	NA	NA	NA	NA	Riser Wrap with Polyken 1027 or 1039 primer		
		Jointing Material Min. 2" width for all products to ensure squeeze out with manufacturer approved primer.							
		Henry Company	NA	NA	NA	NA	Ram-Nek	with Primer	
	Pipe Seals Gravity	Martin Asphalt Company	NA	NA	NA	NA	Evergrip 990	with Primer	
		Trelleborg Pipe Seals	NA	NA	NA	NA	NPC – Bidco C-56	with Primer	
		Resilient Connector Pipe Seals, Manhole - Gravity less than 12-inch and less than 15-ft deep							
	Pipe Seals Gravity	Atlantic Concrete	NA	NA	NA	NA	A-Lok (cast-in-place)		
		Hail Mary Rubber	NA	NA	NA	NA	Star Seal (cast-in-place)		
		IPS	NA	NA	NA	NA	Wedge Style		
NPC		NA	NA	NA	NA	Kor-N-Seal Model WS			
Press seal gasket		NA	NA	NA	NA	PSX Direct Drive			
FM Pipe Seals	Cast in Place Pipe Seals, Manhole - Gravity Greater Than or Equal to 12-inch and all pipe sizes greater than 15-ft deep								
	Atlantic Concrete	NA	NA	NA	NA	A-Lok	cast in place		
	Hail Mary Rubber	NA	NA	NA	NA	Star Seal	cast in place		
Modular Pipe Seals for Wet Well and Valve Box penetrations and all forcemain connections to existing and new precast concrete structures. EPDM Rubber with 316 SS Hardware									
FM Pipe Seals	CCI Pipeline Systems	NA	NA	NA	NA	Wrap-It Link	WL-SS Series		
	Pipeline Seal & Insulator, Inc / Link Seal	NA	NA	NA	NA	Link-Seal S-316	Modular Seal		
	Proco Products, Inc	NA	NA	NA	NA	PenSeal ES-PS	Series		

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APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model #	Comments
Generator	Gen	Generator Systems, Fixed Shall be UL 2200 Certified.				
		Caterpillar	NA NA	NA NA	CAT Diesel Generator Set	
		Cummins Power Generation	NA NA	NA NA	Diesel Generator Set	
	Fuel Tanks	Generator Fuel Tanks. Shall be UL2085 certified.				
		Convault	NA NA	NA NA	CVT-3SF or CVT-3FF	
		Phoenix	NA NA	NA NA	Envirovault	
	GR	Generator Receptacle (GR)				
		Cooper Crouse-Hinds	NA NA	NA NA	AR2042 (230V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Cooper Crouse-Hinds	NA NA	NA NA	AR2042-S22 (460V, 200A, 3P, 4W)	With AJA1 Angle Adaptor
		Pyle National	NA NA	NA NA	JRE-4100 (230V, 100A, 3P, 4W)	
ATS	Generator Transfer Switch					
	Russelectric	NA NA	NA NA	RMTD Series with model 2000 controller	NEMA 12/3R 316SS Enclosure	
Odor Control Units	Biotrickling Filters	Biotrickling filters				
		BioAir	NA NA	NA NA		
		Bioem	NA NA	NA NA	Biosorbens BTF	
		Envirogen	NA NA	NA NA	BTF	
		Siemens	NA NA	NA NA	Zabocs BTF	
Carbon Adsorption Units	Carbon Adsorption Units					
		Calgon	NA NA	NA NA		
		Pure Air Filtration	NA NA	NA NA		
		Siemens	NA NA	NA NA		
Pressure Gauges	Pressure Gauges shall have Diaphragm Seals. Oil filled.					
		Ashcroft	NA NA	NA NA	10 1008SL 02L 60# 25 200SS 02T XYTSE	Gauge Diaphragm Seal
		Terice	NA NA	NA NA	D83LFSS4002LA100 - Gauge M51001SSSS - Diaphragm Seal D99100 Fill and Mount Charge	
		Winter Gauges	NA NA	NA NA	PFQ770 0-60 PSI D70950 top D70954 Bottom	
Pumps	Submersible Pumps					
		ABS	NA NA	NA NA		
		Flygt	NA NA	NA NA		

APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water Model # Comments	Reclaimed Water Model # Comments	Wastewater Model #	Comments
Pumps	Floats	Atlantic Scientific	NA NA	NA NA	Roto-Float	
	Radar	Radar - Pulse Burst Radar Transmitter. Input 24 VDC and Output 4-20 mA		NA NA	R82-520A-011	
Main Service	Disc	Main Service Disconnect Breaker		NA NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
	Surge Protector	Surge Protector - UL 1449, 3rd Edition listed and labeled, minimum 10 year warranty, NEMA LS-1 and IEEE C62, 41/45 tested with NEMA 4X enclosure, internal fusing, voltage and phase to match service. Rated 80,000 amps per mode for Duplex & Triplex stations and 150,000 Amperes per mode for Master Stations. All devices shall be provided with a NEMA 4X Plastic enclosure which is approved in lieu of stainless steel.		NA NA	XN-80, TG-150 or CurrentGuard 150 Plus Series TSS-ST 160 Series, ST 300 Series or JSP-300 Series LSE Series or SHL Series	
Sub Panel	Sub Panel	Sub-Panel Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated finish inside and out, With 3 Point Pad lockable Handle, and Door Stop		NA NA		
	Control Panel	Control Panel Supplier		NA NA		
Pump Station Control Panel	Enclosure	Enclosure - NEMA 12/3R Enclosure 316SS, white polyester Powder coated finish inside and out, With 3 Point Pad lockable Handle, and Door Stop		NA NA		
	Mnts	Mounting Channel for Enclosures		NA NA	1" 5/8 x 1" 5/8 316 SS	
Pump Station Seal-off	Seal-off	Explosion-Proof Sealoff		NA NA	EYSR - 2 Inch Min.	
	FL	Flasher (FL)		NA NA	025-120-105 FS-126	

APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	Comments	
AL	Alarm Light / With Base and Globe (AL)								
	American Electric	NA	NA	NA	NA	F32552			
	Red Dot Globe Red Dot Base	NA	NA	NA	NA	VGLR-01 VA-01			
AH	Alarm Horn (AH)								
	Wheelock	NA	NA	NA	NA	3IT-115-R			
Fuse	Fuses (F)								
	Bussmann	NA	NA	NA	NA	FNQ-R or KTK-R			
HOA	Hand-Auto-Off Selector (HOA)								
	Square D	NA	NA	NA	NA	9001-SKS43B			
HSS	Horn Silence Button (HSS)								
	Square D	NA	NA	NA	NA	9001-SKR 1RH5			
Inter-lock	Mechanical Interlock								
	Square D	NA	NA	NA	NA	S29354			
Breakers	Control Panel Main Circuit Breaker (MCB) With S29450 Circuit Breaker Auxiliary Switch								
	Square D	NA	NA	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
	Emergency Circuit Breaker (ECB) With S29450 Circuit Breaker Auxiliary Switch								
	Square D	NA	NA	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
MS	Motor Circuit Breaker (MB)								
	Square D	NA	NA	NA	NA	NA	NA	H or J Frame 3 Pole 600 Volt (HGL or JGL determined by amperage)	
	Control Circuit Breaker/ GFCI Receptacle Breaker/ SCADA Breaker								
	Square D	NA	NA	NA	NA	NA	NA	QOU120	
OL	Motor Starter (MS)								
	Square D	NA	NA	NA	NA	NA	NA	Type S Class 8536	
OR	Overload Heater(OL)								
	Square D	NA	NA	NA	NA	NA	NA	Part number will vary with size needed	
Transforme r	Overload Reset								
	Square D	NA	NA	NA	NA	NA	NA	9066-RA1	
	Control Circuit Transformer (XMFR)								
	Square D	NA	NA	NA	NA	NA	NA	9070TF75D23	120/24 Volt .075 KVA
SPB	Main Circuit Transformer (MCT)								
	Square D	NA	NA	NA	NA	NA	NA	9070T2000D1	480/120 2KVA
	Supplemental Protector Breaker - 3 pole, 1-amp for Phase Monitor								
	Square D	NA	NA	NA	NA	NA	NA	MG24532	

APPENDIX D LIST OF APPROVED PRODUCTS - PUMP STATION SYSTEMS

FEBRUARY 11, 2011

Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater	
			Model #	Comments	Model #	Comments	Model #	Comments
PM	Phase Monitor (PM)							
	MPE 240 V.		NA	NA	NA	NA	001-230-118-OVG5	
	MPE 480 V.		NA	NA	NA	NA	002-480-123-OVG5	
Pump Alternator	Pump Automatic Alternator (PAA)							
	Diversified Duplex		NA	NA	NA	NA	ARA-120-ACA	
	Diversified Triplex		NA	NA	NA	NA	ARA-120-AME	
	MPE Duplex		NA	NA	NA	NA	008-120-13SP	
	MPE Triplex		NA	NA	NA	NA	009-120-23P	
	MPE Triplex Socket		NA	NA	NA	NA	SD-12-PC	
Alt. Test Switch	Alt. Test Switch							
	Carling Technologies		NA	NA	NA	NA	6GG5E-78	
	Honeywell		NA	NA	NA	NA	2TLJ-50	
Relay	Relay							
	Potter Brumfield 24 Volt		NA	NA	NA	NA	KRPA-11AN-24	
	Potter Brumfield 120 Volt		NA	NA	NA	NA	KRPA-11AN-120	
	Square D 24 Volt		NA	NA	NA	NA	8501KPI2P14V14	
	Square D 120Volt		NA	NA	NA	NA	8501KPI2P14V20	
Relay Base	Relay Base							
	IEDC 8 Pin Relay Base 600 Volt		NA	NA	NA	NA	SR2P-06	
Duplex Receptacle/GFCI	Duplex Receptacle/GFCI (DR) Upgraded to 20 Amp							
	Hubbell		NA	NA	NA	NA	GFTR20BK	
	Pass & Seymour		NA	NA	NA	NA	2095TRBK	
ETM	EIapse Time Meter (ETM)							
	Reddington		NA	NA	NA	NA	711-0160	
Grounding	Grounding System							
	Marathon		NA	NA	NA	NA	Neutral Isolation Block 1421570	
	Panduit		NA	NA	NA	NA	Ground Lug LAM2A 1/0 - 014 -6Y	
	Square D		NA	NA	NA	NA	Ground Buss PK7GTA	
TS	Terminal Strip (TS)							
	Marathon		NA	NA	NA	NA	Series 200	
	Square D		NA	NA	NA	NA	9080GR6	
TS	Terminal Strip End Blocks and End Clamps							
	Square D		NA	NA	NA	NA	9080GM6B & 9080GH10	

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Cat.	Desc	Manufacturer	Water		Reclaimed Water		Wastewater		
			Model #	Comments	Model #	Comments	Model #	Comments	
Pump Station Control Panel	PL	Pilot Light (PL) 24 Volt with 1819 Bulb							
		Dialight	NA	NA	NA	NA	803-1710		
		Lighting Components & Design	NA	NA	NA	NA	Littlelight 930507X		
Pump Station Control Panel	RL	Run Indicator Light (RL) 120 Volt							
		Dialight	NA	NA	NA	NA	803-1710		
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X With 120MB Bulb		
Pump Station Control Panel	MT	Moisture and Temperature Failure Light (MT) 120 Volt with 120MB Bulb							
		Dialight	NA	NA	NA	NA	803-1710		
		Lighting Components & Design	NA	NA	NA	NA	Littlelites 930507X		
Sluice Gate	Sluice Gate	Sluice Gate for Wet Well with Motorized Operator							
		BNW	NA	NA	NA	NA	Model 77 - 316 SS		
		Fontaine	NA	NA	NA	NA	Model 20 - 316 SS		
VFD	VFD	Variable Frequency Drives							
		Square D	NA	NA	NA	NA	NA	NA	

APPENDIX G

ORANGE COUNTY UTILITIES

DEWATERING DISCHARGE OFF-SITE

- **Orange County Environmental Protection Division Work Instruction**
- **Generic Permit for the Discharge of Produced Ground Water From any Non-Contaminated Site Activity**
- **FDEP Notice of New Method for Mercury Testing**
- **Memo – EPA - Analytical Methods for Mercury in NPDES Permits**

**ORANGE COUNTY ENVIRONMENTAL PROTECTION DIVISION
WORK INSTRUCTION**

Title: Dewatering Permitting and Approvals Work Instruction
Number: EPD-WI-2000-04

Effective Date: 10/04/2011 Revision: 1
Renewal Date: 10/04/2014 Revision Date: 10/04/2011
Approved By: Elizabeth R. Johnson, Environmental Programs Administrator

Purpose: The purpose of this work instruction is to provide guidance regarding the approvals required to initiate construction related dewatering in unincorporated Orange County

I. Procedure

County Offices:

Orange County Public Works

For proposed dewatering discharges to the Orange County Municipal Separate Storm Sewer System (MS4), contact Orange County Development Engineering prior to commencement of dewatering. OC Public Works Contact: Miguel Tamayo, 407-836-7914.

Orange County Utilities (OCU)

If the groundwater discharge testing indicates groundwater quality parameter exceedences, the discharge may be allowed to enter into the Orange County sanitary system. Coordinate with OCU. If OCU can accept the discharge, a County Industrial Wastewater Discharge Permit (IWD) will be required. Per Florida Department of Environmental Protection (FDEP), no FDEP dewatering permitting is required if an IWD is received.

Contact: Susanna Littell, OCU/Water Reclamation, 407-254-7710 (Industrial Wastewater Discharge Permits)

Contact: Laura Woodbury, P.E., OCU/Development Engineering, 407-254-9928.

Rules/Permits:

- Chapter 37 Article XX. Addresses industrial waste pretreatment and permitting.
- Industrial Wastewater Discharge (IWD) Permit. Required prior to discharge to the wastewater system.
- OCU Development Engineering Connection Requirements. OCU Development Engineering reviews and approves plans for groundwater dewatering and remediation projects when discharge will be to the OCU sanitary sewer system.

EPD-WI-2000-04	Effective Date: 10/04/2011
The only official copy of this document is on the EPD intranet.	Page 1 of 3

**ORANGE COUNTY ENVIRONMENTAL PROTECTION DIVISION
WORK INSTRUCTION**

State Agencies:

Florida Department of Environmental Protection (FDEP)

For dewatering that is discharged offsite, sampling/analytical work is required prior to dewatering to determine if the proposed activity can be permitted under one of the generic dewatering permits.

FDEP Contacts: Ali Kazi, 407-897-4149; Randall Cunningham, 407-897-4152.

Rules/Permits:

- Generic Permit for Discharges from Petroleum Contaminated Sites (62-621.300(1)).
- Generic Permit for the Discharge of Produced Groundwater from any Non-Contaminated Site Activity (62-621.300(2)).
- Permit for all Other Contaminated Sites (62-04; 62-302; 62-620 & 62-660).

Water Management Districts:

St. Johns River Water Management District

Contact: Richard Kimmel, 407-659-4849.

Rules/Permits:

- No permit ("No Notice").
- Noticed General Permit for Short-term Construction Dewatering.
- Individual and Standard General Consumptive Use Permit.

South Florida Water Management District

Contact: Mario Cabana, 407-858-6100, ext. 3816.

Rules/Permits:

- "No-Notice" Short-Term Dewatering Permits.
- Dewatering General Water Use Permits.
- Long-term Dewatering Individual Permits.

For dewatering activities located in the City of Orlando contact Lisa Lotti at 407-246-2037.

II. Scope

This procedure applies to construction sites within unincorporated Orange County.

Definitions:

Off-site: For the purposes of this Work Instruction, off-site means property not under control of the owner/applicant or (discharging to) the municipal separate storm sewer system or waters of the County.

EPD-WI-2000-04	Effective Date: 10/04/2011
The only official copy of this document is on the EPD intranet.	Page 2 of 3

**ORANGE COUNTY ENVIRONMENTAL PROTECTION DIVISION
WORK INSTRUCTION**

Related Documents:

Florida Department of Environmental Protection's Construction Generic Permit

History of Revisions:

Revision No.	Revision Date	Summary of Revisions
0	06/06/2011	Original
1	10/04/2011	Update contact information

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL PROTECTION

GENERIC PERMIT

FOR THE

DISCHARGE OF PRODUCED GROUND WATER

FROM ANY NON-CONTAMINATED SITE ACTIVITY

Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity

(1) The facility is authorized to discharge produced ground water from any non-contaminated site activity which discharges by a point source to surface waters of the State, as defined in Chapter 62-620, F.A.C., only if the reported values for the parameters listed in Table 1 do not exceed any of the listed screening values. Before discharge of produced ground water can occur from such sites, analytical tests on samples of the proposed untreated discharge water shall be performed to determine if contamination exists.

(2) Minimum reporting requirements for all produced ground water dischargers. The effluent shall be sampled before the commencement of discharge, again within thirty (30) days after commencement of discharge, and then once every six (6) months for the life of the project to maintain continued coverage under this generic permit. Samples taken in compliance with the provisions of this permit shall be taken prior to actual discharge or mixing with the receiving waters. The effluent shall be sampled for the parameters listed in Table 1.

Table 1

Parameter	Screening Values for Discharges into:	
	Fresh Waters	Coastal Waters
Total Organic Carbon (TOC)	10.0 mg/l	10.0 mg/l
pH, standard units	6.0-8.5	6.5-8.5
Total Recoverable Mercury	0.012 µg/l	0.025 µg/l
Total Recoverable Cadmium	9.3 µg/l	9.3 µg/l
Total Recoverable Copper	2.9 µg/l	2.9 µg/l
Total Recoverable Lead	0.03 mg/l	5.6 µg/l
Total Recoverable Zinc	86.0 µg/l	86.0 µg/l
Total Recoverable Chromium (Hex.)	11.0 µg/l	50.0 µg/l
Benzene	1.0 µg/l	1.0 µg/l
Naphthalene	100.0 µg/l	100.0 µg/l

(3) If any of the analytical test results exceed the screening values listed in Table 1, except TOC, the discharge is not authorized by this permit.

(a) For initial TOC values that exceed the screening values listed in Table 1, which may be caused by naturally-occurring, high molecular weight organic compounds, the permittee may request to be exempted from the TOC requirement. To request this exemption, the permittee shall submit additional information with a Notice of Intent (NOI),

described below, which describes the method used to determine that these compounds are naturally occurring. The Department shall grant the exemption if the permittee affirmatively demonstrates that the TOC values are caused by naturally-occurring, high molecular weight organic compounds.

(b) The NOI shall be submitted to the appropriate Department district office thirty (30) days prior to discharge, and contain the following information:

1. the name and address of the person that the permit coverage will be issued to;
2. the name and address of the facility, including county location;
3. any applicable individual wastewater permit number(s);
4. a map showing the facility and discharge location (including latitude and longitude);
5. the name of the receiving water; and
6. the additional information required by paragraph (3)(a) of this permit.

(c) Discharge shall not commence until notification of coverage is received from the Department.

(4) For fresh waters and coastal waters, the pH of the effluent shall not be lowered to less than 6.0 units for fresh waters, or less than 6.5 units for coastal waters, or raised above 8.5 units, unless the permittee submits natural background data confirming a natural background pH outside of this range. If natural background of the receiving water is determined to be less than 6.0 units for fresh waters, or less than 6.5 units in coastal waters, the pH shall not vary below natural background or vary more than one (1) unit above natural background for fresh and coastal waters. If natural background of the receiving water is determined to be higher than 8.5 units, the pH shall not vary above natural background or vary more than one (1) unit below natural background of fresh and coastal waters. The permittee shall include the natural background pH of the receiving waters with the results of the analyses required under paragraph (2) of this permit. For purposes of this section only, fresh waters are those having a chloride concentration of less than 1500 mg/l, and coastal waters are those having a chloride concentration equal to or greater than 1500 mg/l.

(5) In accordance with Rule 62-302.500(1)(a-c), F.A.C., the discharge shall at all times be free from floating solids, visible foam, turbidity, or visible oil in such amounts as to form nuisances on surface waters.

(6) If contamination exists, as indicated by the results of the analytical tests required by paragraph (2), the discharge cannot be covered by this generic permit. The facility shall apply for an individual wastewater permit at least ninety (90) days prior to the date discharge to surface waters of the State is expected, or, if applicable, the facility may seek coverage under any other applicable Department generic permit. No discharge is permissible without an effective permit.

(7) If the analytical tests required by paragraph (2) reveal that no contamination exists from any source, the facility can begin discharge immediately and is covered by this permit without having to submit an NOI request for coverage to the Department. A short summary of the proposed activity and copy of the analytical tests shall be sent to the applicable Department district office within one (1) week after discharge begins. These analytical tests shall be kept on site during discharge and made available to the Department if requested. Additionally, no Discharge Monitoring Report forms are required to be submitted to the Department.

(8) All of the general conditions listed in Rule 62-621.250, F.A.C., are applicable to this generic permit.

(9) There are no annual fees associated with the use of this generic permit.



Department of Environmental Protection

Notice of New Method for Mercury Testing

New Method for Mercury Testing Has Been Approved

In accordance with Rule 62-620.610, Florida Administrative Code (F.A.C.), all sampling and monitoring data, required to be reported to the Department, shall be collected and analyzed in accordance with Rule 62-4.246, Chapters 62-160 and 62-601, F.A.C., and 40 CFR 136, as appropriate. Effective August 25, 2003, Chapter 62-620, F.A.C., was revised to adopt, and incorporate by reference, various sections of Title 40 of the Code of Federal Regulations revised as of July 1, 2003, including the revised 40 CFR 136. The revised 40 CFR 136 includes a new method for low-level mercury analysis, EPA Method 1631(Revision E), Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry (Method 1631E).

Who is Required to Use Method 1631E?

Applicants for a wastewater facility permit and wastewater facility permittees are now required to use the low-level mercury Method 1631E when reporting results associated with water quality standards (WQSs) below 0.2 micrograms per liter (ug/L). The following facilities are now required to use Method 1631E for all **effluent samples**:

- Facilities discharging to Class I and Class II surface waters, including wetlands.
- Facilities discharging to Class III Marine or Fresh surface waters, including wetlands.
- Facilities with Water Quality Based Effluent Limits (WQBELs), or any other limit for mercury specified in a permit, below 0.2 ug/L.

This includes effluent samples collected for any of the following requirements:

- Monitoring specified in Section I, *Reclaimed Water and Effluent Limitations and Monitoring*, section of permits.
- Monitoring performed under Section 3.A. of *Wastewater Permit Application Form 2A For Domestic Wastewater Facilities*; Part VII.C. of *Application to Discharge Process Wastewater from New or Existing Industrial Wastewater Facilities to Surface Water - Form 2CS*; or Part V.C. of *Application to Discharge Process Wastewater from New or Existing Industrial Wastewater Facilities to Ground Water - Form 2CG*.
- Priority pollutant scans performed in accordance with pretreatment program annual report requirements.
- Monitoring performed for the development or re-evaluation of local discharge limitations.
- Monitoring required in Table 4 of the Generic Permit for Discharges from Petroleum Contaminated Sites and Table 1 of the Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity.

The low-level mercury method provides, for the first time, the ability to assess compliance with mercury water quality standards (WQSs) below 0.2 ug/L. Your permit requires that surface water discharges shall be analyzed using a sufficiently sensitive method in accordance with 40 CFR 136. *Wastewater Permit Application Forms 2A, 2CS, and 2CG* require effluent testing be conducted using methods that are able to detect pollutants at levels adequate to meet WQSs and to provide reasonable assurance that the WQSs will not be violated in the future.

Additionally, in order to develop technically and legally defensible local discharge limitations for domestic wastewater facilities that have pretreatment programs, Method 1631E must be used to provide data that clearly establishes the basis for any calculated mercury limitations. Note, regarding local discharge limitations, the requirement to use Method 1631E may be expanded to other locations in the collection and treatment system on a case-by-case basis depending on the initial results from effluent analysis using Method 1631E.

Mercury Laboratory Analysis

Method 1631E has a minimum level of quantitation of 0.0005 ug/L, or 0.5 nanograms per liter (ng/L), which is 400-times more sensitive than Method 245.1 ("Manual Cold Vapor Technique"). Due to the sensitivity of Method 1631E, the results are typically measured in parts per trillion (ng/L) rather than in parts per billion (µg/L). The Department is currently evaluating Method 1631E to determine target method detection limits (MDLs) and target practical quantification limits (PQLs). Until target MDLs and PQLs are incorporated into Rule 62-4.246(4), the laboratory analysis is expected to achieve MDLs close to, or below, 1 ng/L. All laboratory analysis must be done by a NELAP accredited laboratory with current certification by Florida Department of Health for Method 1631E.

Mercury Clean Sampling Techniques

Clean sample handling techniques should be used when collecting samples for low-level mercury analysis to preclude false positives arising from sample collection, handling, or analysis. Sample collection methods should be consistent with *DEP-SOP-001/01: FS 8200 Clean Sampling For Ultratrace Metals in Surface Waters* and *EPA Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA-821-R-96-011). Because FS 8200 and Method 1669 are performance-based procedures, sample collection personnel may modify these procedures or eliminate steps if the modification does not lead to unacceptable contamination of samples or blanks. Any modifications should be thoroughly evaluated and demonstrated to be effective before field samples are collected. This may be accomplished through documentation of uncontaminated samples, equipment blanks and/or other quality control samples.

Note, discrete and composite samplers have been found to contaminate samples with mercury at the ng/L level. Therefore, grab samples are permissible when using Method 1631E. However, grab samples must be representative of the wastewater discharge and a field blank should be collected along with the sample.

In order for a permittee to justify a claim that any reported mercury is due to outside contamination, a blank must have been collected. For this reason, permittees should consider collecting at least one blank at each site for each day a sample is collected. If more than one sample is collected in a day, at least one blank for each 10 samples collected on that day should also be collected. The blank may either be an equipment blank or a field blank. Once a permittee demonstrates the ability to collect samples from a given site using an established procedure that prevents contamination, the permittee may choose to decrease the number of blanks being taken. Specific definitions and procedures for collecting blanks are found in DEP SOP FQ 1000.

Field blanks should be collected only if no equipment other than the sample container is used to collect samples. If the sampling procedure involves the use of additional equipment, such as a peristaltic pump and pump tubing, equipment blanks should be collected. All blanks are subject to the same preservation, digestion, and analysis protocols as regular samples and should have a concentration at least five times lower than the sample concentration. The permittee may not subtract field blank concentrations when reporting sample results.

Sample-collection, preservation, and shipping requirements should be discussed with contract laboratories to ensure the requirements of Method 1631E are met.

Additional Assistance and Information

For additional information on Method 1631:
www.epa.gov/waterscience/methods/1631.html

Please refer questions concerning sample collection to:
Silky Labic: 850-245-8066
Silky.Labic@dep.state.fl.us

Additional information concerning NELAP certified laboratories can be obtained from:
Department of Health Bureau of Laboratories
P.O. Box 210 Jacksonville, FL 32231
(904) 791-1599 (voice)(904) 791-1591 (fax)
[ftp.dep.state.fl.us/pub/labs/assessment/doh/accredited.pdf](ftp://ftp.dep.state.fl.us/pub/labs/assessment/doh/accredited.pdf)



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
WATER

signed: August 23, 2007

MEMORANDUM

SUBJECT: Analytical Methods for Mercury in National Pollutant Discharge Elimination System (NPDES) Permits

FROM: James A. Hanlon, Director
Office of Wastewater Management

TO: Water Division Directors, Regions 1 - 10

The purpose of this memorandum is to inform you of EPA's March 12, 2007, approval of Method 245.7 for measurement of mercury and modified versions of approved analytical methods for mercury as well as the impact of their approval on the NPDES permitting process. While several different methods are currently approved under 40 CFR Part 136 for the analysis of mercury, some of these methods have much greater sensitivities and lower quantitation levels than others. This memorandum clarifies and explains that, in light of existing regulatory requirements for NPDES permitting,¹ only the most sensitive methods such as Methods 1631E and 245.7 are appropriate in most instances for use in deciding whether to set a permit limitation for mercury and for sampling and analysis of mercury pursuant to the monitoring requirements within a permit.

BACKGROUND

Section 301 of the Clean Water Act (CWA) requires NPDES permits to include effluent limitations that are as stringent as necessary to meet water quality standards. Thus, under the Act and EPA regulations, each permit must include, as necessary, requirements in addition to or more stringent than technology-based effluent limitations established under section 301 of the CWA in order to achieve water quality standards. 40 C.F.R. § 122.44(d)(1). The regulations require limitations to control all pollutants that the NPDES program director determines are or may be discharged at a level that "will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard," including both narrative and

¹ This memorandum is based on existing legal requirements and authorities. It does not impose any new, legally binding requirements on EPA, states, or the regulated community.

numeric criteria, 40 C.F.R. § 122.44(d)(1)(i). If the program director determines that a discharge has the reasonable potential to cause or contribute to such an excursion, the permit must contain water quality-based effluent limitations for the pollutant, 40 C.F.R. § 122.44(d)(1)(iii). Thus, a prospective permittee may need to measure various pollutants in its effluent at two stages: first, at the permit application stage so that the program director can determine whether “reasonable potential” exists and establish appropriate permit limits; and second, where a permit limit has been established, to meet the monitoring requirements within the permit. The following discussion explains which analytical methods permit applicants and permittees should use to make these measurements when mercury is the pollutant at issue.

Approved Analytical Methods

Measurements included on NPDES permit applications and on reports required to be submitted under the permit must generally be made using analytical methods approved by EPA under 40 CFR Part 136. See 40 CFR 136.1, 136.4, 136.5, 122.21(g)(7), and 122.41(j). For mercury, there are three methods commonly used in the NPDES program that EPA has approved under Part 136: Method 245.1, Method 245.2, and Method 1631E. Methods 245.1 and 245.2 were approved by EPA in 1974 and can achieve measurement of mercury down to 200 parts per trillion (ppt). Additionally, EPA approved Method 1631 Revision E in 2002. Method 1631E has a quantitation level of 0.5 ppt, making it 400 times more sensitive than Methods 245.1 and 245.2. In fact, the sensitivity of Methods 245.1 and 245.2 are well above the water quality criteria now adopted in most states (as well as the criteria included by EPA in the Final Water Quality Guidance for the Great Lakes System) for the protection of aquatic life and human health, which generally fall in the range of 1 to 50 ppt.² In contrast, Method 1631E, with a quantitation level of 0.5 ppt, does support the measurement of mercury at these low levels.

In addition to Methods 245.1, 245.2, and 1631E listed above, EPA approved Method 245.7 as well as modified versions of other EPA-approved methods on March 12, 2007. See 72 FR 11200. Method 245.7 has a quantitation level of 5.0 ppt, making it 40 times more sensitive than Methods 245.1 and 245.2. Additionally, modified versions of EPA-approved methods may also be used for the measurement of mercury. Methods approved under Part 136, such as 245.1 and 245.2, may be modified to achieve lower quantitation levels than can be achieved by the method as written.³ Modifications to an EPA-approved method for mercury that meet the method

² Many states have adopted mercury water quality criteria of 12 ppt for protection of aquatic life and 50 ppt for the protection of human health, and for discharges to the Great Lakes Basin, the applicable water quality criteria for mercury are 1.3 ppt for the protection of wildlife and 1.8 ppt for the protection of human health. In 2001, EPA issued new recommended water quality criteria guidance for the protection of human health. This new guidance recommends adoption of a methylmercury water quality criterion of 0.3 milligrams of methylmercury per kilogram (mg/kg) in fish tissue. EPA is currently developing implementation guidance to assist states in implementing the criterion, and *Draft Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion* (EPA-823-B-04-001) was released for public comment in August 2006.

³ Examples of such modification may include changes in the sample preparation digestion procedures such as the use of reagents similar in properties to ones used in the approved method, changes in the equipment operating parameters such as the use of an alternate more sensitive wavelength, adjusting the sample volume to optimize method performance, and changes in the calibration ranges (provided that the modified range covers any relevant regulatory limit).

performance requirements of Part 136.6 are considered to be approved methods and require no further EPA approval. See 72 FR 11239-40 (March 12, 2007). For analytical method modifications that do not fall within the flexibility of Part 136.6, the modified methods may be approved under the alternate test procedure program as defined by Parts 136.4 and 136.5.

ACTIONS RESULTING FROM THE MARCH 12, 2007, RULEMAKING

To implement the March 12, 2007, rule, the Office of Wastewater Management (OWM) provides the following guidance:

Monitoring Data Submitted as Part of NPDES Permit Applications

As noted, most states have adopted water quality criteria for the protection of aquatic life and human health that fall in the range of 1 to 50 ppt, and Methods 245.1 and 245.2, as written, do not detect or quantify mercury in this range. A "did not detect" result using Method 245.1 or Method 245.2 would show only that mercury levels are below 200 ppt but would not establish that they are at or below the applicable water quality criterion. Therefore, when a permit writer receives a permit application reporting mercury data analyzed with Method 245.1 or Method 245.2 as "did not detect" results, the permit writer in reality may lack the information needed to make a "reasonable potential" determination. In contrast, Method 1631E is able to detect and quantify mercury concentrations at these low levels.

EPA therefore expects, in general, that all facilities with the potential to discharge mercury will provide with their NPDES permit applications monitoring data for mercury using Method 1631E or another sufficiently sensitive EPA-approved method. For purposes of permit applications, a method for mercury is "sufficiently sensitive" when (1) its method quantitation level is at or below the level of the applicable water quality criterion for mercury or (2) its method quantitation level is above the applicable water quality criterion, but the amount of mercury in a facility's discharge is high enough that the method detects and quantifies the level of mercury in the discharge.⁴ Accordingly, EPA strongly recommends that the permitting authority determine that a permit application that lacks effluent data analyzed with a sufficiently sensitive EPA-approved method such as Method 1631E is incomplete unless and until the facility supplements the original application with data analyzed with such a method. See 40 CFR 122.21(e) (a permit application is determined to be complete at the discretion of the permitting authority) and 40 CFR 122.21(g)(13) (the applicant shall provide to the Director, upon request, such other information as the Director may reasonably require to assess the discharge). Such data would allow the permitting authority to characterize the effluent to determine whether the discharge causes, has the reasonable potential to cause, or contributes to an excursion of state water quality standards for mercury and would consequently allow the permitting authority to determine whether a water quality-based effluent limit for mercury is necessary in the permit.

⁴ To illustrate the latter, if the water quality criterion for mercury in a particular state is 2.0 ppt, Method 245.7 (with a quantitation level of 5.0 ppt) would be sufficiently sensitive where it reveals that the level of mercury in a facility's discharge is 5.0 ppt or greater. In contrast, Method 245.7 would not be sufficiently sensitive if it resulted in a level of non-detect for that discharge because it could not be known whether mercury existed in the discharge at a level between 2.0 and 5.0 (less than the quantitation level but exceeding the water quality criterion).

Monitoring Requirements in Permits

Where a permit authority establishes a permit limit for mercury, it also needs to consider specifying an analytical method that the permittee must use to monitor for mercury during the term of the permit. Methods 245.1 and 245.2, as written, are not likely to be sensitive enough to detect or quantify the concentration of mercury in the discharge at a level that matches the limitation for mercury in the permit. EPA therefore expects the permitting authority to require the use of a sufficiently sensitive EPA-approved method for monitoring under the permit in order to ensure that the sampling and measurements required are "representative of the monitored activity" (as required by 40 CFR 122.41(j)(1)). For purposes of monitoring under a permit, a method for mercury is "sufficiently sensitive" when (1) its method quantitation level is at or below the level of the mercury limit established in the permit or (2) its method quantitation level is above the mercury limit in the permit, but the amount of mercury in a facility's discharge is high enough that the method detects and quantifies the level of mercury in the discharge.⁵

EPA Permit Review and Objection to State Issued Permits

For NPDES-authorized states, EPA regions are expected to review state permits and should strongly consider objecting to permits that are issued based on analytical data collected and analyzed using an EPA-approved method that is not sufficiently sensitive or that do not require use of a sufficiently sensitive EPA-approved method for monitoring when the permit includes a limit for mercury. OWM is expecting to undertake a permit quality review of a small representative number of permits with respect to mercury limitations and other conditions.

If you have questions concerning the content of this memorandum, please contact Linda Boornazian, Director of the Water Permits Division, at 202-564-0221 or have your staff contact Marcus Zobrist of the State and Regional Branch at 202-564-8311 or zobrist.marcus@epa.gov.

cc: NPDES Branch Chiefs Regions 1 - 10

⁵ See footnote 4.

SPECIFICATION MANUAL
BID PACKAGE 'A' - VOLUME II
Division 13 through Division 16
ORANGE COUNTY
HOLDEN HEIGHTS COMMUNITY
CENTER



Prepared by:



C.T. HSU + ASSOCIATES, P.A.

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Bid Documents

February 22, 2013



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Division 13

Special Construction

SECTION 13851
FIRE ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes fire alarm systems.
- B. Related Sections include the following:
 - 1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

1.3 DEFINITIONS

- A. FACP: Fire alarm control panel.
- B. LED: Light-emitting diode.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.
 - 1. Interface with existing fire alarm system.
- B. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.
 - 1. Interface with existing fire alarm system.

1.5 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. Fire alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Verified automatic alarm operation of smoke detectors.
 - 5. Automatic sprinkler system water flow.
 - 6. Fire extinguishing system operation.
- C. Fire alarm signal shall initiate the following actions:
 - 1. Alarm notification appliances shall operate continuously.
 - 2. Identify alarm at the FACP and remote annunciators.
 - 3. De-energize electromagnetic door holders.
 - 4. Transmit an alarm signal to the remote alarm receiving station.
 - 5. Unlock electric door locks in designated egress paths.
 - 6. Release fire and smoke doors held open by magnetic door holders.
 - 7. Activate voice/alarm communication system.
 - 8. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
 - 9. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
 - 10. Record events in the system memory.
 - 11. Record events by the system printer.
- D. Supervisory signal initiation shall be by one or more of the following devices or actions:
 - 1. Operation of a fire-protection system valve tamper.
- E. System trouble signal initiation shall be by one or more of the following devices or actions:
 - 1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
 - 2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of primary power at the FACP.
 - 4. Ground or a single break in FACP internal circuits.
 - 5. Abnormal ac voltage at the FACP.
 - 6. A break in standby battery circuitry.
 - 7. Failure of battery charging.
 - 8. Abnormal position of any switch at the FACP or annunciator.
 - 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
 - 10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

- F. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators. Record the event on system printer.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire alarm system design.
 - b. Fire alarm certified by NICET, minimum Level III.
 - 2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 - 3. Device Address List: Coordinate with final system programming.
 - 4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
 - 5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
 - 6. Batteries: Size calculations.
 - 7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 8. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 9. Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - 10. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.

- F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.
- G. Documentation:
 - 1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
 - 2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
 - a. Electronic media may be provided to Architect

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Work of this Section be performed by a UL-listed company.
- C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level [II] [III].
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 - 3. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
 - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
 - 5. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - 6. Audible and Visual Notification Appliances: One of each type installed.
 - 7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. FACP and Equipment:
 - a. Grinnell Fire Protection; a Tyco International Company.
 - b. Harrington Signal, Inc.
 - c. NOTIFIER; a GE-Honeywell Company.
 - d. Siemens Building Technologies, Inc.; a Cerberus Division.
 - e. Silent Knight; a GE-Honeywell Company.
 - f. SimplexGrinnell LP; a Tyco International Company.
 - 2. Wire and Cable:
 - a. Comtran Corporation.
 - b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
 - c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
 - d. West Penn Wire/CDT; a division of Cable Design Technologies.
 - 3. Audible and Visual Signals:
 - a. Amseco; a division of Kobishi America, Inc.
 - b. Commercial Products Group.
 - c. Gentex Corporation.
 - d. System Sensor; a GE-Honeywell Company.

2.2 FACP

- A. General Description:
 - 1. Modular, power-limited design with electronic modules, UL 864 listed.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation

and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Signaling Line Circuits: NFPA 72, Class A, Style 7.
2. Signaling Line Circuits: NFPA 72, Class B, Style 4.5.
 - a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.
3. Notification-Appliance Circuits: NFPA 72, Class A, Style Z.
4. Notification-Appliance Circuits: NFPA 72, Class B, Style [W] [X] [Y].
5. Actuation of alarm notification appliances, emergency voice communications, annunciation, and actuation of suppression system shall occur within 10 seconds after the activation of an initiating device.
6. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel FACP indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.

2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- H. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
- I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.
- J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.
- K. Voice/Alarm Signaling Service: A central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet.
1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.
 2. Notification-Appliance Circuits: NFPA 72, Class A.
 3. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
 4. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- L. Service Modem: Ports shall be RS-232 for system printer and for connection to a dial-in terminal unit.

1. The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.
- M. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- N. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.
1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
 2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."
- O. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
1. Batteries: Sealed lead calcium.
 2. Battery and Charger Capacity: Comply with NFPA 72.
- P. Surge Protection:
1. Install surge protection on normal ac power for the FACP and its accessories. Comply with Division 16 Section "Transient Voltage Suppression" for auxiliary panel suppressors.
 2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
- Q. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- ### 2.3 MANUAL FIRE ALARM BOXES
- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.

2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.4 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Multipurpose type, containing the following:
 - a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - b. Piezoelectric sounder rated at 88 dBA at 10 feet (3 m) according to UL 464.
 - c. Heat sensor, combination rate-of-rise and fixed temperature.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
 - a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F (8 or 11 deg C) per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F (57 or 68 deg C).
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

C. Ionization Smoke Detector:

1. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
2. Detector Sensitivity: Between 0.5 and 1.7 percent/foot (0.0016 and 0.0056 percent/mm) smoke obscuration when tested according to UL 268A.

D. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:
 - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
 - a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
8. Each sensor shall have multiple levels of detection sensitivity.
9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
10. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

- A. General: UL 521 listed.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate-of-rise of temperature that exceeds 15 deg F (8 deg C) per minute, unless otherwise indicated.
 1. Mounting: Adapter plate for outlet box mounting.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 NOTIFICATION APPLIANCES

- A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
- B. Bells: Electric-vibrating, 24-V dc, under-dome type; with provision for housing the operating mechanism behind the bell. Bells shall produce a sound-pressure level of 94 dBA, measured 10 feet (3 m) from the bell. 10-inch (254-mm) size, unless otherwise indicated. Bells are weatherproof where indicated.
- C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn.
- F. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - 1. Rated Light Output: 110 candela.
 - 2. Strobe Leads: Factory connected to screw terminals.
- G. Voice/Tone Speakers:
 - 1. UL 1480 listed.
 - 2. High-Range Units: Rated 2 to 15 W.
 - 3. Low-Range Units: Rated 1 to 2 W.
 - 4. Mounting: Flush, semirecessed, or surface mounted; bidirectional as indicated.
 - 5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

2.7 SPRINKLER SYSTEM REMOTE INDICATORS

- A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.8 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Class 1.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled according to UL 632.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.
- C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 GUARDS FOR PHYSICAL PROTECTION

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by manufacturer of the device.
 - 2. Finish: Paint of color to match the protected device.

2.12 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 - 3. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Smoke or Heat Detector Spacing:
 - 1. Smooth ceiling spacing shall not exceed 30 feet (9 m).
 - 2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
 - 3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.
- B. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
- C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

3.2 WIRING INSTALLATION

- A. Install wiring according to the following:
 - 1. NECA 1.

2. TIA/EIA 568-A.
- B. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways and Boxes."
 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
 - C. Wiring Method:
 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 2. Fire-Rated Cables: Use of 2-hour fire-rated fire alarm cables, NFPA 70 Types MI and CI, is not permitted.
 3. Signaling Line Circuits: Power-limited fire alarm cable shall not be installed in the same cable or raceway as signaling line circuits.
 - D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
 - E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
 - F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
 - G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
 - H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.4 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect test, and adjust field-assembled components and equipment installation, including connection, and to assist in field testing. Report results in writing.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
 - 2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - a. Include the existing system in tests and inspections.
 - 3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
 - 4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
 - a. Detectors that are outside their marked sensitivity range shall be replaced.
 - 5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.
- C. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- D. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices.

END OF SECTION 13851

Division 15 Mechanical

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 15060
HANGERS & SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 15 Section(s) "Metal Ducts" and "Nonmetal Ducts for additional duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B.]Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.

- B. Manufacturers:

- 1. Carpenter & Paterson, Inc.
- 2. ERICO/Michigan Hanger Co.
- 3. PHS Industries, Inc.
- 4. Pipe Shields, Inc.
- 5. Rilco Manufacturing Company, Inc.
- 6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Manufacturers:

- a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

- 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).

2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 15075
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Duct markers.
 - 7. Valve tags.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.

- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)], unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- (1.6-mm-) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme. Provide 5/32-inch (4-mm) hole for fastener.
 - 1. Material: 0.032-inch- (0.8-mm-) thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is

damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Meters, gages, thermometers, and similar units.
 - c. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - e. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - f. Fans, blowers, primary balancing dampers, and mixing boxes.
 - g. Packaged HVAC central-station and zone-type units.
 - h. Tanks and pressure vessels.
 - i. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.

2. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch (19 mm) wide, lapped at least 1-1/2 inches (38 mm) at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide, lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 1. Green: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 1. Valve-Tag Size and Shape:
 - a. 1-1/2 inches square
 2. Valve-Tag Color:
 - a. Yellow
 3. Letter Color:

- a. Black

3.6 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- B. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

SECTION 15080
MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.
9. Securements.
10. Corner angles.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control inspection reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
1. Products:
 - a. Fibrex Insulations Inc.; FBX.

- b. Johns Manville; 1000 Series Spin-Glas.
 - c. Owens Corning; High Temperature Industrial Board Insulations.
 - d. Rock Wool Manufacturing Company; Delta Board.
 - e. Roxul Inc.; Roxul RW.
 - f. Thermafiber; Thermafiber Industrial Felt.
- K. Mineral-Fiber, Preformed Pipe Insulation:
1. Products:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- L. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
1.]Products:
 - a. Knauf Insulation; Permawick Pipe Insulation.
 - b. Owens Corning; VaporWick Pipe Insulation.
- M. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.3 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products:

- a. Childers Products, Division of ITW; CP-96.
- b. Foster Products Corporation, H. B. Fuller Company; 81-33.

- C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.

1. Products:

- a. Aeroflex USA Inc.; Aero seal.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- d. RBX Corporation; Rubatex Contact Adhesive.

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

- F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

- a. Dow Chemical Company (The); 739, Dow Silicone.
- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates: Comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

- a. Childers Products, Division of ITW; CP-35.
- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
- c. ITW TACC, Division of Illinois Tool Works; CB-50.
- d. Marathon Industries, Inc.; 590.
- e. Mon-Eco Industries, Inc.; 55-40.
- f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTMD 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products:

- a. Childers Products, Division of ITW; CP-76.
- b. Foster Products Corporation, H. B. Fuller Company; 30-45.
- c. Marathon Industries, Inc.; 405.
- d. Mon-Eco Industries, Inc.; 44-05.
- e. Pittsburgh Corning Corporation; Pittseal 444.
- f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products:

- a. Childers Products, Division of ITW; CP-70.
- b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
- c. Marathon Industries, Inc.; 405.
- d. Mon-Eco Industries, Inc.; 44-05.
- e. Vimasco Corporation; 750.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products:

- a. Childers Products, Division of ITW; CP-76-8.
- b. Foster Products Corporation, H. B. Fuller Company; 95-44.
- c. Marathon Industries, Inc.; 405.
- d. Mon-Eco Industries, Inc.; 44-05.
- e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products:

- a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 1. Products:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Sheet and roll stock ready for shop or field sizing.
 3. Finish and thickness are indicated in field-applied jacket schedules.
 4. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
1. Width: 3 inches (75 mm).
 2. Thickness: 11.5 mils (0.29 mm).
 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Width: 3 inches (75 mm).
 2. Thickness: 6.5 mils (0.16 mm).
 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Width: 2 inches (50 mm).
 2. Thickness: 3.7 mils (0.093 mm).
 3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal.
- B. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
1. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness

indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

1. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 2. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- D. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
1. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 3. Adhesive-backed base with a peel-off protective cover.
- E. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- F. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- G. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- H. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.
- 2.11 CORNER ANGLES
- A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation with tightly butted joints free of voids and gaps. Vapor barriers shall be continuous. Before installing jacket material, install vapor-barrier system.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Hangers and Anchors: Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies according to Division 7 Section "Through-Penetration Firestop Systems."

3.4 DUCT AND PLENUM INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (50 mm) o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply vapor-barrier mastic to open ends, joints, seams, breaks, and punctures in insulation. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Secure single-layer insulation with bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
- C. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with bands at 12-inch (300-mm) intervals.
- D. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- E. Cover segmented insulated surfaces with a layer of insulating cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- F. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- G. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- H. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed insulation to pipe with wire or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 4. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 5. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- I. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of same insulation material and thickness as pipe insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.
 5. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- J. Insulation Installation on Pipe Fittings and Elbows:
1. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 2. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
- K. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap

- adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 5. Install insulation to flanges as specified for flange insulation application.
- L. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- M. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
- N. Special Installation Requirements for Flexible Elastomeric and Polyolefin Insulation:

1. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
2. Insulation Installation on Pipe Flanges:
 - a. Install pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - d. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install mitered sections of pipe insulation.
 - b. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket as specified in Division 9 painting Sections.

1. Apply two finish coats of interior, flat, latex-emulsion size over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
 - 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe,
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.
- C. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.10 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in nonconditioned space.
 - 4. Indoor, exposed return located in nonconditioned space.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Metal ducts exposed within an air conditioned storage space.
 - 4. Double wall preinsulated metal ducts.
 - 5. Factory-insulated flexible ducts.

6. Factory-insulated plenums and casings.
7. Flexible connectors.
8. Vibration-control devices.
9. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply, Return-Air Duct and Plenum Insulation (non mechanical room): Mineral-fiber blanket, 2.2 inches 0.75-lb/cu. Ft (R=6 minimum) nominal density.
- B. Concealed, Supply, Return-Air Duct and Plenum Insulation (non mechanical room): Mineral-fiber board, 3.0 inches 0.75-lb/cu. Ft (R=6 minimum) nominal density.

3.12 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Chilled-water pump & Heating Hot Water Pump insulation shall be the following (unless factory insulated by pump package manufacturer):
 1. Mineral-fiber board, 2 inches, 2-lb/cu. ft. (32-kg/cu. m)] <Insert value> nominal density.
- D. Chilled-water and Heating Hot water expansion/compression tank, air separator, insulation shall be the following:
 1. Mineral-fiber pipe and tank, 1 inch thick.

3.13 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 1. Fire-suppression piping.
 2. Drainage piping located in crawl spaces.
 3. Below-grade piping.
 4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR & OUTDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Mineral-fiber pipe insulation, Type I, 1 inch (25 mm) thick.
- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Flexible elastomeric 1/2 inch thick.
- C. Chilled Water, above 40 Deg F (5 Deg C): Insulation shall be the following:
 - 1. Cellular glass, 2 inches (50 mm) thick (Increase to 2.5 inches for outdoor)
- D. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and below: Mineral-fiber, preformed pipe, Type I - 1-1/2 inches (50 mm) thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
 - 1. aluminum, smooth, 0.016 inch (0.41 mm)
- D. Piping, Exposed:
 - 1. aluminum, smooth, 0.024 inch (0.61 mm)

END OF SECTION

SECTION 15140
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Flexible connectors.
4. Escutcheons.
5. Sleeves and sleeve seals.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- C. Install domestic water piping level and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valves as indicated on contract drawings. Use ball valves.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2-1/2 and smaller. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Aboveground Domestic Water Piping NPS 2-1/2 and Smaller: Plastic-to-metal transition fittings.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.9 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. Seal space outside of sleeves in concrete slabs and walls with grout.
- I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- J. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.

- a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.
- 3.11 SLEEVE SEAL INSTALLATION
- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
 - B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- 3.12 IDENTIFICATION
- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- 3.13 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
 - B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.14 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.15 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Aboveground domestic water piping, NPS 2-1/2 and smaller, shall be one of the following:
- 1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper solder-joint fittings; and brazed or soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.16 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
- 1. Shutoff Duty: Use ball valves for piping NPS 2-1/2 and smaller.
 - 2. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 - 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 15145
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
1. Vacuum breakers.
 2. Balancing valves.
 3. Temperature-actuated water mixing valves.
 4. Strainers.
 5. Hose bibbs.
 6. Wall hydrants.
 7. Drain valves.
 8. Water hammer arresters.
 9. Trap-seal primer valves.
- B. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Rough bronze.

2.2 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: 400-psig minimum CWP.

5. Size: NPS 2 or smaller.
6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Type: Thermostatically controlled water mixing valve.
6. Material: Bronze body with corrosion-resistant interior components.
7. Connections: Threaded inlets and outlet.
8. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Tempered-Water Setting: as indicated.
10. Tempered-Water Design Flow Rate: as indicated.
11. Valve Finish: Chrome plated.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2-1/2 and smaller
3. End Connections: Threaded for NPS 2-1/2 and smaller.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.

5. Perforation Size:
 - a. Strainers NPS 2-1/2 and Smaller: 0.020 inch.
6. Drain: Pipe plug.

2.5 HOSE BIBBS

- A. Hose Bibbs:
 1. Refer to plumbing fixture schedule on contract drawings.

2.6 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants:
 1. Refer to plumbing fixture schedule on contract drawings:

2.7 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
 1. Refer to plumbing fixture schedule on contract drawings:

2.9 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer Valves:
 1. Refer to plumbing fixture schedule on contract drawings:

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each pump.
- E. Install water hammer arresters in water piping according to PDI-WH 201.
- F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- G. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 FIELD QUALITY CONTROL

- A. Remove and replace malfunctioning domestic water piping specialties.

3.3 ADJUSTING

- A. Set field-adjustable flow of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 15150
SANITARY WASTE & VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

- a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Aboveground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- B. Underground, soil, waste, and vent piping NPS 6 and smaller shall be the following:
 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."

- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use full-port ball valve for piping NPS 2 and smaller.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4: 60 inches with 5/8-inch rod.
 - 4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 2. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 15155
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials.
6. Grease interceptors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping

4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Refer to plumbing fixture schedule on contract drawings.

C. Cast-Iron Exterior Cleanouts:

1. Refer to plumbing fixture schedule on contract drawings.

D. Cast-Iron Floor Cleanouts:

1. Refer to plumbing fixture schedule on contract drawings.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Refer to plumbing fixture schedule on contract drawings.

B. Cast-Iron Floor Sinks:

1. Refer to plumbing fixture schedule on contract drawings.

C. Cast-Iron Condensate Drains:

1. Refer to plumbing fixture schedule on contract drawings.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acorn Engineering Company; Elmdor/Stoneman Div.
- b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.6 GREASE INTERCEPTORS

- A. Grease Interceptors:
 - 1. Refer to plumbing fixture schedule on contract drawings:

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit and vent to unit inlet.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 15160
FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following storm drainage piping inside the building.
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

- b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
- 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns.
 - 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Aboveground storm drainage piping shall be any of the following:
 - 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and coupled joints.
- C. Underground storm drainage shall be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- E. Install wall-penetration-fitting system at each service pipe penetration through foundation wall. Make installation watertight.

- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- G. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- H. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow.
 - 2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install underground PVC storm drainage piping according to ASTM D 2321.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Install backwater valves in accessible locations.

3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 2. NPS 6 and larger: 60 inches with 3/4-inch rod.
 3. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- E. Install supports for vertical cast-iron soil piping every 15 feet.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- D. Test storm drainage piping according to procedures of authorities having jurisdiction.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

SECTION 15161
STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Roof drains.
 - 4. Miscellaneous storm drainage piping specialties.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Refer to plumbing fixture schedule in contract drawings.

2.2 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:
 - 1. Refer to plumbing fixture schedule in contract drawings.
- B. Cast-Iron Floor Cleanouts:
 - 1. Refer to plumbing fixture schedule in contract drawings.
- C. Cast-Iron Exterior Cleanouts:
 - 1. Refer to plumbing fixture schedule in contract drawings.

- D. Cast-Iron Wall Cleanouts:
 - 1. Refer to plumbing fixture schedule in contract drawings.

2.3 ROOF DRAINS

- A. Cast-Iron Roof Drains:
 - 1. Refer to plumbing fixture schedule in contract drawings.

2.4 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Conductor Nozzles:
 - 1. Refer to plumbing fixture schedule in contract drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roof materials are specified in Division 07.
 - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.

- F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- G. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 15300
FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Sections included under Division 1, General Requirements, and Section 15050 of this Division are included as a part of this Section as though bound herein.
- B. Related Sections
 - 1. 15050, BASIC MECHANICAL MATERIALS AND METHODS
 - 2. 15060, PIPE AND FITTINGS
 - 3. 15100, VALVES
 - 4. 15250, THERMAL INSULATION
- C. Related Code References
 - 1. Florida Fire Prevention Code, 2007 Edition
 - 2. NFPA 13, 2002 Edition
 - 3. NFPA 20, 2003 Edition

1.02 SECTION INCLUDES

- A. Piping system.
- B. Dry Pipe Sprinkler System equipment.
- C. Fire department connections.
- D. Indicator valves.

1.03 SUMMARY

- A. The Contractor shall provide the labor, materials, equipment, appliances, services and transportation, and perform operations in connection with the construction and installation of the Work.
- B. Dry Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry pipe valve. Water then flows into piping and discharges from open sprinkler.
- C. Fire sprinkler contractor shall start work beginning 5 FT outside of the building and by the requirements of this Section.
- D. Work shall be governed by applicable codes referenced above, the State Fire Marshal, and the local fire department regulations.

1.04 SUBMITTALS

- A. The Contractor shall submit detailed shop drawings for approval for all equipment to be constructed and installed. Such shop drawings shall be complete, giving all required information, and shall be properly checked and coordinated with the work of other trades before submission. No work shall be performed until application shop drawings and layout drawings have been approved by the A/E and Fire Marshall.
- B. Submittals shall consist of:
 - 1. Certification of compliance with sprinkler designer's registration seal.
 - 2. Maintenance drawings.
 - 3. Product drawings.
 - 4. Record drawings.
 - 5. Test reports and certificates due upon completion of work and testing.
 - 6. Submit hydraulic calculations and shop drawings per NFPA 13, "Working Drawings" for review and approval prior to submission to the State Fire Marshal.
 - 7. Submit hydraulic calculations and shop drawings per NFPA 13, "Working Drawings" to the local Fire Marshal.
 - 8. Submit shop drawings and hydraulic calculations to the State Insurance Approval Agency for review and approval if applicable.

1.05 QUALITY ASSURANCE

- A. Comply with ANSI, NFPA 13, 2002 EDITION, state and local fire codes.
- B. Sprinkler heads shall be UL and FM listed and shall be located on spacing requirements as noted in NFPA 13 according to the hazard designation.
- C. Provide fire sprinkler piping products which have been approved and labeled by Underwriters Laboratories.
- D. Contractor shall provide to A/E a letter stating compliance with all relevant codes, regulations, standards, and agencies. Also include in the letter the exact location and results of the flow test(s) used to design the system.
- E. The system shall be installed by an experienced firm regularly engaged in the installation of fire suppression systems. The contractor shall provide documentation indicating a minimum of five (5) years experience in design, installation, testing and service of these systems.
- F. The contractor shall provide a list of at least five (5) references for systems similar in nature and size. This will be required to accompany the quotation for information purposes. Failure to supply this information will result in the bidder being considered non-responsive.
- G. The contractor shall be bonded and maintain project and liability insurance. Minimum liability coverage shall not be less than \$2,000,000.00 or 10% of the total installation amount, whichever is greater. Upon receipt of an order, the contractor shall name the Owner as an additionally insured.

1.06 WARRANTY

- A. The components of the Fire Protection System(s) furnished under this division of the specifications shall be guaranteed for a period of one (1) year from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier, against defective materials, design and workmanship. Upon receipt of notice from Architect of failure of any part of the equipment during the guarantee period, the affected part or parts, shall be replaced promptly which includes removing the defective part or parts, replacing and installing the new part or parts and at the expense of the contractor.
- B. A certificate or letter of approval from owner's insurance underwriters shall be obtained by the fire protection contractor and turned over to the Owner of his representative.
- C. Operating and maintenance instructions, printed and bound in hard cover three-ring loose leaf notebooks, shall be provided to the Owner of his representative.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Acceptable Sprinkler Head Manufacturers
 - 1. The Reliable Sprinkler Corp.
 - 2. Tyco
 - 3. Victaulic
 - 4. Viking Corp.

2.02 PIPING SYSTEMS

- A. Aboveground Piping to include schedule 40 black steel and schedule 10 black steel.
- B. All DRY SPRINKLER PIPING along with ALL piping subject to the outside conditions shall be galvanized pipe. No exceptions.
- C. Piping shall be installed from approved hangers and spacing as required per NFPA 13, 2002 EDITION and Specification Section 15060.
- D. Hangers from steel joists must be located at panel points or up to 3 inches on either side of the panel point.
- E. Provide inspection and drain valve and label.
- F. Valves, meters and gauges are to comply with NFPA 13, 2002 EDITION and Specification Sections 15050 and 15100.

2.03 WET PIPE SPRINKLER SYSTEM EQUIPMENT

- A. Provide a valve position supervisory switch for monitoring control valve. Provide Potter Electric PCVS or OSYSU-A2 supervisory switch.
- B. Provide a test station for testing alarm systems. Provide control valve test and drain assembly.
- C. Provide grooved check valves and butterfly valves with tamper units in locations as required.

2.04 DRY PIPE SPRINKLER SYSTEM EQUIPMENT

- A. Dry pipe valve shall be UL listed/FM approved, latching differential type valve designed to separate the water supply from the dry pipe sprinkler system and shall combine a positive latching clapper and air plate assembly with a differential air to water seat design. The valve shall be capable of operating a water motor alarm and an electric pressure alarm switch and shall be provided complete with all accessories and appurtenances required for the proper operation of the dry pipe system. Provision shall be made to prevent excessive water columning and, if applicable, an approved quick-opening device for each dry pipe valve having a system capacity greater than 500 gallons shall be provided.
- D. Air Compressor: Maintenance air compressor shall be packaged riser mounted, UL listed/FM approved, air-cooled, piston type with permanently lubricated electric motor. Provide safety relief valve set at 75 psi, single pole, double throw adjustable differential pressure switch, check valve, drain valve and inlet filter. Provide piping and all accessories required for the proper operation of the motor compressor unit.

2.05 FIRE DEPARTMENT CONNECTIONS

- A. Fire department siamese connection shall be flush wall type; three-way connection (2-1/2 inch by 2-1/2 inch by 4 inch) (2-way); straight body; polished cast brass body with escutcheon; body inlets complete with individual drop clapper valve and plugs with secure chains; nominal 4-1/2 inch by 12 inch cast brass wall plate with words "FIRE DEPARTMENT CONNECTION" in 1 inch raised letters; hose connections shall conform to local Fire Department standards.

2.06 VALVES AND DEVICES

- B. DRY PIPE VALVE: Provide dry pipe valve for vertical installation. The valve shall be equipped to give a local low air pressure signal at 65 percent of the normal air pressure. The valve shall be provided with standard trimmings including priming connections, water and air pressure gauges, pressure switch, low air alarm switch, alarm testing by pass, and all necessary pipe, fittings and accessories required to provide a complete installation.
- C. AIR COMPRESSOR: Air supply shall be provided for the dry pipe valve from an air compressor as per the requirements of NFPA 13.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fire protection signs on piping in accordance with ANSI/NFPA 13, 2002 Edition requirements.
- B. Comply with requirements of ANSI/NFPA 13, 2002 Edition for installation of fire sprinkler piping materials. Install fire sprinkler piping products where indicated, in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that fire sprinkler piping complies with requirements and serves intended purposes.
- C. Coordinate with other work, including plumbing, HVAC, electrical, etc., as necessary to interface components of fire sprinkler piping properly with other work.
- D. Install supports, anchors, seals, valves, meters, and gauges per NFPA 13, 2002 Edition and other sections of this specification.
- E. Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections, and control portions of sprinkler piping. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system, as required to remove foreign substances, under pressure as specified in ANSI/NFPA 13, 2002 Edition. Continue flushing until water is clear and check to ensure that debris has not clogged sprinklers.
- F. After flushing system, test fire sprinkler piping hydrostatically, for a period of 2 hours, at not less than 200 psi or at 50 psi in excess of maximum static pressure when maximum static pressure is in excess of 150 psi. Check system for leakage of joints. Measure hydrostatic pressure at low point of system.
- G. Repair or replace piping system as required to eliminate leakage in accordance with ANSI/NFPA standards. Retest as specified to demonstrate compliance.
- H. Furnish per NFPA 13, 2002 Edition additional sprinkler heads for each type of head provided, complete with metal wall cabinet.

3.02 FIELD QUALITY CONTROL

- A. Contractor is responsible for coordinating and witnessing all flow tests with the local water utility.
- B. Flow test shall be taken on the main to which the building supply and the fire protection are to connect. The location of the test shall not exceed a distance of 500 feet from the point of connection. If there are no hydrants on the main to which the building is to connect, the Contractor shall contact the A/E for approval on the nearest alternative location.

- C. In the situation that the building supply is to connect to a main, which is a lateral branch between two mains of equal or greater size, the Contractor shall execute flow tests on both of the other mains. Flow test locations on the two mains are not to exceed a distance of 500 feet from the point of connection to the lateral branch main. A flow test shall also be taken on the lateral branch main to which the building is to connect. Flow test on the lateral branch main shall be executed as per part (B) above.
- D. Flow test(s) shall not be dated earlier than the date of the bid opening. Results obtained by the Contractor are to be forwarded to the A/E within 7 days.

END OF SECTION

SECTION 15410
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Faucets for lavatories showers and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Disposers.
7. Water closets.
8. Urinals.
9. Lavatories.
10. Individual showers.
11. Sinks.
12. Mop sinks.

B. Related Sections include the following:

1. Division 22 Section "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.

- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities "Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 2. Vitreous-China Fixtures: ASME A112.19.2M.
 - 3. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 4. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 2. Faucets: ASME A112.18.1.
 - 3. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 4. Hose-Coupling Threads: ASME B1.20.7.
 - 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 6. NSF Potable-Water Materials: NSF 61.
 - 7. Pipe Threads: ASME B1.20.1.
 - 8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 9. Supply Fittings: ASME A112.18.1.
 - 10. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.

3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Pipe Threads: ASME B1.20.1.
 8. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Off-Floor Fixture Supports: ASME A112.6.1M.
 6. Pipe Threads: ASME B1.20.1.
 7. Plastic Toilet Seats: ANSI Z124.5.
 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Refer to plumbing fixture schedule on contract drawings.

2.2 SHOWER FAUCETS

A. Shower Faucets:

1. Refer to plumbing fixture schedule on contract drawings.

2.3 SINK FAUCETS

A. Sink Faucets:

1. Refer to plumbing fixture schedule on contract drawings.

2.4 FLUSHOMETERS

A. Flushometers:

1. Refer to plumbing fixture schedule on contract drawings.

2.5 TOILET SEATS

A. Toilet Seats:

1. Refer to plumbing fixture schedule on contract drawings.

2.6 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of M/G Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.7 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.

5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports:

1. Description: Combination carrier designed for accessible, standard, or child mounting height of wall-mounting, water-closet-type fixture. Refer to contract drawings for mounting heights. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.8 DISPOSERS

A. Disposers:

1. Refer to plumbing fixture schedule on contract drawings.

2.9 WATER CLOSETS

A. Water Closets:

1. Refer to plumbing fixture schedule on contract drawings.

2.10 URINALS

A. Urinals:

1. Refer to plumbing fixture schedule on contract drawings.

2.11 LAVATORIES

A. Lavatories:

1. Refer to plumbing fixture schedule on contract drawings.

2.12 SINKS

A. Sinks:

1. Refer to plumbing fixture schedule on contract drawings.

2.13 MOP SINKS

A. Mop Sinks:

1. Refer to plumbing fixture schedule on contract drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- P. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- Q. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- R. Connect inlet hose to dishwasher and outlet hose to disposer.
- S. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- T. Set showers in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 15415
DRINKING FOUNTAINS & WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Type PB, pressure with bubbler, Style W, wall-mounting water coolers.
 - 2. Fixture supports.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"[; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act";] for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Water Coolers:

1. Refer to plumbing fixture schedule on contract drawings.

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

- B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping as indicated on contract drawings. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

END OF SECTION 224700

SECTION 15420
DISINFECTION OF WATER LINE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMAMRY

- A. This section includes furnishing all labor, equipment, materials and transport, required for the disinfection of all water lines, and the collection and testing of water samples for bacteriological analysis and regulatory approval. If necessary, this work shall be conducted in phases, with separate regulatory clearances for each phase of the work. Phasing of the work shall be done at no additional cost to Owner.
- B. Related work: The following sections contain requirements that related to this Section
 - 1. Section 02650 – Water Distribution System
- C. All disinfection and bacteriological sampling and testing shall be in compliance with Rule 62-555 F.A.C. A letter of clearance must be issued by the applicable regulatory agencies prior to placing any temporary or permanent construction in service.

1.03 SUBMITTALS

- A. Submit schedule of disinfection of water line in accordance with AWWA C651 "Disinfecting Water Mains".

PART 2 - MATERIALS

2.01 CHLORINE

- A. Chlorine and water for flushing, testing and chlorination shall be furnished and paid by the Contractor.
- B. Chlorine may be derived from chlorine gas, or 70 percent (high test) calcium hypochlorite (HTH or perchloron, or equal).

PART 3 - EXECUTION

3.01 FLUSHING

- A. Flushing: Flush all water mains with water to remove all sand and other foreign matter. Dispose of the flushing water without causing a nuisance or property damage.

3.02 DISINFECTION

- A. Before any portion of water distribution system is to be placed in service, disinfect it in accordance with the requirements of AWWA C651 and demonstrate its disinfection by bacteriological test conducted in accordance with Standard Methods for Examination of Water and Wastewater, by an approved laboratory acceptable to Owner and the Florida Department of Environmental Protection.
- B. Use free chlorine in aqueous solution as the disinfecting agent, with sustained concentration for 12 hours or more of not less than 50 parts per million. Administration may be by any of the several methods described in AWWA C651 as proposed by Contractor and approved by Owner. The method must be approved prior to commencement of the disinfection process.

3.03 SAMPLING

- A. After disinfection has been completed, samples of water for bacteriological analysis shall be collected for at least two consecutive days and submitted for testing by a State Certified Laboratory, at no additional cost to the Owner. Samples of water will be contained in sterile containers obtained from the approved laboratory for analysis. Sample locations shall be in compliance with the FDEP construction permit for the potable water distribution system.
- B. If samples do not demonstrate satisfactory results, repeat the disinfection and sampling procedures until two series of satisfactory samples are obtained, the period between such series of samples to be a minimum of twenty-four hours.

3.04 REPORTING

- A. Results of the tests shall be submitted to the applicable regulatory agencies.
- B. Prepare reports for purging and disinfecting activities and satisfactory laboratory

bacteriological test results to Owner.

END OF SECTION

SECTION 15425
HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes furnishing labor, equipment, materials and transport for the installation and performance of a complete testing system of water distribution, consisting of pressure piping, valves and appurtenant items, as shown on the Drawings and specified herein.

PART 2- PRODUCTS

2.01 JOB CONDITIONS

- A. Do not allow the pipelines being installed to be used as drains for water, and keep the ends of the pipe properly and adequately blocked during construction by the use of approved stoppers and not by improvised equipment.
- B. Take all necessary precautions to prevent the entrance of mud, sand, or other obstructing matter into the pipelines and upon completion of the work, if any such material has entered, clean the pipelines as directed by Owner so that the entire system will be left clean and unobstructed.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Flushing: Flush all water mains with potable water to remove all sand and other foreign matter. Dispose of the flushing water without causing a nuisance or property damage.
- B. Hydrostatic Tests:
 - 1. Furnish, install and operate all pumps, gauges and measuring devices as

approved by Owner. Perform all pressure and leakage testing in the presence of Owner.

2. Use only potable water for testing and flushing.
3. Test all components of the water distribution system, including fittings, connections and valves before backfilling, provided, however, that pipe trenches under traveled streets or roads or in unstable soil conditions may be backfilled with the permission of Owner.
4. Perform no testing until all concrete thrust blocking or restraint joints are in place and set. In testing, fill the part of the system under test with water and subject it to a sustained pressure of 150 pounds per square inch for water line. Test the system in sections, thereby testing each valve for secure closure.
5. While the system is being filled, carefully and completely exhaust the air. If permanent air vents are not located at all high points, install corporation stops or fittings and valves at such points so the air can be expelled as the pipe system is slowly filled with water.
6. Maintain test pressure by pumping for at least 2 hours and until all sections under test have been checked for evidence of leakage. Rate of loss shall not exceed that specified hereinafter. Correct visible leaks regardless of total leakage shown by test.
7. Retest the system as a whole, or any part, after completion of backfilling, as required for final acceptance.

C. Allowable Limits For Leakage:

1. No water main installation, or section thereof, will be acceptable until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{SD \sqrt{P}}{133200}$$

in which,

L= Allowable leakage, in gallons per hour

S= Length of pipe being tested in feet

D= Nominal pipe diameter; in inches

P= Average test pressure during the test, in psi gauge.

2. For a 1000-foot segment of main with an average test pressure of 150 psi the following table may be used.

Pipe Diameter (D) Inches	Allowable Leakage (L) Gal/Hr.	Pipe Diameter (D) Inches	Allowable Leakage (L) Gal/Hr.
3	0.30	14	1.30
4	0.40	16	1.50
6	0.55	18	1.65
8	0.70	20	1.85
10	0.90	24	2.20
12	1.10	30	2.80

3. Supply water to the main during the test period as required, to maintain the test pressure as specified. Compare the quantity used, as measured by pumping from a calibrated container, to the above allowable quantity. A 5/8-inch meter installed on the discharge side of the pump may be used to measure the leakage for large mains when approved by Owner.

D. Correction of Work:

1. Where leakage exceeds the allowable limit, as specified hereinbefore, locate and repair the defective pipe or joints. If the defective portions cannot be located, remove and reconstruct as much of the work as is necessary in order to conform to the specified limits.
2. Repair or replace any visible leaks or any defective pipe or joint as directed by Owner even though the total leakage is within the specified allowable limits.
3. No additional payment will be made for the correction of defective work, or to damage to other parts of the work resulting from such corrective work.

END OF SECTION

SECTION 15485
ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Light-commercial electric water heaters.
 - 2. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE/IESNA-90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period(s): From date of Substantial Completion:
- a. Household Electric Water Heaters: Five years.
 - b. Commercial Electric Water Heaters: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

- A. Description: Comply with UL 174 for household, storage electric water heaters.
1. Refer to plumbing fixture schedule on contract drawings.

2.3 WATER HEATER ACCESSORIES

- A. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
1. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- E. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- F. Fill water heaters with water.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.
- B. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223300

SECTION 15732
PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Package roof top unit.
- B. Heat exchanger.
- C. Refrigeration components.
- D. Unit operating controls.
- E. Roof curb.
- F. Electrical power connections.
- G. Operation and maintenance service.

1.02 RELATED SECTIONS

- A. Section 15080 - Mechanical Insulation.
- B. Section 15990 – Direct Digital Controls.

1.03 REFERENCES

- A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.
- B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. AHRI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
- D. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
- E. ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.
- F. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.
- G. California Energy Commission Administrative Code - Title 20/24 - Establishes the minimum efficiency requirements for HVAC equipment

installed in new buildings in the State of California.

- H. AHRI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment.
- I. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
- J. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
- K. ANSI/NFPA 70-1995 - National Electric Code.

1.04 SUBMITTALS

- A. Submit unit performance data including: capacity, nominal and operating performance.
- B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.
- C. Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
- D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

1.05 DELIVERY, STORAGE and HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory-shipping covers in place until installation.

1.06 WARRANTY

- A. Provide parts warranty (excluding refrigerant) for one year from start-up or 18 months from shipment, whichever occurs first.
- B. Provide five-year extended warranty for compressors.

PART 2 PRODUCTS

2.01 SUMMARY

- A. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. APPROVED MANUFACTURERS
 - 1. Trane
 - 2. Carrier
 - 3. Lennox
 - 4. Substitutions: [10 working days prior approval required] as indicated under the general and/or supplemental conditions of these specifications. Mechanical contractor shall be responsible for electrical and mechanical changes to the structure when using a product other than the specified product. As built drawing changes are the responsibility of the mechanical contractor.

2.02 GENERAL UNIT DESCRIPTION

- A. Unit(s) furnished and installed shall be packaged rooftop (s) as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on the current AHRI Standard . Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls.
- B. Unit(s) shall be 100% factory run tested and fully charged with R-410A.
- C. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- D. Units shall be convertible airflow design as manufactured.
- E. Wiring internal to the unit shall be colored and numbered for identification.

2.03 UNIT CASING

- A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge.
- B. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.
- C. Cabinet construction shall allow for all service/ maintenance from one side of the unit.

- D. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
- E. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
- F. Units base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.
- G. Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
- H. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.
- I. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

2.04 AIR FILTERS

- A. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. One-inch thick glass fiber disposable media filters shall be provided with the provisions within the unit for 2 inch thick filters to be field- provided and installed.

2.05 FANS AND MOTORS

- A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
- B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
- C. Provide units 5 tons and below with direct drive, multiple speed, dynamically balanced supply fans.
- D. Provide units 6 tons and above with belt driven, supply fans with adjustable motor sheaves.
- E. Outdoor and Indoor Fan shall be permanently lubricated and have internal thermal overload protection.
- F. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
- G. Provide shafts constructed of solid hot rolled steel, ground and polished, with

key-way, and protectively coated with lubricating oil.

2.06 ELECTRIC HEATING SECTION

- A. Provide heavy duty nickel chromium heating elements internally wired. Heater shall have pilot duty or automatic reset line voltage limit controls and any circuit carrying more than 48 amps shall have fuse protection in compliance with N.E.C.
- B. Heater shall be internal to unit cabinet.
- C. Heater shall be UL and CSA listed and approved and provide single point power connection.

2.07 EVAPORATOR COIL

- A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
- B. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.
- C. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.

2.08 CONDENSER SECTION

- A. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

2.09 REFRIGERATION SYSTEM

- A. Compressor(s): Provide scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.
- B. Units shall have cooling capabilities down to 0 degree F as standard. For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.
- C. Provide each unit with one (or two) refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.
- D. For heat pump units, provide reversing valve, discharge muffler, flow control check valve, and electronic adaptive demand defrost control on all units.

2.10 EXHAUST/RETURN SECTION (if scheduled)

- A. Provide, on downflow units above 6 tons, a factory supplied field installed power exhaust assembly that shall assist the barometric relief damper in the economizer in relieving building pressurization.

2.11 OUTDOOR AIR SECTION

- A. Provide economizer.
- B. Provide adjustable minimum position control located in the economizer section of the unit.
- C. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

2.12 OPERATING CONTROLS

- A. Provide microprocessor unit-mounted DDC control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling, and ventilating decisions through resident software logic.
- B. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.
- C. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.
- D. Economizer Preferred Cooling (if supplied with economizer) - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

2.13 STAGING CONTROLS

- B. Provide programmable electronic microcomputer based zone control.
 - 1. Zone control shall incorporate:
 - a. Automatic changeover from heating to cooling.
 - b. Set-up for at least 2 - sets of separate heating and cooling temperatures per day.
 - c. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - d. Switch selection features including Fahrenheit display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.

- e. Smart Fan Operation: Allows the unit fan operation to default to the Auto Mode during unoccupied periods, regardless of the Fan switch position.
- f. Economizer Minimum Position Override: Allows the unit controller to override and close the minimum position setting on the economizer damper during unoccupied time periods.

2. Zone sensor display shall be capable of:

- a. Time of day.
- b. Actual room temperature.
- c. Programmed temperature.
- d. Programmed time.
- e. Duration of timed override.
- f. Day of week.
- g. System mode indication: heating, cooling, low battery, and fan on.

C. Provide remote temperature sensor capability.

D. Provide mixed air sensor in supply air to close outside air damper.

2.14 BUILDING MANAGEMENT SYSTEM

- A. Interface control module to Energy Management System to be furnished and mounted by rooftop unit manufacturer. Through this interface module, all Energy Management functions (specified in Energy Management Section) shall be performed. If not furnished by rooftop unit manufacturer, this shall be furnished by Energy Management System Contractor for factory mounting by rooftop unit manufacturer in rooftop unit and rated for service up to 140 F. The only field connection to Energy Management System shall be a single communication link.
- B. Control Functions: Include unit scheduling, occupied/unoccupied mode, start-up and coast-down modes, nighttime free-cool purge mode, demand limiting, night setback, discharge air set point adjustment, timed override and alarm shutdown

2.15 ROOF CURB

- A. Contractor shall provide factory supplied roof curb, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.
- B. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Contractor shall verify that roof is ready to receive work.
- B. Contractor shall verify that proper power supply is available.

3.02 INSTALLATION

- A. Contractor shall install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

SECTION 15738
SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

- A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Units shall be designed to operate with HCFC-free refrigerants.

1.4 WARRANTY

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fails in materials and workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Air Conditioning; Div. of Carrier Corp.
 2. EMI
 3. Mitsubishi

2.2 EVAPORATOR-FAN UNIT

- A. Concealed Unit Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
1. Insulation: Faced, glass-fiber duct liner.
 2. Drain Pans: Galvanized steel, with connection for drain; insulated.
- B. Floor-Mounting, Unit Cabinet: Enameled steel with removable panels on front and ends.
- C. Insulation: Faced, glass-fiber, duct liner.
- D. Drain Pans: Galvanized steel, with connection for drain; insulated.
- E. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- F. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- G. Fan Motor: Multispeed.
- H. Filters: 1 inch 25 mm thick, in fiberboard frames

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

- A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

- B. Compressor: Hermetically sealed scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - 1. Refrigerant Charge: R-410A
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid sub cooler.
- D. Fan: Aluminum-propeller type directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit: Permits operation down to 40 deg F 7 deg C.
- G. Mounting Base: Steel/Fiber mesh reinforced Concrete Pad

2.4 ACCESSORIES

- A. Thermostat: Programmable Low voltage with sub base to control compressor and evaporator fan.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- B. Install ground-mounted, compressor-condenser components on reinforced concrete base; 6 inches 100 mm larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

3.2 CONNECTIONS

- A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Connect supply and return water coil with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

- C. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- D. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 15815
METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes metal, rectangular ducts and fittings for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa).
- B. See Division 15 Section "Nonmetal Ducts" for fibrous-glass ducts.
- C. See Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal ducts.
 - 1. Penetrations through fire-rated and other partitions.
 - 2. Duct accessories, including access doors and panels.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 SEALANT MATERIALS

- A. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.
- B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Lockformer.
 - 2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
 - 3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

2.6 DOUBLE WALL PREINSULATED SPIRAL DUCT SYSTEM:

MATERIAL

- Galvanized steel conforming to ASTM standards A653 and A924
- Stainless steel type 304L conforming to ASTM standard A240
- Stainless steel type 316L conforming to ASTM standard A240
- Aluminum T3003 (nongasketed only)
- Double Wall
 1. Perforated inner liner will consist of 0.125 inch perforations on 0.250 inch staggered centers corresponding to an overall open area of 23%.
 2. Glass fiber insulation will have a maximum conductivity factor (k) of 0.26 BTU-in/hr x ft² x °F at 75°F mean ambient temperature.
 3. Retaining fabric will be 0.008 inch thick, 15.6 lb/ft² density non-woven polyester fabric with an air permeability rate of 9.2 ft³/ft² x s.
 4. Insulation stop will be a closed-cell elastomeric foam with a maximum conductivity factor (k) of 0.28 BTU-in/hr x ft² x °F and an operating temperature range of -70°F to +220°F.

SURFACE FINISH

- **Galvanized steel** (galvanized in accordance with latest SMACNA standards).
- **Stainless steel** type 304L - 2B Mill Finish
- **Stainless steel** type 316L - 2B Mill Finish
- **Coated** with an average thickness of 4 mils (0.004 inch) inside and out. Coating to meet or exceed 1,000 hour Salt Spray Test per ASTM B117-97.
- **Antimicrobial** - Coating containing antimicrobial compound complies with UL standard - not to exceed flame or smoke developed ratings of 25/50

THICKNESS

Material thickness constructed from galvanized steel in accordance with the latest SMACNA's HVAC Duct Construction Standards for +10" water gauge pressure.

CONSTRUCTION

- A. Duct is of spiral lock seam construction with a mechanically formed seam locking indentation evenly spaced along the spiral seam. All spiral duct 8 inch diameter and larger shall incorporate multiple corrugations between spiral seams. Inner and outer duct will be of spiral lockseam construction.
- B. Double wall duct and fittings will consist of a perforated or solid inner liner, 1" 1.50 lb/ft² layer of glass fiber insulation, and a solid outer pressure shell. When a perforated inner liner is specified, a retaining fabric must be wrapped, between the perforated inner and the glass fiber insulation. This is to prevent glass fiber tearing into the airstream and maintains the desired acoustical properties.
- C. Double wall options: 1" thick insulation (standard); and 2" thick insulation (optional).
- D. The outer pressure shell diameter shall be two times the insulation thickness larger than the inner liner.

- E. Fittings shall be manufactured using one or more of the following construction methods:
 - Overlapped edges stitch welded along the entire length of the fitting
 - Standing seam gore locked and internally sealed
 - Button punched and internally sealed
 - Elbows 3" through 12" diameter will be die stamped and continuously stitch welded

CONNECTIONS

Fitting ends shall be sized to slip-fit into spiral duct of the same nominal size.

JOINT SEALING

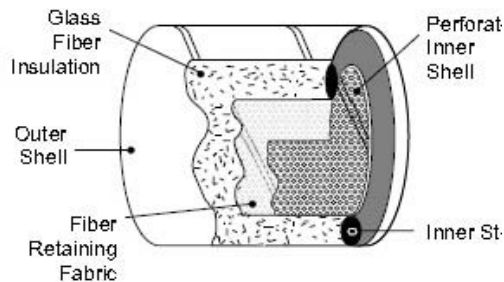
Fitting ends are equipped with factory installed, triple-lipped gaskets. When installed in spiral duct per manufacturer's installation instructions, the gasket creates a seal against the interior of the spiral duct. The system tightness shall be factory warranted to meet SMACNA's Leakage Class 3 performance.

If no gasket is used, all joints must be sealed by the installer during the installation process. The type of sealant used as well as the method and level of application should be as directed by the specification and in accordance with the sealant manufacturer's published installation instructions.

GASKET

The gasket shall be EPDM rubber. The gasket is located in a groove at the end of the fitting. In order to achieve optimum sealing for all diameters, different size gaskets shall be used. The gasket shall be classified by Underwriters Laboratories for flame spread and smoke developed in accordance with ASTM E84-91a.

A silicone gasket meeting the same performance request must be offered by duct manufacturer for special applications.



PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Modular Air Handler Ducts and FCU-A-4.1, all other FCU ducts exposed (other than ducts exposed within the auditorium area):
 - 1. Supply Ducts: 2-inch wg (500 Pa) METAL
 - 2. Return Ducts (Negative Pressure): 1-inch wg (250 Pa) METAL
- B. Ducts exposed within the auditorium area:
 - 1. Double Wall Pre-insulated ducts (BASIS OF DESIGN – EHG-3)
- C. All outside air ducts
 - 1. (Negative Pressure): 1-inch wg (250 Pa) METAL
- D. All FCU ducts other than dimmer room fan coil
 - 1. See non-metal ducts - 15816

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.
- E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

- J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).
- M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."
- N. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
 - 1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.
- B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION

SECTION 15820
DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Fire dampers.
 - 4. Combination fire and smoke dampers.
 - 5. Turning vanes.
 - 6. Duct-mounting access doors.
 - 7. Flexible connectors.
 - 8. Flexible ducts.
 - 9. Duct accessory hardware.
 - 10. Duct Silencers

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Fire dampers.
 - 4. Combination fire and smoke dampers.
 - 5. Turning vanes.
 - 6. Duct-mounting access doors.
 - 7. Flexible connectors.
 - 8. Flexible ducts.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. Greenheck.
 2. Penn Ventilation Company, Inc.
 3. Ruskin Company.
- B. Description: Multiple-blade, parallel action gravity balanced, with[center-pivoted] blades of maximum 6-inch (150-mm) width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Frame: 0.052-inch-1.3-mm- thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: 0.050-inch- (1.2-mm-) thick aluminum sheet.
- E. Blade Seals: Neoprene.

- F. Blade Axles: Galvanized steel.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: [Oil-impregnated bronze] [Molded synthetic] [Stainless-steel sleeve].
5. Tie Bars and Brackets: Galvanized steel.

D. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 FIRE DAMPERS

- A. Manufacturers:
 - 1. Greenheck.
 - 2. McGill AirFlow Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. Fire dampers shall be labeled according to UL 555.
- C. Fire Rating: See Architectural Plans.
- D. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick as indicated and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Fusible Links: Replaceable, 165 deg F (74 deg C) rated.

2.6 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, [single] [double]-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. METALAIRE, Inc.
 - d. Ward Industries, Inc.

- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.7 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - 1. Manufacturers:
 - a. American Warming and Ventilating.
 - b. CESCO Products.
 - c. Ductmate Industries, Inc.
 - d. Flexmaster U.S.A., Inc.
 - e. Greenheck.
 - f. McGill AirFlow Corporation.
 - g. Nailor Industries Inc.
 - h. Ventfabrics, Inc.
 - i. Ward Industries, Inc.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
 - b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches[with outside and inside handles].
 - d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch (25-mm) thickness. Include cam latches.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Flexmaster U.S.A., Inc.
 - 2. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corp.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.9 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart & Cooley, Inc.
3. McGill AirFlow Corporation.

B. Noninsulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg 250 Pa negative.
2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 28 to plus 99 deg C).

C. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches (75 to 450 mm) to suit duct size.

2.10 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers[, turning vanes,] and equipment.
 - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
 - 5. On sides of ducts where adequate clearance is available.
- I. Install the following sizes for duct-mounting, rectangular access doors:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).

2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body Plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- J. Label access doors according to Division 15 Section "Mechanical Identification."
- K. Install flexible connectors for metal ducts connecting to grilles at all walls penetrating into auditorium area from mechanical rooms. Provide additional wrap insulation over flexible connector.
- L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- M. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts[directly or] with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- Q. Install duct test holes where indicated and required for testing and balancing purposes.
- 3.2 ADJUSTING
- A. Adjust duct accessories for proper settings.
 - B. Adjust fire and smoke dampers for proper action.
 - C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 15838
HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal roof ventilators.
 - 2. Ceiling-mounting ventilators.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- B. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
1. Greenheck.
 2. Loren Cook Company.
 3. Penn Ventilation.
- C. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- D. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- E. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- F. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust airstream.
- G. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- H. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Built-in cant and mounting flange.
 2. Overall Height: 12 inches (300 mm)
 3. Sound Curb: Curb with sound-absorbing insulation matrix.
 4. Pitch Mounting: Manufacture curb for roof slope.
 5. Metal Liner: Galvanized steel.
 6. Mounting Pedestal: Galvanized steel with removable access panel.
 7. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 CEILING-MOUNTING VENTILATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Penn Ventilation.
- D. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
- E. Housing: Steel, lined with acoustical insulation. Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- G. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- H. Accessories:
 - 1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
 - 2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
 - 3. Motion Sensor: Motion detector with adjustable shutoff timer.
 - 4. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
 - 5. Filter: Washable aluminum to fit between fan and grille.
 - 6. Isolation: Rubber-in-shear vibration isolators.
 - 7. Manufacturer's standard roof jack or wall cap, and transition fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support units using restrained elastomeric.

- C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- D. Support suspended units from structure using threaded steel rods and spring hangers.
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Division 15 Section "Identification for HVAC Piping and Equipment."
- G. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Air Duct Accessories."
- H. Install ducts adjacent to power ventilators to allow service and maintenance.
- I. Ground equipment according to Division 16 Section "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning control and equipment.

END OF SECTION

Holden Heights Community Center

15838-4

HVAC POWER
VENTILATORSS

SECTION 15870
COMMERCIAL-KITCHEN HOODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes Type I commercial kitchen hoods.

1.2 SUBMITTALS

- A. Product Data: For the following:

- 1. Filters/baffles.
- 2. Fire-suppression systems.
- 3. Lighting fixtures.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer.

- 1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
- 2. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
- 3. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
- 4. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 5. Design Calculations: Calculate requirements for selecting seismic restraints.
- 6. Wiring Diagrams: Power, signal, and control wiring.
- 7. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

- C. Welding certificates.

- D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
1. Minimum Thickness **0.050 inch (1.3 mm)**.
 2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
 - a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
 3. Concealed Stainless-Steel Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished finish).
 4. Exposed Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished).
 5. Exposed Surfaces: ASTM A 480/A 480M, No. 3 finish (intermediate polished surface).
 6. Exposed Surfaces: ASTM A 480/A 480M, No. 4 finish (directional satin).
 7. Exposed Surfaces: ASTM A 480/A 480M, No. 6 finish (dull satin).
 8. Exposed Surfaces: ASTM A 480/A 480M, No. 7 finish (reflective, directional polish).
 9. Exposed Surfaces: ASTM A 480/A 480M, No. 8 finish (mirrorlike reflective, nondirectional polish).
 10. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Zinc-Coated Steel Shapes: ASTM A 36/A 36M, zinc coated according to ASTM A 123/A 123M requirements.
- C. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.
1. Color: As selected by Architect from manufacturer's full range.
 2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- D. Sound Dampening: NSF-certified, nonabsorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum **1/8-inch (3-mm)** thickness that does not chip, flake, or blister.

- E. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.2 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
 - 1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
 - 2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
 - 3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
 - 4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
- B. For metal butt joints, comply with SMACNA's "Kitchen Equipment Fabrication Guidelines."
- C. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- D. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- E. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- F. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- G. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- H. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.
- I. Fabricate seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines," Appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment."
- J. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Equipment Fabrication Guidelines."
- K. Fabricate enclosure panels to ceiling and wall as follows:

1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
2. Wall Offset Spacer: Minimum of **3 inches (75 mm)**.
3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Equipment Fabrication Guidelines," with minimum **0.0625-inch- (1.58-mm-)** thick, stainless-steel shelf tops.

2.3 TYPE I EXHAUST HOOD FABRICATION

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide [a comparable product by one of the following:
 1. Greasemaster.
 2. Greenheck.
 3. Gaylord
- D. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
 1. Fabricate hoods according to NSF 2, "Food Equipment."
 2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
 3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
 4. Include access panels as required for access to fire dampers and fusible links.
 5. Duct Collars Without Fire Dampers: Minimum **0.0598-inch- (1.5-mm-)** thick steel at least **3 inches (75 mm)** long, continuously welded to top of hood and at corners. Fabricate a collar with a **0.5-inch- (13-mm-)** wide duct flange.
 6. Duct-Collar With Fire Dampers: Collar and damper shall comply with UL 710 testing and listing required for the entire hood.
 - a. Collar: Minimum **0.0598-inch- (1.5-mm-)** thick stainless steel, at least **3 inches (75 mm)** long, continuously welded to top of hood and at corners. Fabricate a collar with a minimum **0.5-inch- (13-mm-)** wide duct flange.
 - b. Blades: Minimum **0.1046-inch- (2.7-mm-)** thick stainless steel, counterbalanced to remain closed after actuation.
 - c. Blade Pivot and Spring: Stainless steel.
 - d. Fusible Link: Replaceable, **212 deg F (100 deg C)** rated.
 7. Makeup Air Fire Dampers: Labeled, according to UL 555, by a testing agency acceptable to authorities having jurisdiction.

- a. Fire Rating: 1-1/2 hours.
 - b. Frame: SMACNA Type A, with blades in airstream; fabricated with roll-formed, stainless steel; with mitered and interlocking corners.
 - c. Blades: Roll-formed, interlocking or folded, minimum **0.034-inch- (0.86-mm-)** thick, galvanized-steel sheet.
 - d. Horizontal Dampers: Include a blade lock and stainless-steel closure spring.
 - e. Fusible Link: Replaceable, **165 deg F (74 deg C)** rated.
- E. Hood Configuration: Exhaust and makeup air.
1. Makeup air shall be introduced through laminar-flow-type, perforated metal panels on front of hood canopy.
- F. Hood Style: Wall-mounted canopy
- G. Filters/Baffles: Removable, stainless-steel. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- H. Lighting Fixtures: Recessed fluorescent fixtures and lamps with lenses sealed vaportight. Wiring shall be installed in conduit on hood exterior. Number and location of fixtures shall provide a minimum of **70 fc (753 lx)** at **30 inches (762 mm)** above finished floor.
1. Light switches shall be mounted on front panel of hood canopy
- I. Hood Controls: Hood]-mounting control cabinet, factory wired to control groups of adjacent hoods, and fabricated of stainless steel.
1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation. Motor starters shall comply with Division 26 Section "Enclosed Controllers."
 2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
 3. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete field assembly of hoods where required.

1. Make closed butt and contact joints that do not require filler.
 2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication Requirements" Article.
- B. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- C. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- D. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.
- E. Install hoods to operate free from vibration.
- F. Install seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines," Appendix 1, "Guidelines for Seismic Restraints of Kitchen Equipment."
- G. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at **48 inches (1200 mm)** o.c. maximum.
- H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- I. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- J. Set initial temperatures, and calibrate sensors.
- K. Set field-adjustable switches.
- L. Connect ducts according to requirements in Division 23 Section "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.
- M. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Perform hood performance tests required by authorities having jurisdiction.
 4. Perform fire-suppression system performance tests required by authorities having jurisdiction.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 15950
TESTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - c. Multizone systems.
 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 3. HVAC equipment quantitative-performance settings.
 4. Kitchen hood airflow balancing.
 5. Existing systems TAB.
 6. Verifying that automatic control devices are functioning properly.
 7. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Strategies and Procedures Plan: Within [30] [60] [90] days from Contractor's Notice to Proceed, submit [2] [4] [6] copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by [AABC] [NEBB] [either AABC or NEBB].
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from [AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."] [NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."] [SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing."] [TAB firm's forms approved by Architect.]
- 1.4 PROJECT CONDITIONS
- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
 - B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.5 COORDINATION
- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
 - B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- 1.6 WARRANTY
- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.
 - B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.

- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in [AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems"] [NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"] [SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing"] and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur.

Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at full flow through the cooling coil if coil has that capacity.
- B. Adjust each zone damper to indicated airflow.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 - 1. Measure condenser-water flow to each cell of the cooling tower.
 - 2. Measure entering- and leaving-water temperatures.
 - 3. Measure wet- and dry-bulb temperatures of entering air.
 - 4. Measure wet- and dry-bulb temperatures of leaving air.
 - 5. Measure condenser-water flow rate recirculating through the cooling tower.
 - 6. Measure cooling tower pump discharge pressure.
 - 7. Adjust water level and feed rate of makeup-water system.

3.14 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.15 PROCEDURES FOR BOILERS

- A. If hydronic, measure entering- and leaving-water temperatures and water flow.
- B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Electric-Heating Coils: Measure the following data for each coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.

5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.17 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.18 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches (300 mm) between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
 3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.

1. Check duct slopes as required.
 2. Verify that duct access is installed as required.
 3. Verify that point of termination is as required.
 4. Verify that duct air velocity is within the range required.
 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.
- 3.19 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS
- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 4. Air balance each air outlet.

3.20 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.21 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
 - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.22 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer, type size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.

3.23 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 15990
DIRECT DIGITAL CONTROLS

PART 1 - GENERAL

1.0 SECTION INCLUDES

- .1 Products Furnished But Not Installed Under This Section
- .2 Products Installed But Not Furnished Under This Section
- .3 Products Not Furnished or Installed But Integrated with the Work of this Section
- .4 Related Sections
- .5 Description
- .6 Approved Control System Contractor
- .7 Quality Assurance
- .8 Codes and Standards
- .9 System Performance
- .10 Submittals
- .11 Warranty
- .12 Ownership of Proprietary Material

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Division 15 - Hydronic Piping:
 - 1. Control Valves
 - 2. Flow Switches
 - 3. Temperature Sensor Wells and Sockets
 - 4. Flow Meters
- B. Division 15 - Refrigerant Piping:
 - 1. Pressure and Temperature Sensor Wells and Sockets
- C. Division 15 - Ductwork Accessories:
 - 1. Automatic Dampers
 - 2. Airflow Stations
 - 3. Terminal Unit Controls

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Division 15 - Refrigeration Equipment:
 - 1. Refrigerant Leak Detectors
- B. Division 15 - Rooftop Air Handling Equipment:
 - 1. Thermostats
 - 2. Sensors
 - 3. Controllers

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE
WORK OF THIS SECTION

- A. Division 15 – Heat Generation Equipment
 - 1. Boilers
- B. Division 15 – Refrigeration Equipment
 - 1. Chiller controls
- C. Division 15 – Variable Frequency Drives
 - 1. Pump controls

1.4 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 0 and Division 1.

1.5 DESCRIPTION

- A. General: The control system shall be as indicated on the drawings and described in the specifications, and consist of a peer-to-peer network of digital building control panels and operator workstation(s). The operator workstation shall be a personal computer (PC) including a color monitor, mouse and keyboard. The PC shall provide users an interface with the system through dynamic color graphics of building areas and systems.
- B. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.
- C. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator password. An operator shall be able to log onto any workstation of the control system and have access to all designated data.
- D. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.
- E. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A modem or network communications card shall be provided to for remote access to the system.

1.6 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

- A. Approved Control System Contractors and Manufacturers:

Company Name
Trane Company
Or Pre-Approved Equal

1. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.
2. To be considered a "Pre-Approved Equal", the manufacturer must submit in writing 10 days prior to the bid a full compliance letter to each section of the specification to the Design Engineer. Acceptance will be approved / disapproved prior to bid via Addendum. Manufacturers not receiving pre-approval will not be acceptable.

1.7 QUALITY ASSURANCE

A. System Installer Qualifications

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. The installer shall have an office within [50] miles of the project site and provide [24-hour] response in the event of a customer call.

1.8 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of local, state and federal authorities. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:
1. National Electric Code (NEC)
 2. International Building Code (IBC)
 3. International Mechanical Code (IMC)
 4. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
 5. ANSI/ASHRAE Standard 135-2004 (BACnet)
 6. ANSI/EIA/CEA-709.1 (LonTalk)

1.9 SYSTEM PERFORMANCE

A. Performance Standards. The system shall conform to the following:

1. Graphic Display. The system shall display a graphic with a minimum of [20] dynamic points with current data displayed within [20] seconds of the request.
2. Graphic Refresh. The system shall update all dynamic points with current data within [30] seconds.

3. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be [10] seconds. Analog objects shall start to adjust within [10] seconds.
4. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior [60] seconds.
5. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed [45] seconds.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every [5] seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every [5] seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8. Multiple Alarm Annunciation. All workstations on the network shall receive alarms within [5] seconds of each other.
9. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C [±1°F]
Ducted Air	±1.0°C [±2°F]
Outside Air	±1.0°C [±2°F]
Water Temperature	±0.5°C [±1°F]
Delta-T	±0.15°C [±0.25°F]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Air Flow (terminal)	±10% of reading *Note 1
Air Flow (measuring stations)	±5% of reading
Air Pressure (ducts)	±25 Pa [±0.1 "W.G.]
Air Pressure (space)	±3 Pa [±0.01 "W.G.]
Water Pressure	±2% of full scale *Note 2
Electrical Power	± 5% of reading *Note 3
Carbon Monoxide (CO)	± 5% of reading
Carbon Dioxide (CO2)	± 50 PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

Note 2: for both absolute and differential pressure

Note 3: * not including utility supplied meters

1.10 SUBMITTALS

- A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any seg-

ment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. [Six (6)] copies are required. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats.

- B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- D. Submit the following within [60] days of contract award:
1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
 2. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
 3. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
 4. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover. Include:
 - a) Building Controllers
 - b) Custom Application Controllers
 - c) Application Specific Controllers
 - d) Operator Interface Computer(s)
 - e) Portable Operator Workstation
 - f) Auxiliary Control Devices
 - g) Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling
 - h) Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled
 - i) Points list showing all system objects, and the proposed English language object names
 - j) Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project
 - k) Provide a BACnet Product Implementation Conformance Statement (PICS) for each BACnet device type in the submittal
 - l) Color prints of proposed graphics with a list of points for display
- E. Project Record Documents. Upon completion of installation submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:

1. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
2. Testing and Commissioning Reports and Checklists.
3. Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
 - a) Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - b) Operators Manual with procedures of operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
 - c) Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
 - d) Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - e) A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
 - f) One set of electronic media containing files of all color-graphic screens created for the project.
 - g) Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
 - h) Complete original issue media for all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - i) Licenses and warranty documents for all equipment and systems.
 - j) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.

F. Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least 3 weeks prior to first class.

1.11 WARRANTY

A. Warrant all work as follows:

1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The

Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.

2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
3. Operator workstation software, project specific software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.
4. The system provider shall provide a web-accessible system and support on-line resource that provides the Owner access to a question/answer forum, graphics library, user tips, upgrades, and manufacturer training schedules.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:
1. Project graphic images
 2. Record drawings
 3. Project database
 4. Project-specific application programming code
 5. All documentation

PART 2 - PRODUCTS

2.0 SECTION INCLUDES

- .1 Materials
- .2 Communication
- .3 Operator Interface
- .4 Application and Control Software
- .5 Building Controllers
- .6 Custom Application Controllers
- .7 Application Specific Controllers
- .8 Input/Output Interface
- .9 Auxiliary Control Devices

2.1 MATERIALS

- A. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 2 years. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least 5 years after completion of this contract.

2.2 COMMUNICATION

- A. This project shall comprise of a network utilizing high-speed [BACnet] for communications between Building Controllers and PC Workstations. [LonTalk] sub-networks shall be used for communications between Building Controllers, Custom Application Controllers and Application Specific Controllers.
- B. The controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the DDC system internetwork.]
- C. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either a network interface node for connection to the Ethernet network or an RS-232 port for Point to Point connection.
- D. Remote operator interface via a 56K baud modem shall allow for communication with any and all controllers on this network as described in the following paragraph.
- E. Communications services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
 - 1. Connection of an operator interface device to any one building controller on the internetwork will allow the operator to interface with all other building controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all building controllers shall be available for viewing and editing from any one building controller on the internetwork.
 - 2. All database values (i.e., points, software variable, custom program variables) of any one building controller shall be readable by any other building controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.
- F. The time clocks in all controllers shall be automatically synchronized daily.

2.3 OPERATOR INTERFACE

- A. Operator Interface. Furnish [1] PC based workstations as shown on the system drawings. Each workstation shall be able to access all information in the system. Workstations shall reside on the same high-speed network as the building controllers, and also be able to dial into the system.]
 - B. [Workstation information access shall use the BACnet Protocol. Communication shall use the ISO 8802-3 (Ethernet) Physical/Data Link layer protocol. Remote communications shall use the BACnet Point to Point Physical/Data Link Layer Protocol.]
- A. Hardware. Each operator workstation shall consist of the following:

1. Personal Computer. Furnish IBM-compatible PCs to be used as DDC system workstation. The CPU shall be a minimum of an Intel Pentium 4 or AMD Athlon 64 processor and operate at a minimum 2.2 GHz. Include a minimum 512 Megabytes of RAM, 48X CD ROM drive, 80 Gigabyte hard disk, and two-button mouse. Furnish all required serial, parallel, and network communication ports, and all cables for proper system operation. The PC shall include a minimum 17", color monitor with 1024 x 768 screen resolution.
2. Modems. Furnish auto-dial telephone modems and associated cables as required for communication to remote buildings, and workstations. The modem shall be capable of transmitting at up to 56K baud, and communicate over voice-grade telephone lines.

D. System Software

1. Operating System. Furnish a commercially available, concurrent multi-tasking operating system. Acceptable operating systems are Microsoft Windows XP Professional.
2. System Graphics. The Operator Workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The system graphics shall be able to be modified while the system is on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment. Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions (V17). Graphics shall be capable of launching other PC applications.
3. Custom Graphics. Custom graphic files shall be created with the use of commonly available graphics packages such as Corel Paint Shop Pro. The graphics generation package shall create and modify graphics that are saved in industry standard formats such as BMP, GIF and JPEG.
4. Graphics Library. Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators, including 2-dimensional and 3-dimensional graphic depictions. The library shall include a minimum of 300 such files available for use by the Owner. This library shall also include standard graphical representations of equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.
5. Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by locality to select the desired units for each measurement. Engineering units on this project shall be [Inch Pound] [SI].

E. System Applications. Each workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation.

1. Automatic System Database Save and Restore. Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require operator intervention. In the event of a database loss in a building management panel, the first workstation to detect the loss shall automatically restore the database for that panel.
2. Manual Database Save and Restore. A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.
3. System Configuration. The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, and assign modems to devices. This shall allow for future system changes or additions.
4. On-Line Help and Training. Provide a context sensitive, on line help system to assist the operator in operation and editing of the system. On-line help shall be available for all system functions and shall provide the relevant data for that particular screen. Additional help shall be available through the use of hypertext links onscreen.
5. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.
6. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
7. Alarm Notification. Alarm messages shall use full language, easily recognized descriptors for alarm. System shall allow the user to have up to 10 popup windows appear for incoming alarms. The popup dialog shall allow the user to silence and acknowledge alarms, view an expanded message or graphic, and add and save comments for the alarm.
8. Alarm Processing. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
9. Alarm Reactions. The operator shall be able to determine what actions, if any, are to be taken, by object, during an alarm. Actions shall include logging, printing, start a custom control program, displaying messages, dialing out to remote workstations, paging or text message to a cell phone, forwarding to an e-mail address, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator specified time period shall be re-routed to an alternate operator specified alarm receipt

- device. For text messaging, the system shall support TAP protocol including parities 7-E-1 and 8-n-1, such that if the system fails to dial out/connect with one parity it will automatically try the other one.
10. Alarm and Event Log. The operator shall be able to view all logged system alarms and events from any location in the system. The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in up to 5 color-coded categories based on Owner preference (V17). Include an alarm count summary for each alarm category on the system toolbar. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation. Provide a comment field in the event log that allows a user to add specific comments associated with any alarm.
 11. Trend Logs. The operator shall be able to define a trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 30 seconds, 1, 5, 15, 30, and 60 minutes as well as once a shift (8 hours), once a day, once a week, and once a month shall be selectable. Each trend shall accommodate up to 64 system objects. The system operator shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the workstation hard disk. Trend data shall be able to be viewed and printed from the operator interface software. Trends must be viewable in a text-based format or graphically. Trends shall also be storable in a tab delimited ASCII format for use by other industry standard word processing and spreadsheet packages.
 12. Dynamic Graphical Trending. The system shall have the ability to save the data collected by a trend object and display that collected data in a graphical chart. Trend viewing capabilities shall include the ability to show up to 10 points on a chart, to include live and/or historical data. Each data point trend line shall be an individual color, and include on-graph icons that represent associated events/alarms, manual overrides, and automated changes that have occurred over the time frame represented on the chart. Navigation and viewing functions shall include scrolling and zooming of x and y axes, and a trace display of the associated time stamp, and values for any selected point along the x-axis. Trend data shall be able to be stored for up to 10 years on the PC workstation.
 13. Object and Property Status and Control. Provide a method for the operator to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics or through custom programs.
 14. Clock Synchronization. The real time clocks in all building controllers and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks; daily from any operator designated device in the system. The system shall automatically adjust for daylight savings time if applicable.
 15. Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be

readily printed to the system printer. The operator shall be able to designate reports that shall be printed or stored to disk at selectable intervals. Provide a means to list and access the last 10 reports viewed by the user.

- a) Custom Reports: Provide the capability for the operator to define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title.
- b) Standard Reports. The following standard system reports shall be provided for this project. These reports shall be readily customized to the project by the owner.
 - i. Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly electrical consumption and peak demand for each meter.
 - ii. All Points in Alarm Report: Provide an on demand report showing all current alarms.
 - iii. All Points in Override Report: Provide an on demand report showing all overrides in effect.
 - iv. Schedule Report: Provide a summary of all schedules including Holiday and Exception schedules.
 - v. Commissioning Report: Provide a one time report that lists all equipment with the unit configuration and present operation.
 - vi. ASHRAE Standard 147 Report: Provide a daily report that shows the operating condition of each chiller as required by ASHRAE Standard 147. At minimum this report shall include:
 - 1. Chilled Water (or other fluid) inlet and outlet temperature
 - 2. Chilled Water (or other fluid) flow
 - 3. Chilled Water (or other fluid) inlet and outlet pressures
 - 4. Evaporator refrigerant pressure and temperature
 - 5. Condenser refrigerant pressure and liquid temperature
 - 6. Condenser water inlet and outlet temperatures
 - 7. Condenser water flow
 - 8. Oil pressure and temperature
 - 9. Oil level (if applicable)
 - 10. Compressor refrigerant discharge temperature
 - 11. Compressor refrigerant suction temperature
 - 12. Manual entry field for addition of refrigerant
 - 13. Manual entry field for addition of oil
 - 14. Manual entry field for vibration levels
 - 15. Motor amperes per phase
 - 16. Motor volts per phase
 - 17. Purge exhaust time or discharge count
 - 18. Ambient temperatures (dry bulb and wet bulb)
 - 19. Date and time data logged

F. Workstation Applications Editors. Each PC workstation shall support dedicated screens for editing of all system applications. Provide editors for each application at the PC work-

station. The applications shall be downloaded and executed at the appropriate controller panels.

1. Controller. Provide a full screen editor for each type custom application, and application specific controller that shall allow the operator to view and change the configuration, name, control parameters, and system set-points.
2. Scheduling. An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. An advance and delay time for each object shall be adjustable from this master schedule. An operator shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and/or dates.
3. Manual Control and Override. Provide a means of manually controlling analog and binary output points. Control overrides shall be performed through a simple, graphical on-off-auto editor for binary points, and auto-manual selector for analog control. Provide a icon indicator of override status when a point, unit controller or application has been overridden manually.
4. Air System Equipment Coordination. Provide editor screens with monitoring and control functions that group together and coordinates the operation of air handling equipment and associated VAV boxes as specified in the sequence of operations. For each air system, the editor pages shall include:
 - a) System mode of the air handling system
 - b) Listing and assignment of the associated air handler and VAV boxes
 - c) AHU supply air cooling and heating setpoints
 - d) AHU minimum, maximum and nominal static pressure setpoints
 - e) VAV box minimum and maximum flow, and drive open and close overrides
5. Chiller System. A chiller plant control application shall be configured using a full screen editor and shall provide operating status for the system. The display shall include:
 - a) System mode of the chiller plant
 - b) Chiller enable/disable status
 - c) System supply water setpoint
 - d) System supply and return water temperature
 - e) System Chilled water pump status
 - f) System Chilled water flow
 - g) Bypass pipe flow rate (if applicable)
 - h) Messages as to when an additional chiller will be added or removed from operational sequence
 - i) Chiller or system failure information
 - j) Chiller rotation information
 - k) Override capabilities to force an added chiller, subtract a chiller, or change of sequence.
 - l) Control to remove a chiller from a sequence temporarily for service purposes.

Note to Bidders: Submit printouts of example operator interface screen(s) with bid. Operator interface content and functionality shall be validated during the commissioning phase of the project.

6. Chiller System Operator Interface: The Chiller Control Program shall include the following operator interface elements:

Chiller Plant Control Application Operational Status Screen to include:

- a) Chiller System Status (Off/Soft Start/Normal/Ambient Lock-out/Shutdown in Progress)
- b) Chiller Plant Supply Water Setpoint
- c) Chilled Water System Supply Water Temperature
- d) Chilled Water System Return Water Temperature
- e) Prediction chiller addition / subtract status messages (i.e Next Chiller to Add will be added if the system supply water temp [40.1] exceeds [41.5] degrees for [15] minutes. OR Next Chiller to Subtract will be subtracted if there is no add request and the actual system Delta T [12.7] degrees is less than [10.2] degrees for [15] minutes.)
- f) Individual Chiller Failure Reset (Push Button)
- g) All Chiller Failure Reset (Push Button)
- h) System Pump Failure Reset (Push Button)
- i) Manual Addition of Chiller (Push Button)
- j) Manual Subtraction of Chiller (Push Button)
- k) Manual Rotation of Chiller Sequence (Push Button)

Chiller Plant Control program shall include a screen(s) that allows editing of the following data without entering program code editor:

- a) Supply Water Setpoint
- b) System Soft Loading Setpoints
- c) Ambient Lockout Setpoints
- d) Chiller Addition Setpoints
- e) Chiller Subtraction Setpoints
- f) Auto Rotation Setpoints
- g) Alarm Handling Setup
- h) Security Setup
- i) Flow type (Variable or Constant)
- j) Start Interval adjustment
- k) Powerfail Recovery options (Normal or Rapid)
- l) Soft Start
- m) Chiller Selection Type (Normal, Peak, Swing or Base)

Individual Chiller Status Graphic Screen(s)

- a) Chiller Name
- b) Chiller Operating Mode
- c) Chilled Water Setpoint
- d) Chiller RLA %
- e) Chiller Number of Starts

- f) Chiller Run Hours
- g) Entering Chiller Water Temperature
- h) Leaving Chilled Water Temperature
- i) Evaporator Flow Status
- j) Condenser Flow Status
- k) Purge Unit Status (Low pressure machines only)
- l) Purge Compressor Daily Run Time (Low pressure machines only)
- m) Compressor Phase Voltages 1/2/3
- n) Compressor Phase Amperages % of FLA 1/2/3
- o) Compressor Motor Winding Temperatures 1/2/3

Chiller Status Report - Provide an operating status report for each chiller. The report(s) shall provide the present status for the following information to provide the operator with critical chiller operating data.

- a) Compressor On/Off Status.
- b) Compressor Starts/Run Hours
- c) Compressor Phase 1/2/3 Percent RLA - separate for each compressor
- d) Compressor Current Draw - RLA Percent
- e) Active Chiller Diagnostics or Alarms
- f) Leaving Chilled Water Temperature
- g) Entering Chilled Water Temperature
- h) Condenser Water Entering/Leaving Temperatures
- i) Chilled Water Setpoint.
- j) Refrigerant Temperature Evaporator/Condenser - Separate for each circuit
- k) Operating Mode
- l) Chiller Model and Serial Number
- m) Outside Air Temperature

Diagnostics/Protection - the BAS system shall be able to alarm from all sensed points and diagnostic alarms sensed by the chiller controller.

Alarm limits shall be designated for all sensed points.

Sensed diagnostic points shall include the following at a minimum:

- a) System Chilled Water Supply Temperature
- b) System Chilled Water Return Temperature

System diagnostic and alarm indication:

The chiller plant control system contractor shall provide a list of all system and chiller diagnostics and alarms to the engineer with the bid package for this project.

The chiller plant control system shall display the chiller plant diagnostic and alarm status at the operator PC workstation. The PC workstation diagnostic and alarm display shall include an English language description, indication as to whether the alarm is an individual chiller alarm or a chiller system alarm, and the time and date of the alarm.

- a) Individual chiller and chiller plant system alarms shall be classified as either Manual Reset Diagnostic, Auto Reset Diagnostic or Informational Warning. Both Manual Reset Diagnostics and Auto Reset Diagnostics will shut down the chiller.
- b) Manual Reset Diagnostics and Auto Reset Diagnostics will cause an alarm message to be printed on the optional system printer, and will automatically log the alarm message in the Event Log.
- c) The chiller plant control system shall have an "audible alarm" feature which, when activated by the operator, will generate an audible tone at the operator workstation and initiate an autodial sequence via an autodial modem when a latching alarm occurs.
- d) Latching alarms shall only be resettable at the chiller unit control panel. The chiller plant control system shall automatically record a "return-to-normal" message in the software Event Log when a latching alarm is reset by the operator.
- e) The chiller plant control system shall have a "print changes" and "save changes" feature which, when activated by the operator, will cause messages for Auto Reset Diagnostics to be printed or automatically logged in the Event Log.

Individual chiller diagnostic and alarm statuses shall include the following Manual Reset items for each chiller:

- a) Leaving Evaporator Sensor Failure
- b) Entering Evaporator Sensor Failure
- c) Low Chilled Water Temperature
- d) Compressor Overload Trip - separate for each compressor
- e) Compressor High Motor Temperature - separate for each compressor
- f) Compressor Contactor Failure - separate for each compressor
- g) Compressor High Oil Temperature - separate for each compressor
- h) Compressor Oil Temperature Sensor Failure - separate for each compressor
- i) Compressor Oil System Fault - separate for each compressor
- j) Low Pressure Cutout - separate for each circuit
- k) High Pressure Cutout - separate for each circuit
- l) Solenoid Valve Failure - separate for each circuit
- m) Phase Loss
- n) External Interlock Status
- o) Unit Controller Status

Individual chiller diagnostic and alarm statuses shall include the following auto reset and informational warnings for each chiller:

- a) Leaving Condenser Sensor Failure
- b) Entering Evaporator Sensor Failure
- c) Outdoor Air Temperature Sensor Failure
- d) Zone Temperature Sensor Failure
- e) High Voltage
- f) Low Voltage

- g) Phase Reversal
- h) Chiller Water Flow Interlock
- i) Unit Communication Loss
- j) Low Chilled Water Temperature (unit off)
- k) Circuit 1 - Pumpdown Timeout
- l) Circuit 2 - Pumpdown Timeout

G. Custom Application Programming. Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded.

2.4 APPLICATION AND CONTROL SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

B. System Security

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
3. User logon/logoff attempts shall be recorded.
4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to [10] events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1. Weekly Schedule. Provide separate schedules for each day of the week.
2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
4. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate

sets of heating and cooling rates for zones that have been unoccupied for less than and greater than 24 hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

- D. Remote Communications. The system shall have the ability to transmit alarms to multiple associated alarm receivers. Receivers shall include PC Workstations, email addresses, cell phones and alphanumeric pagers. The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system utilizing the system Ethernet communications, or dial up communications via modem, in the same format and method used on site as described under the Operator Interface section of this specification.
- E. Demand Limiting. The demand limiting program shall monitor building power consumption from signals generated by a pulse generator (provided by others) mounted at the building power meter, or from a watt transducer or current transformer attached to the building feeder lines.
1. The demand limiting program shall be based on a predictive sliding window algorithm. The sliding window duration and sampling interval shall be set equal to that of the local Electrical Utility.
 2. Control system shall be capable of demand limiting by resetting HVAC system set-points to reduce load while maintaining a widened band of comfort control in the space.
 3. Input capability shall also be provided for an end-of-billing period indication.
- F. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.
- G. Chiller Sequencing. Provide applications software to properly sequence the chiller plant to minimize energy use. This application shall perform the following functions:
1. The chiller plant control application shall have the ability to control up to 25 chillers as detailed in the sequence of operations.
 2. This application shall be able to control both constant and variable flow systems as well as parallel, series and decoupled piping configurations.
 3. The chiller plant control application shall be able to control multiple chiller plants per site.
 4. Diagnostics/Protection - The chiller plant application program shall be able to integrate individual chiller diagnostics into control action decisions.
 5. Event Processing - All chiller plant control and status events shall be recorded, at the operator's selection, in the building management system event log to facilitate troubleshooting.
 6. Alarm Indications - The chiller plant control status screens shall display chiller plant and individual chiller alarm messages.
 7. Add/Subtract actions - The status screens shall provide information on when the next chiller add or subtract action will occur. The operator shall have the ability to manually force a chiller addition or a chiller subtraction.

- H. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.
- I. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, workstation, or the operator display. The amount of time that the override takes precedence will be selectable from the workstation.
- J. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.
- K. System Calculations. Provide software to allow instantaneous power (e.g. KW), flow rates (e.g. L/s [GPM]) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window KW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.
- L. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

2.5 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - 1. The Building Automation System shall be composed of one or more independent, standalone, microprocessor based Building Controllers to manage the global strategies described in System software section.
 - 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 3. The controller shall provide a communications port for connection of the Portable Operators Terminal.
 - 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 5. Controllers that perform scheduling shall have a real time clock.
 - 6. Data shall be shared between networked Building Controllers.
 - 7. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.
 - 8. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

- a) Assume a predetermined failure mode.
 - b) Generate an alarm notification.
 - c) Create a retrievable file of the state of all applicable memory locations at the time of the failure.
 - d) Automatically reset the Building Controller to return to a normal operating mode.
- A. Communications. Each Building Controller shall reside on a BACnet internetwork using the ISO 8802-3 (Ethernet) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.] [Optional – Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers using LonTalk FTT-10 and LonMark profiles.]
- A. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].
- B. Serviceability. Provide diagnostic LEDs for power, communications, and processor. The Building Controller shall have a display on the main board that indicates the current operating mode of the controller. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable. The primary logic board shall be removable without disconnecting field wiring.
- C. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- D. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage

2.6 CUSTOM APPLICATION CONTROLLERS

- A. General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
- 1. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 2. Controllers that perform scheduling shall have a real time clock.
 - 3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 4. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode, and generate an alarm notification.
 - 5. Custom application controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall be with the use of LonMark-approved SNVTs.
- B. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controller used in conditioned ambient shall be mounted in NEMA 1 type enclosures, and shall be rated for operation at 0 C to 50 C [32 F to 120 F].
 2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 70 C [-40 F to 158 F].
- C. Serviceability. Provide diagnostic LEDs for power, communications, and processor. All low voltage wiring connections shall be made such that the controller electronics can be removed and/or replaced without disconnection of field termination wiring.
- D. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.7 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 2. Each ASC will contain sufficient I/O capacity to control the target system.
- B. Environment. The hardware shall be suitable for the anticipated ambient conditions.
1. Controller used in conditioned ambient spaces shall be mounted in NEMA 1 type rated enclosures. Controllers located where not to be disturbed by building activity (such as above ceiling grid), may be provided with plenum-rated enclosures and non-enclosed wiring connections for plenum cabling. All controllers shall be rated for operation at 0 C to 50 C [32 F to 120 F].
 2. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40 C to 65 C [-40 F to 150 F].
- C. Serviceability. Provide diagnostic LEDs for power and communications. All wiring connections shall be clearly labeled and made to be field removable.
- D. Memory. The Application Specific Controller shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.
- E. Immunity to Power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

- F. Transformer. Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.
- G. Application Specific Controllers shall communicate using LonTalk. Controllers shall use FTT-10 transceivers. All communications shall follow LonMark profiles. ASCs which do not have a profile that applies must comply with LonMark standards, utilize SNVTs for all listed points, and be provided with a XIF file for self-documentation.

2.8 INPUT/OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 3 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on/off operation. Terminal unit and zone control applications may use 2 outputs for drive-open, drive-close (tri-state) modulating control. [Optional: Binary outputs on custom application controllers shall have 3-mode (on/off/auto) program override control from the panel with output status lights.]
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. [Optional: Analog outputs on custom application controllers shall have a 2-mode (auto/manual) program override control, with manual output adjustment over 0-100% of range.]

2.9 AUXILIARY CONTROL DEVICES

- A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
 - 1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
 - 2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.

3. Damper shaft bearings shall be as recommended by manufacturer for application.
4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.

B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.

C. Electric damper/valve actuators.

1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
7. Actuators shall be Underwriters Laboratories Standard 873 listed.
8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Control Valves

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.
2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a) Water Valves:
 - i. Two-way: 150% of total system (pump) head.
 - ii. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - b) Steam Valves: 150% of operating (inlet) pressure.
3. Water Valves:

- a) Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
- b) Sizing Criteria:
 - i. Two-position service: Line size.
 - ii. Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or [5] psi, whichever is greater.
 - iii. Three-way Modulating Service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), [5] psi maximum.
 - iv. Valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball.
 - v. 2-1/2" valves and larger shall be cast iron ANSI Class 125 with guided plug and Teflon packing.
- c) Water valves shall fail normally open or closed as scheduled on plans or as follows:
 - i. Heating coils in air handlers - normally open.
 - ii. Chilled water control valves - normally closed.
 - iii. Other applications - as scheduled or as required by sequence of operation.
- d) Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

E. Binary Temperature Devices

- 1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
- 2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
- 3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

F. Temperature Sensors

- 1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
- 2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.

3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with set-point adjustment, override switch, display, and/or communication port as shown on the drawings.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].
6. [Optional] The space temperature, setpoint, and override confirmation will be annunciated by a digital display for each zone sensor. The setpoint will be selectable utilizing buttons.

G. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of $\pm 5\%$ R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 C to 75 C [-40 F to 170 F].
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

H. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

I. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

J. Carbon Dioxide (CO₂) Sensors

1. Carbon Dioxide sensors shall measure CO₂ in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.

K. Flow Switches

1. Flow-proving switches shall be either paddle or differential pressure type, as shown.
2. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified:
3. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
4. Current sensing relays may be used for flow sensing or terminal devices.

L. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

M. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0 C and 50 C.
4. Unit shall be UL recognized.

N. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

O. LOCAL CONTROL PANELS

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

3. Provide on/off power switch with over-current protection for control power sources to each local panel.

PART 3 - EXECUTION

3.0 SECTION INCLUDES:

- .1 Examination
- .2 Protection
- .3 General Workmanship
- .4 Field Quality Control
- .5 Wiring
- .6 Fiber Optic Cable
- .7 Installation of Sensors
- .8 Flow Switch Installation
- .9 Actuators
- .10 Warning Labels
- .11 Identification of Hardware and Wiring
- .12 Controllers
- .13 Programming
- .14 Cleaning
- .15 Training
- .16 Acceptance

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect/Engineer for resolution before rough-in work is started.

3.2 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.4 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.5 WIRING

- A. All control and interlock wiring shall comply with the national and local electrical codes and Division 16 of these specifications. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.
- B. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
- C. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- D. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- E. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- F. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.

- G. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- H. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- I. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- J. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- K. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- L. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- M. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- N. Adhere to Division 16 requirements for installation of raceway.
- O. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- P. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

3.6 FIBER OPTIC CABLE SYSTEM (where required)

- A. All cabling shall be installed in a neat and workmanlike manner. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.
- B. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post installation residual cable tension shall be within cable manufacturer's specifications.
- C. Fiber optic cabinets, hardware, and cable entering the cabinet shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii as specified by cable manufacturer shall be maintained.

3.7 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.8 FLOW SWITCH INSTALLATION

- A. Use correct paddle for pipe diameter.
- B. Install and adjust flow switch in accordance with manufacturers' instructions.
- C. Assure correct flow direction and alignment.
- D. Mount in horizontal piping - flow switch on top of the pipe.

3.9 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
 - 1. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 3. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.10 WARNING LABELS

- A. Affix labels on each starter and equipment automatically controlled through the DDC System. Warning label shall indicate the following:

CAUTION

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

- B. Affix labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects. Labels shall indicate the following:

CAUTION

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.11 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.
- C. Identify control panels with minimum 1-cm (1/2") letters on nameplates.
- D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.12 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. A custom application controller may control more than one system provided that all points associated with that system are assigned to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of [15%] spare I/O point capacity for each point type found at each location. If input points are not universal, [15%] of each type is required. If outputs are not universal, [15%] of each type is required. A minimum of one spare is required for each type of point used.

1. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

3.13 PROGRAMMING

A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming

1. Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

D. Operators' Interface

1. Standard Graphics. Provide graphics for each major piece of equipment and floor plan in the building. This includes each Chiller, Air Handler, VAV Terminal, Fan Coil, Boiler, and Cooling Tower. These standard graphics shall show all points dynamically as specified in the points list.
2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.
3. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of [16] hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.

E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.14 VAV AIR SYSTEM AUTO-COMMISSIONING / AUTO-CALIBRATION

A. The building automation system shall provide the ability to automatically commission and calibrate the VAV Air System. The following tests shall be performed, at a minimum:

1. Calibration of the air valve / damper
 2. Verification of air flow through the VAV box
 3. Verification of local reheat performance for hydronic, as well as, multiple stages of electric reheat
- B. The building automation system (BAS) shall provide the ability to initiate the auto-commissioning /auto-calibration command directly from the user interface. Special service tools shall not be required.
- C. The BAS shall provide the ability to stagger the auto-commissioning /auto-calibration sequence for groups of VAV boxes to allow the sequence to be performed during occupied hours, if necessary.
- D. An auto-commissioning report for the VAV Air System shall be generated that contains the results of the auto-commissioning / auto-calibration tests. This report shall contain, at a minimum, the following information for each VAV box in the system:
1. Name of VAV box
 2. Date and time the VAV box was tested
 3. Presence of any alarms
 4. Space temperature and setpoint
 5. Active airflow (in CFM)
 6. Air valve / damper position when the VAV box reaches 40% of the maximum cooling airflow setpoint
 7. Air valve / damper position when the VAV box reaches 100% of the maximum cooling airflow setpoint
 8. Discharge air temperature of the VAV box when the VAV local fan is off[omit if the VAV box does not have a local fan]
 9. Discharge air temperature of the VAV box when the VAV local fan is on[omit if the VAV box does not have a local fan]
 10. Discharge air temperature of the VAV box when the hydronic heat is active[omit if the VAV box does not have a local hydronic reheat]
 11. Discharge air temperature when each stage of electric heat is energized, up to three stages of heat[omit if the VAV box does not have a local electric reheat]

3.15 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired

to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.16 TRAINING

- A. Provide a minimum of [2] classroom training sessions, [4] hours each, throughout the contract period for personnel designated by the Owner. Computer-based audio-visual training may be substituted for up to [4] hours of hands on training.
- B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system, and perform routine diagnostic and troubleshooting procedures.
- C. Additional training shall be available in courses designed to meet objectives as divided into three logical groupings; participants may attend one or more of these, depending on the level of knowledge required:
 - 1. Day-to-day Operators
 - 2. Advanced Operators
 - 3. System Managers/Administrators
- D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- F. Classroom training shall be done using a network of working controllers representative of the installed hardware or at the customer's site.
- G. This training shall be made available in addition to the interactive audio-visual tutorial, provided with the system.

3.17 ACCEPTANCE

The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION

Division 16

Electrical

SECTION 16050
BASIC ELECTRICAL MATERIALS & METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Electrical equipment coordination and installation.
 2. Sleeves for raceways and cables.
 3. Sleeve seals.
 4. Common electrical installation requirements.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 3. To allow right of way for piping and conduit installed at required slope.
 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
 5. So that underground raceways that extend under the building grade slab are routed clear of footings, grade beams and similar including drainage provisions and the work of other trades. Where the number of sweeps or bends exceeds practical limits, furnish and install hand holes, manholes and similar appurtenances to facilitate the pulling in of cables.
 6. So that raceways run "overhead" are located at elevations and in such a manner that does not interfere with the work of other trades or restrict proper use and access of the area or space in which the raceway is located. In particular locate circuitry to Connector Strips at a suitable elevation above the catwalks.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
- C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION

SECTION 16060
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 3/0 stranded.
 - 5. Bonding Conductor: No. 4, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: copper-clad steel $\frac{3}{4}$ " x 20'.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for #10 AWG and smaller, and stranded conductors for #8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.

2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal or Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 2 Section "Underground Ducts and Utility Structures," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 16072
ELECTRICAL SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 SUBMITTALS

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of component used.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of 5 times the applied force.
- B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Manufacturers:
 - a. Cooper B-Line; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Allied Support Systems; Power-Strut Unit.
 - d. GS Metals Corp.
 - e. Michigan Hanger Co., Inc.; O-Strut Div.
 - f. National Pipe Hanger Corp.
 - g. Thomas & Betts Corporation.
 - h. Unistrut; Tyco International, Ltd.
 - i. Wesanco, Inc.
 2. Channel Dimensions: Selected for structural loading
- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers:
 - 1) Cooper B-Line; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Construction Products.
 - 5) MKT Fastening, LLC.
 - 6) Powers Fasteners.
 2. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 4. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
 5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, unless requirements in this Section or applicable Code are stricter.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated by Code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. To Steel: [Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts] [Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69] [Spring-tension clamps].
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
- B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 6. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete (Limited Applications)."

END OF SECTION

SECTION 16075
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Identification for conductors and communication and control cable.
 - 2. Warning labels and signs.
 - 3. Equipment identification labels.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70, NFPA 70 E and 29 CFR 1910.145.

- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- F. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."
 - 3. PPE Personnel protection equipment labels identifying level of hazard and the required protective items as prescribed by NEC 70 E.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

PART 3 - EXECUTION

3.1 APPLICATION

- A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
 - 2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

- B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply [self-adhesive warning labels]. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: [Self-adhesive, engraved, laminated acrylic or melamine label]. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
 - c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Electrical switchgear and switchboards.
 - c. Transformers.
 - d. Motor-control centers.
 - e. Disconnect switches.
 - f. Enclosed circuit breakers.
 - g. Motor starters.
 - h. Push-button stations.
 - i. Power transfer equipment.
 - j. Contactors.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.

- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.

END OF SECTION

SECTION 16120
CONDUCTORS & CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Aluminum and Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, THHW and other insulation types as required based on the environment to which the conductor will be subjected.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
 - 6. IIsco
 - 7. NSI Industries – “Polaris Taps”
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- D. Where required due to limitations on the “approved termination devices” provided with equipment (approved for use by the AHJ, the contractor shall provided “transition boxes” and connectors to allow for the reduction of conductor size (oversized to account for voltage drop) to occur without voiding warranties or violating code limitations on wire bending space, clearance or cross sectional area limits.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.4 SLEEVE SEALS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.

- D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic, include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHW or THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHW or THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHW or THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHW or THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHW or THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHW or THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHW or THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

- I. Class 1 Control Circuits: Type THHW or THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHW or THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Electrical Supports".
- F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- D. Cut sleeves to length for mounting flush with both wall surfaces.
- E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 7 Section "Joint Sealants."
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 7 Section "Through-Penetration Firestop Systems."
- J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test[service entrance and feeder conductors, and conductors feeding the following critical equipment and services] for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 16130
RACEWAYS & BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. See Division 2 Section "Underground Ducts and Utility Structures" for exterior ductbanks and manholes, and underground handholes, boxes, and utility construction.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.

- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel or die-cast, set-screw or compression type.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. RNC: NEMA TC 2, Type EPC-40-PVC unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: As indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Manufacturing Company; Walker Division.
 - b. Enduro Systems, Inc.; Composite Products Division.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. Panduit Corp.
 - f. Walker Systems, Inc.; Wiremold Company (The).
 - g. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- E. Nonmetallic Floor Boxes: Nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic finished inside with radio-frequency-resistant paint.
- I. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: SCH 80 PVC.
 - 2. Concealed Conduit Aboveground: SCH 80 PVC.
 - 3. Underground Conduit: 80-PVC, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed: EMT or SCH 40 PVC.

2. Concealed in Ceilings and Interior Walls and Partitions: EMT (MC Cable may be used in interior walls only).
 3. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 16 Section "Electrical Supports and Seismic Restraints."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- K. Raceways for Optical Fiber and Communications Cable: Install as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- N. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Wall-box motion sensors.
 - 3. Snap switches and wall-box dimmers.
 - 4. Solid-state fan speed controls.
 - 5. Wall-switch and exterior occupancy sensors.
 - 6. Communications outlets.
- B. See Division 16 Section "Voice and Data Communication Cabling" for workstation outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
3. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.

- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.5 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable rotary knob; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 1. 1200 W; dimmers shall require no derating when ganged with other devices.
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 1. Continuously adjustable rotary knob, 5 A.

2.7 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

B. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

C. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

D. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).

E. Wide-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

F. Exterior Occupancy Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; PS200-10.
 - b. Watt Stopper (The); EW-100-120.
3. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot (34-m) detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.8 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1 complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.
3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic [0.035-inch-(1-mm-)]
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.11 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION

SECTION 16145
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor occupancy sensors.
 - 2. Lighting Relay Control Panels

- B. See Division 16 Section "Wiring Devices" for wall-box dimmers and manual light switches.

- C. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. All Labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.

1.2 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
- C. Submittal Data for Lighting Relay Panels
 - A. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, DTC, photocells and other interfaces. Shop drawings shall indicate exact location of each device or a RFI to confirm location. Plans are diagrammatical. EC to verify all lighting control material requirements from approved shop drawings. "Cut Sheet" submittal not acceptable.
 - B. Product Data: Submit for approval manufacturer's data on the specific lighting control system and components. Submittal shall be electronic format with hard copy available. To prevent departures from approved system operation, electronic files submitted shall

be able to be directly downloaded to the specified system at manufacturer facility. Submit a complete bill of materials with part numbers, description and voltage specifications.

- D. Manufacturer shall provide free software that can be used to specify the system, detail all programming and generate a single line in a format that can be dropped into industry standard CAD packages.
- E. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component if it differs from that illustrated in the riser diagram in these specifications. Submittals that show typical riser diagrams are not acceptable.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 DESCRIPTION OF WORK for Lighting Relay Panel

- A. Furnish and install a complete system for the control of lighting and other equipment as indicated on the plans, detailed in the manufacturer submittal and as further defined herein. Contractor is solely responsible to verify quantity, installation locations and wiring requirements for this project. Specific manufacturer's catalog numbers, when listed in this section are for reference only. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.
- B. The system shall include but not be limited by the following list: Pre-wired, microprocessor controlled relay or dimming panels with latching relays controlled via a complete list of communication based accessories including digital switches, digital photocells, digital occupancy sensors, digital SmartBreaker panelboards, Digital Time Clock (DTC) and interface cards to HVAC building automation systems. The type of lighting control equipment and wiring specified in this section is covered by the description: Microprocessor Controlled Digital Lighting Control system with RS 485 Bus communications. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring. They are not the work of this section.
- C. SmartBreaker panel boards shall operate as if each breaker were a relay in the lighting control system. All references in this spec to the operation of relays shall apply equally to the solenoid operated thermal magnetic breakers within SmartBreaker panel boards.

1.6 System Description for Lighting Relay Panel

- A. The lighting control system is a networked system that communicates via RS485. The system must be able to communicate with fully digital centralized relay panels, small distributed relay panels (Available with 0-10VDC dimming outputs), (also called Micro Panels), Fully distributed fixture level control by bus connected relays or dimmers, (also called X-Point) smart breaker panels, digital switches, photocells, various interfaces and operational software. The intent of the specification is to integrate all lighting control into one system. Distributed lighting control shall be provided using networked micro relay panels or bus connected fixture level control (X Point.) Lighting control system shall include all hardware and software. Software shall be resident within the lighting control system. System shall provide local access to all programming functions at the master LCP and remote access to all programming functions via dial up modem and through any standard computer workstation. Lighting control system shall have the capability to be remotely controlled via the internet or building wide Ethernet LAN. Desktop computers are not part of this section and will be provided by others.
- B. System software shall provide real time status of each relay, each zone and each group.
- C. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on line PC or server for normal operation are not acceptable
- D. All devices shall be pre-addressed at the factory. If required by the client the system may be specified without pre-addressing and simple software is to be provided to simplify addressing in place. This particularly applies to fixture level control where controls may be factory mounted on the fixture in advance to speed installation.
- E. All programs, schedules, time of day, etc, shall be held in non-volatile memory for an indefinite time exceeding 10 years in the event of power failure. At restoration of power, lighting control system shall implement programs required by current time and date. Time of day shall be battery backed for at least 10 years.
- F. System shall be capable of warning of an impending off sweep by flashing lights Off/On once or twice (programmable) by relay or by zone prior to the lights being turned off. The warning interval times between the flash and the final lights off signal shall be definable for each zone. Additionally an audible signal shall be able to be programmed that gives a mild note on the first flash and a more insistent signal on the second one. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.

- G. The system shall be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, contact closure switches, time clock schedules including offsets from dusk and dawn by up to 10 hours, photocell, pc software or other devices connected to programmable inputs in a lighting control panel.
- H. The lighting control system shall provide the ability to control each relay and each relay group per this specifications requirement. All programming and scheduling shall be able to be done locally at the master LCP and remotely via dial up modem and via the Internet. Remote connection to the lighting control system shall provide real time control and real time feedback.
- I. Micro relay panels shall be capable of taking inputs from contact closure switches and outputting up to 8 independent 0-10VDC dimming signals. All micro relay panels and all devices connected to micro relay panels (switches, photocells and occupancy sensors, etc) shall be wired per lighting control manufacturers instructions.
- J. X Point relay or dimming modules shall be fed from an X Point router that sits on the GR 2400 Bus in the manner of a relay panel. Individual modules are fed from this panel on a separate bus. Each router may feed two strings of up to 64 modules on a 2000ft string. Each Module may be a single relay, a dual relay or a dimming (0-10Volt) module. Relays in the modules are to be capable of being separately controlled in the same manner as an individual relay or dimmer in a relay or dimmer panel. Additionally multiple relays may be collected together to act together as a single multi-pole load or dimmer for ease of programming. Graphical software shall be available that does these assignments and reassignments in a straightforward and logical manner. Relays shall have the same specifications as laid out in 2.1.C. Modules with reduced current ratings may be supplied with Quick Connect connectors for more rapid installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 LIGHTING RELAY PANEL SYSTEM

F. Relay Panels:

1. All LCP's shall be in NEMA 1 rated enclosure with screw cover or hinged door. Other NEMA rated types optional.
2. A barrier shall separate the high voltage and low voltage compartments of the panel and separate 120VAC and 277VAC.
3. LCP input power shall be capable of accepting 120VAC or 277VAC without re-wiring or 120VAC or 347VAC for Canadian applications.
4. Control electronics in the low voltage section shall be capable of driving 2 to 48, latching relays per section 2.1.C, control any individual or group of relays, provide individual relay overrides, provide a master override for each panel, store all programming in non-volatile memory, after power is restored return system to the correct state for time of day, provide programmable dual blink warn timers for each relay or zone of relays, and be able to control Normally Open Latching (NOL) or Normally Closed Latching (NCL) relays.
5. Lighting control system shall be digital and consist of a Master LCP, Remote LCPs, Micro LCPs with up to 8 individual relays, X Point Router and associated relays or dimmers emulating standard or Micro LCPs, digital switches, digital interface cards and if required, SmartBreaker panelboards. All system components shall connect and be controlled via Category 5, 4 twisted pair cable with RJ45 connectors, providing real time two-way communication with each system component. All Micro LCP's shall provide multiple inputs for photocells and occupancy sensors. Analog systems are not acceptable.

G. Micro Relay Panels

1. Micro relay panels shall have from 2 to 8 latching relays per section 2.1.C and shall control all lighting in the designated area indicated on the plans and be part of the lighting control network. Each micro relay panel shall provide minimum 300ma at 12/24VDC for powering occupancy sensors. Micro relay panels that require a separate occupancy sensor power pack are not acceptable.
2. Micro relay panel shall provide a minimum of 4-programmable photocell inputs, a minimum of 8-programmable occupancy sensor contact closure inputs. This requirement is to insure integration of entire lighting system into one networked, lighting control system.
3. Micro relay panels shall be capable of outputting minimum 4 and up to 8 independent 0-10VDC dimming signals, one independent dimming signal for each of 8 relays. In order to maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim, fade up rate, fade down rate, time delay and enable/disable masking. All photocell settings must be remotely accessible. Systems providing On, Off with Time Delay only, and system that do not provide remote access are not acceptable.
4. MicroPanels shall have built in capability to take commands from a fully compatible wireless switch. Wireless switch shall contain no battery; have 32-bit unique ID and a minimum 90-foot range line of sight.

- H. Standard Output relays
1. UL Listed 30A @277VAC Ballast and HID, 20A Tungsten at 120VAC and 347VAC Ballast and HID at 20A Latching Relay with 18,000A SCCR @277VAC.
 2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #8AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable. Relays to be rated for 250,000 operations minimum at a full 30A lighting load. Standard relay shall default to closed at normal power loss, Normally Closed Latching (NCL).
 3. Optional relay types available shall include: Normally Open Latching (NOL) relay rated for 250,000 operations, a 600VAC 2-pole NO or NC, and a Single Pole, Double Throw (SPDT) relay.
- I. Low Voltage Switches
1. All switches shall be digital and communicate via RS 485. Contact closure style switches, except as specified for connection to the micro relay panel programmable contact closure inputs, shall not be acceptable. The programming for a digital switch shall reside in the switch itself, via double EPROM memory. Any digital switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
 2. Digital low voltage switch shall be a device that sits on the lighting control system bus. Digital switch shall connect to the system bus using the same cable and connection method required for relay panels. Each button shall be capable of being programmed for On only, Off only, Mix (Some on some off), On/Off (toggle), Raise (Dim up) and Lower (Dim down). Further each button shall be able to be enabled or disabled over the bus. An audible alarm shall be available on all switches that can be programmed to beep on button push or with warning light blinks.
 3. Keyed switches shall be similarly programmable and connect to the lighting control system bus.
 4. Digital switches for high abuse areas (common areas, gymnasiums, etc.) shall be vandal resistant, contain no moving parts, and be touch sensitive and available with up to two buttons in a single gang. Multi gang versions shall also be available. Touch pads shall be Stainless Steel and capable of handling both high abuse and wash down locations. High abuse switches shall connect to the lighting control system digital bus. Each high abuse touch button shall be able to be programmed in the same way as other digital switch buttons. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cmspark) without any interruption or failure in operation.
- J. Wireless Switches-System shall have the capability to accept in inputs from 32-bit unique ID wireless switches. Wireless switches shall have no battery and be capable of On, Off, Raise and Lower commands. Wireless switches shall have a minimum 90 foot line of sight range
- K. DTC - Digital Electronic Time Clock
1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept modem (RS232) inputs.
 2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.

3. The DTC shall be capable of controlling digital devices at up to 127 addresses on a single bus and capable of interfacing digitally with other buses using manufacturer supplied interface cards.
 4. The DTC shall accept control locally using built in button prompts and use of an 8 line 21-space display or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. The DTC shall be run from non-volatile memory so that all system programming is retained indefinitely and time of day is battery backed for up to 10 years.
 5. Unity™ lighting control software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone. System shall be capable of running optional Unity GX lighting control software. Unity GX shall provide for importing vector based graphics and a simple interface that allows users or a factory programmer to overlay color "controls" that are associated with relays or collections of relays. Clicking on the overlays changes the color and the status of the relays for visual display of large systems.
 6. System shall come with a pre-installed modem that allows for remote programming from any location using a PC and free remote control software.
 7. DTC shall provide system wide timed overrides. Any relay, group or zone that is overridden ON, before or after hours, shall automatically be swept OFF by the DTC a maximum of 2 hours later.
- L. PHOTOCELL: Photocells to be mounted in location indicated on the plans. Photocells used for exterior lights shall provide multiple trip points from 1 roof mounted unit. All trip points shall be able to be changed remotely via Internet or dial up modem. Photocells requiring manual trip point adjustment are not acceptable. Photocell used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up, fade-down, etc. All settings shall be remotely accessible and adjustable. Systems providing local adjustment only are not acceptable. Photocells to be certified to comply with the current energy code covering this project at time of submittal of plans for building permit.
- M. Interfaces: For future expansion capability, systems are to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.
1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card on runs over 200ft.
 2. Uplink Interface card that allows a single bus to be part of a greater system connected together by a Back Bone Bus. The back Bone bus requires a server for the Modem and Ethernet connections to such a large system.
 3. An interface card (T-LINK) that allows the DTC to control up to 32 digital XCI brand thermostats. Programming of thermostats is to be capable of being done locally (at the DTC) or remotely, via modem, Internet or Ethernet.
 4. When Unity GX software is specified full graphic pages shall be designed to the owner's specifications. Owner is to provide to manufacturer all necessary files and criteria. Provide ____ GX pages.
 5. Direct digital interface to SmartBreaker panelboards. Relay panel and Smart-Breaker panelboard circuits shall appear on the system software as similar, yet distinct, items and maintain all functions and features of the system software.
 6. Direct digital interface to DMX 512 based systems. DMX interface shall provide 14 global commands, each of which can be modified locally or remotely using lighting controls manufacturer supplied software. DMX interface shall be integral to the system bus and shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time response from the lighting control system to DMX commands.

8. Direct digital interface to building automation systems using DDC protocols such as BACnet, Metasys (N2) and ModBus that accept on/off commands, time schedules and report status of all relays in all panels in real time. Interface cards shall "self populate" each individual relay and each group to the BAS. All BAS system programming required shall be the responsibility of the BAS system provider.

2.4 SWITCH-BOX OCCUPANCY SENSORS

A. Manufacturers:

1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting Inc.
3. Leviton Mfg. Company Inc.
4. Lightolier Controls; a Genlyte Company.
5. Lithonia Lighting.
6. MYTECH Corporation.
7. Novitas, Inc.
8. RAB Electric Manufacturing, Inc.
9. Sensor Switch, Inc.
10. TORK.
11. Unenco Electronics; a Hubbell Company.
12. Watt Stopper (The).

- ### B. Description:
- PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.

1. Include ground wire.
2. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present.

2.5 INDOOR OCCUPANCY SENSORS

A. Manufacturers:

1. Hubbell Lighting Inc.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting.
4. MYTECH Corporation.
5. Novitas, Inc.
6. RAB Electric Manufacturing, Inc.
7. Sensor Switch, Inc.
8. TORK.
9. Unenco Electronics; a Hubbell Company.
10. Watt Stopper (The).

- B. Description: Wall- or ceiling-mounting, solid-state, PIR-type units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present.
 8. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm).
 9. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 10. Detection Coverage (Corridor): Detect occupancy within 90 feet (27 m) when mounted on a 10-foot- (3-m-) high ceiling.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 16 Section "Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Division 16 Section "Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 14 AWG, complying with Division 16 Section "Conductors and Cables."
- D. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Division 16 Section "Voice and Data Communication Cabling."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 LIGHTING RELAY PANEL INSTALLATION

- Mount relay control cabinets adjacent to respective lighting panel board. Cabinet shall be surface or flush mount, per plans. Wiring between relay control cabinets and panelboards shall be in accordance with local codes and acceptable industry standards. Under no circumstances will any extra payment be authorized for the EC or GC due to the EC's lack of knowledge or understanding of any and all prevailing codes or specified manufacturer's installation requirements. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each relay panel and each digital switch from dust and debris. Any damage done to electronic components due to failure to protect them shall be the sole responsibility of the installing contractor.
- Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. EC is specifically responsible to supply and install the required low voltage cable, Category 5, 4 twisted pair, with RJ45 connectors (commonly referred to as Cat 5 patch cable) between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester. All low voltage wire to be run in conduit, per local codes.
- Manufacturer to provide on all systems of more than 2 panels a crimping kit with sufficient approved EZ Brand RJ 45 connectors to populate the whole system. A simple manual that shows all the pitfalls of crimping RJ 45s and how to do it right must be both provided and read by the installing contractor.
- Wiring
- Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
- Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
- Place manufacturer supplied "terminators" at each end of the system bus per manufacturer's instructions.
- Plug in Category 5 patch cable with RJ45 end connector that has been field-tested with a recognized cable tester, at the indicated RJ45 connector provided at each lighting control device, per manufacturer's instructions.

- Use Category 5 patch cable for all system low voltage connections. Additional conductors may be required to compensate for voltage drop with specific system designs. Contact LC&D or refer to the GR2400 manual for further information. Use shielded cable for dry contact inputs on runs over 200ft.
- Do not exceed 4000ft-wire length for the system bus.
- All items on the bus shall be connected in sequence (daisy chained). Star and spur topologies are not acceptable.
- The specified lighting control system shall be installed by the electrical contractor who shall make all necessary wiring connections to external devices and equipment, to include photocell. EC to wire per manufacturer instructions.

- **INSTALLATION AND SET-UP**

- Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel in low-voltage areas. Refer to manufacturer's plans and approved shop drawings for location of line and low-voltage areas. This is especially applicable in jobs where back boxes are sipped in advance. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.

- For approved contact closure switches, use #18 AWG stranded conductors. For all other digital switches, provide wiring required by system manufacturer.

- For classroom digital switches provide wiring required by system manufacturer

- Contractor to test all low voltage cable for integrity and proper operation prior to turn over. Verify with system manufacturer all wiring and testing requirements.

- Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, commissioning of the lighting control system and Owner instruction includes:
 - Confirmation of entire system operation and communication to each device.
 - Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors
 - Confirmation of system Programming, photocell settings, override settings, etc.

- Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.
- Panels shall be located so that they are readily accessible and not exposed to physical damage.
- Panel locations shall be furnished with sufficient working space around panels to comply with the National Electric Electrical Code.
- Panels shall be securely fastened to the mounting surface by at least 4 points.
- Unused openings in the cabinet shall be effectively closed.
- Cabinets shall be grounded as specified in the National Electrical Code.
- Lugs shall be suitable and listed for installation with the conductor being connected.
- Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- Maintain the required bending radius of conductors inside cabinets.
- Clean cabinets of foreign material such as cement, plaster and paint.
- Distribute and arrange conductors neatly in the wiring gutters.
- Follow the manufacturer's torque values to tighten lugs.

- Before energizing the panelboard, the following steps shall be taken:
- Retighten relay connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
- Remove shipping blocks from component devices and the panel interior.
- Remove debris from panelboard interior.

- Follow manufacturers' instructions for installation and all low voltage wiring.

- Service and Operation Manuals:
- Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
- Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.

- Comply with energy code lighting control system "Acceptance Requirements". Acceptance tests are used to verify that lighting controls were installed and calibrated correctly. These tests may require that a responsible party certify that controls are installed and calibrated properly. This is the installing contractor's responsibility. Verify requirements with building authority.

- DOCUMENTATION

- Each relay shall have an identification label indicating the originating branch circuit number and panelboard name as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.

- Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of

switches and location of photocell. Original to be given to owner, copies placed inside the door of each LCP.

- SERVICE AND SUPPORT

- Start Up: EC shall contact LC&D at least 7 days before turnover of project. LC&D will remotely dial into the lighting control system, run diagnostics and confirm system programming. EC shall be available at the time of dial in to perform any corrections required by LC&D. EC is responsible for coordinating with GC and the owner the installation of a dedicated telephone line or a shared phone line with an automatic Fax/Modem switch. Phone jack to be mounted within 12" of Master LCP. Label jack with phone number. EC to connect phone line from jack to Master LCP.

- Telephone factory support shall be available at no additional cost to the EC or Owner both during and after the warranty period. Factory to pre-program the lighting control system per plans and approved submittal, to the extent data is available. The specified manufacturer, at no added cost, shall provide additional remote programming via modem as required by the EC or Owner for as long as a phone line is available for the life of the system. Upon request manufacturer to provide remote dial up software at no added cost to system owner. No exceptions.

- Provide a factory technician for on-site training of the owners' representatives and maintenance personnel. Coordinate timing with General Contractor. Provide ___ days of factory on-site training.

- CLEANING

- Division 1 - Execution Requirements: Final cleaning.
- Clean photocell lens as recommended by manufacturer.
- Clean all switch faceplates.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION

SECTION 16211
ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes equipment for utility company's electricity metering.

1.2 SUBMITTALS

- A. Product Data: For each metering component specified.
- B. Shop Drawings for Electricity-Metering Equipment: Include dimensioned plans and sections or elevation layouts. Include wiring diagrams showing power, signal, and control wiring specific to this Project.
- C. Operation and Maintenance Data: For electricity-metering equipment to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center as specified in NECA 400.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's written permission.

1.6 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company. Where CT's are installed at the Utility transformer, follow instructions and provide metering pedestal and other items as directed.
- B. Meter Sockets: Comply with requirements of electrical power utility company.
 - 1. Meter Socket: Type as approved by utility company, with rating coordinated with indicated tenant feeder circuit rating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

END OF SECTION

SECTION 16289
TRANSIENT VOLTAGE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TVSSs for low-voltage power equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."
- E. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, "Transient Voltage Surge Suppressors."

1.4 PROJECT CONDITIONS

- A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies, Inc.
 - 2. Atlantic Scientific.
 - 3. Current Technology, Inc.
 - 4. Cutler-Hammer, Inc.; Eaton Corporation.
 - 5. Entrelec International.
 - 6. General Electric Company.
 - 7. Innovative Technology, Inc.
 - 8. Intermatic, Inc.
 - 9. LEA International.
 - 10. Leviton Mfg. Company Inc.
 - 11. Liebert Corporation; a division of Emerson.
 - 12. Northern Technologies, Inc.
 - 13. Siemens Energy & Automation, Inc.
 - 14. Square D; Schneider Electric.
 - 15. Surge Suppression Incorporated.
 - 16. Sutton Designs Inc.
 - 17. Transtector Systems, Inc.
 - 18. Tycor; Cutler-Hammer, Inc.
 - 19. United Power Corporation.
 - 20. Zero Surge Inc.

2.2 SERVICE ENTRANCE SUPPRESSORS

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
 - 1. LED indicator lights for power and protection status.
 - 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 3. Fuses, rated at 200-kA interrupting capacity.
 - 4. Integral disconnect switch.
 - 5. Redundant suppression circuits.
 - 6. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: 320 kA per phase.
- C. Connection Means: Permanently wired.

- D. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of 480Y/277, 208Y/120] 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277, 400 V for 208Y/120.
 2. Line to Ground: 800 V for 480Y/277, 400 V for 208Y/120.
 3. Neutral to Ground: 800 V for 480Y/277, 400 V for 208Y/120.
- E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- F. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- G. Protection modes and UL 1449 suppressed voltage rating for voltages of 240 or 480, 3-phase, 3-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
 2. Line to Ground: 2000 V for 480 V, 1000 V for 240 V.

2.3 PANELBOARD SUPPRESSORS

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
1. LED indicator lights for power and protection status.
 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 3. Fuses, rated at 200-kA interrupting capacity.
 4. Integral disconnect switch.
 5. Redundant suppression circuits.
 6. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: 160 kA per phase.
- C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of 480Y/277, 208Y/120, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277, 400 V for 208Y/120.
 2. Line to Ground: 800 V for 480Y/277, 400 V for 208Y/120
 3. Neutral to Ground: 800 V for 480Y/277, 400 V for 208Y/120
- D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:

1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240 or 480, 3-phase, 3-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
 2. Line to Ground: 1500 V for 480 V, 800 V for 240 V.

2.4 SUPPRESSORS FOR ELECTRONIC-GRADE PANELBOARDS

- A. Surge Protection Device Description: Sine-wave-tracking type, panel-mounted design with the following features and accessories:
1. LED indicator lights for power and protection status.
 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 3. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
- B. Peak Single-Impulse Surge Current Rating: 160kA per phase.
- C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of 480Y/277, 208Y/120, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277, 400 V for 208Y/120
 2. Line to Ground: 800 V for 480Y/277, 400 V for 208Y/120
 3. Neutral to Ground: 800 V for 480Y/277, 400 V for 208Y/120
- D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.

- F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240, 480, or 600, 3-phase, 3-wire, delta circuits shall be as follows:
 - 1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
 - 2. Line to Ground: 1500 V for 480 V, 800 V for 240 V.

2.5 ENCLOSURES

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multipole, 30, 60 or 100]-A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.

3.2 PLACING SYSTEM INTO SERVICE

- A. Do not energize or connect [service entrance equipment] [panelboards] [control terminals] [data terminals] to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL

- A. Testing: [Owner will engage] [Engage] a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports:
- B. Testing: Perform the following field tests and inspections and prepare test reports:
 - 1. Complete startup checks according to manufacturer's written instructions.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

END OF SECTION

SECTION 16410
ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Enclosures.

1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Moeller Electric Corporation.
4. Siemens Energy & Automation, Inc.
5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

4. GFCI Circuit Breakers: Single- and two-pole configurations with [5]-mA trip sensitivity.
- C. Molded-Case Circuit-Breaker Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 16 Section "Basic Electrical Materials and Methods Electrical Supports and Seismic Restraints," and concrete materials and installation requirements are specified in Division 3.
- C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- E. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work Electrical Supports and Seismic Restraints."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- G. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION

SECTION 16441
SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes service and distribution switchboards rated 600 V and less.

1.2 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - a. Mimic-bus diagram.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MANUFACTURED UNITS

- A. Manufacturers:
1. Eaton Corporation; Cutler-Hammer Products.
 2. General Electric Co.; Electrical Distribution & Protection Div.
 3. Siemens Energy & Automation, Inc.
 4. Square D.
- B. Front-Connected, Front-Accessible Switchboard: main device, panel-mounted branches, and sections rear aligned.
- C. Nominal System Voltage: 208Y/120 V
- D. Main-Bus Continuous: 3000 A.
- E. Enclosure: Steel, NEMA 250, Type 1.
- F. Enclosure Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- G. Barriers: Between adjacent switchboard sections.
- H. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- J. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- K. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 2. Set back from front to clear circuit-breaker removal mechanism.
 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- L. Buses and Connections: Three phase, four wire, unless otherwise indicated. Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
1. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 2. Contact Surfaces of Buses: Silver plated.
 3. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 4. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
 5. Neutral Buses: 50 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.
- M. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- 2.3 TRANSIENT VOLTAGE SUPPRESSION DEVICES
- A. IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
- B. Minimum single-impulse current rating shall be as follows:
1. Line to Neutral: 100,000
 2. Line to Ground: 100,000
 3. Neutral to Ground: 50,000A.
- C. Protection modes shall be as follows:
1. Line to neutral.
 2. Line to ground.
 3. Neutral to ground.
- D. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.

- E. Maximum Category C combination wave clamping voltage shall not exceed 600 V, line to neutral and line to ground.
- F. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.
- G. Accessories:
 - 1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
 - 2. Audible alarm activated on failure of any surge diversion module.
 - 3. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments with I^2t response.
 - d. Ground-fault pickup level, time delay, and I^2t response.

2.5 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
 1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 3. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.6 CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.

- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- C. Furnish one portable, floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- D. Furnish overhead circuit-breaker lifting device, mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.
- E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.8 IDENTIFICATION

- A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- B. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.
- B. Install and anchor switchboards level on concrete bases, 4-inch (100-mm) nominal thickness. Concrete base is specified in Division 16 Section "Basic Electrical Materials and Methods Electrical Supports," and concrete materials and installation requirements are specified in Division 3.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install spare-fuse cabinet.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods Electrical Identification."
- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION

SECTION 16442
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Field quality-control test reports.
 - 4. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Protection Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D.

2.2 MANUFACTURED UNITS

- A. Enclosures: Flush- and surface mounted cabinets. NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Locations: NEMA 250, Type 1.
 - b. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- B. Phase and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- C. Conductor Connectors: Suitable for use with conductor material.
 - 1. Ground Lugs and Bus Configured Terminators: Compression type.
- D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Rating:
 - 1. UL label indicating series-connected rating with integral or remote upstream overcurrent protective devices. Include size and type of upstream device

allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.3 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- B. Main Overcurrent Protective Devices: Circuit breaker or Fused switch.
- C. Branch Overcurrent Protective Devices:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 3. Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- C. Non-Dimmed Panels "ND" as defined in the DSL documents are to be equipped with micro-processor based programmable logic controllers as manufactured by Eaton and of the "Power Command" style or "Lyn Tec" style.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
 - 3. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - a. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

- c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- C. Fuses are specified in Division 16 Section "Fuses."

2.6 CONTROLLERS

- A. Motor Controllers: NEMA ICS 2, Class A, combination controller equipped for panelboard mounting and including the following accessories:
 - 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Bimetallic-element overload relay.
 - 4. Indicating lights.
 - 5. Seal-in contact.
 - 6. 2 convertible auxiliary contacts.
 - 7. Push buttons.
 - 8. Selector switches.
- B. Contactors: NEMA ICS 2, Class A, combination controller equipped for panelboard mounting and including the following accessories:
 - 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Indicating lights.
 - 4. Seal-in contact.
 - 5. 2 convertible auxiliary contacts.
 - 6. Push buttons.
 - 7. Selector switches.
- C. Controller Disconnect Switches: Fused switch mounted adjacent to and interlocked with controller.
 - 1. Auxiliary Contacts: Integral with disconnect switches to de-energize external control-power source.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller.
 - 1. Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. Control-Power Source: 120-V branch circuit.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.
- C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section " r Electrical Work Electrical Supports."
- C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Install overcurrent protective devices and controllers.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- I. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- J. Ground equipment according to Division 16 Section "Grounding and Bonding."
- K. Connect wiring according to Division 16 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION

SECTION 16511
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Interior lighting fixtures, lamps, and ballasts.
 2. Emergency lighting units.
 3. Exit signs.
 4. Lighting fixture supports.
 5. Retrofit kits for fluorescent lighting fixtures.
- B. See Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
- C. See Division 16 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multiple lighting relays and contactors.
- D. See DSL documents for theatrical "Stage Lighting" fixtures and their controls.
- E. See Division 16 Section "Dimming Controls" for other dimming systems, as applicable.

1.2 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 3. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

- H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- I. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least [0.125 inch (3.175 mm)] minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- J. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 15 Section "Diffusers, Registers, and Grilles."
 - 1. Air Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
 - 2. Heat Removal Units: Air path leads through lamp cavity.
 - 3. Combination Heat Removal and Air Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air supply units.
 - 4. Dampers: Operable from outside fixture for control of return-air volume.
 - 5. Static Fixture: Air supply slots are blanked off, and fixture appearance matches active units.

2.3 BALLASTS

- A. Electronic Ballasts for Linear Fluorescent Lamps: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
 - 1. Sound Rating: A.
 - 2. Total Harmonic Distortion Rating: Less than 10 percent.
 - 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 4. Operating Frequency: 20 kHz or higher.
 - 5. Lamp Current Crest Factor: 1.7 or less.
 - 6. BF: 0.85 or higher.
 - 7. Power Factor: 0.95 or higher.

- B. Electromagnetic Ballasts for Linear Fluorescent Lamps: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
 - 1. Ballast Manufacturer Certification: Indicated by label.
- C. Ballasts for Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher for Linear Fluorescent Lamps: Electromagnetic type designed for use with indicated lamp types.
- D. Ballasts for Dimmer-Controlled Lighting Fixtures with Linear Fluorescent Lamps: Electronic type.
 - 1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
- E. Ballasts for Bi-Level Controlled Lighting Fixtures with Linear Fluorescent Lamps: Electronic type.
 - 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
 - 2. Ballast shall provide equal current to each lamp in each operating mode.
 - 3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.
- F. Ballasts for Compact Fluorescent Lamps: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
 - 1. Lamp end-of-life detection and shutdown circuit.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: A.
 - 4. Total Harmonic Distortion Rating: Less than 20 percent.
 - 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 6. Operating Frequency: 20 kHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.95 or higher, unless otherwise indicated.
 - 9. Power Factor: 0.95 or higher.
 - 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 - 11. Ballast Case Temperature: 75 deg C, maximum.

- G. Ballasts for Dimmer-Controlled Lighting Fixtures with Compact Fluorescent Lamps: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
- H. Internal-Type Emergency Fluorescent Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
1. Emergency Connection: Operate 1 fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Night-Light Connection: Operate one fluorescent lamp continuously.
 3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- I. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- J. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: .90 or higher.

7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 8. Protection: Class P thermal cutout.
- K. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
 2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).
 3. Open-circuit operation shall not reduce average lamp life.

2.4 EXIT SIGNS

- A. Internally Lighted Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
1. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
 2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.5 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 LAMPS

- A. Low-Mercury Fluorescent Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 32 W maximum, nominal length 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.
- C. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. Compact Fluorescent Lamps: 4-Pin, low mercury CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start.
 - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - 6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).
- E. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65 , and color temperature 4000K.
- F. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000K.
- G. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80 , and color temperature 4000K.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Electrical Supports and Seismic Restraints" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, [12 gage (2.68 mm)].
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, [12 gage (2.68 mm)].

- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.8 RETROFIT KITS FOR FLUORESCENT LIGHTING FIXTURES

- A. Comply with UL 1598 listing requirements.
 - 1. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed lighting fixtures by improving reflectivity of fixture surfaces.
 - 2. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- E. Adjust aimable lighting fixtures to provide required light intensities.
- F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 16701
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The work described herein and on the drawings consists of labor, materials, equipment, programming, testing, and other services necessary to provide and install the systems called for within Division 167XX (where "XX" is replaced by the specific number of an individual section. Any labor, material, programming, testing, etc. not specifically mentioned within these specifications or not shown on the drawings but required for a complete, fully functional and properly performing system and completion of the work of this project shall be provided and installed by the Contractor.
- B. It is understood that the Contractor may employ Installers to accomplish the actual installation of the systems outlined herein. Use of the term "Installer" shall not relieve the Contractor from responsibility to complete the work in accordance with the intent of the contract documents.
- C. Where conflicts exist the most stringent requirement shall apply.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 RELATED SECTIONS

- A. Comply with applicable requirements of the following divisions and sections, including additional information outlined within this section and other Division 167XX sections:
 - 1. Section 01310 – Project Management and Coordination
 - 2. Section 01330 – Submittal Procedures
 - 3. Section 01400 – Quality Requirements
 - 4. Section 01770 – Closeout Procedures
 - 5. Section 07842 – Firestopping
 - 6. Section 08311 – Access Doors
 - 7. Section 09900 – Painting
- B. The requirements outlined within this section shall apply to the following Division 167XX sections:
 - 1. Section 16740 – Voice/Data Cable Infrastructure (Empty Raceway)
 - 2. Section 16770 – Audio Video Systems
 - 3. Section 16716780 – TV Distribution System

- 4. Section 16716791 – Intrusion Detection System
- 5. Section 16716795 – CCTV System

1.4 DEFINITIONS

- A. NEC: National Electric Code, NFPA 70

1.5 SUMMARY

- A. Section Includes:

- 1. General

- a. Standards, Codes, References and Regulatory Requirements
 - b. Quality assurance
 - c. Submittals
 - d. Requests for substitution
 - e. Requests for information
 - f. Project Conditions
 - g. Delivery, Storage and Handling
 - h. Coordination
 - i. Closeout document
 - j. Warranty
 - k. Maintenance Service
 - l. Spare Capacity
 - m. Extra Materials
 - n. Testing
 - o. Owner Training

- 2. Products

- a. General Pathway Requirements
 - b. Service Entrance Pathways
 - c. Sleeves for Pathways and Cables
 - d. Grout
 - e. Conduit bushings
 - f. Pull strings
 - g. Surge Suppression Equipment
 - h. Labels

- 3. Execution

- a. Sleeve Installation For Communications Penetrations

- d. Pathways

- e. Grounding
 - f. Terminal Boxes, Junction Boxes, and Cabinets
 - g. Cables/Wires
 - h. Outlets

- i. Labels
- j. Protection And Cleaning
- k. Testing
- l. Demonstration

1.6 ALTERNATES

- A. Not used.

1.7 STANDARDS, CODES, REFERENCES AND REGULATORY REQUIREMENTS

- A. The requirements for the Division 167XX systems outlined in the drawings and these specifications comply, to the best of the Designer's knowledge, with applicable codes at the time of design. However, it is the Contractor's responsibility to coordinate and verify the requirements of the Authority Having Jurisdiction over this project. The Contractor shall bring any discrepancies to the Designer's attention immediately upon discovery.
- B. The Contractor shall comply with applicable Standards, Codes, References, and Regulatory Requirements outlined below as well as those additional requirements outlined in individual Division 167XX sections.
- C. The equipment and installation shall comply with the current and applicable provisions of the following standards, codes, references, and regulatory requirements including all ratified addenda:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. FCC: Federal Communication Commission Part 68 as modified by Wiring Docket 88-57.
 - 3. NEC - National Electrical Code (NFPA-70).
 - 4. NFPA 262-1985 - National Fire Prevention Association, 1470 Atlantic Avenue, Boston, MA 02210.
 - 5. UL Listed - Underwriters Laboratories Listed.
 - 6. UL 444 – Communications Cables
 - 7. UL 497 – Protectors for Paired Conductor Communications Circuits
 - 8. UL 497A – Secondary Protectors for Communications Circuits
 - 9. UL 497B – Protectors for Data Communication and Fire Alarm Cables
 - 10. UL 1449 – Standard For Safety, Transient Voltage Surge Suppressors.
- D. The equipment and installation shall comply with the latest adopted provisions of the following codes and laws:
 - 1. Americans with Disabilities Act (ADA): Where applicable, the system shall comply with ADA, Public Law 101-336, 1990 and with the ADA Accessibility Guidelines (ADAAG).
 - 2. Local and State Building Codes.
 - a. Florida Building Code: 2010 edition with all adopted supplements

3. Authority Having Jurisdiction: The systems shall comply with applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by Underwriters Laboratory, and marked for intended location and application.

1.8 QUALITY ASSURANCE

- A. All quality assurance requirements shall be as of the date the project bid. Failure of the Manufacturer or Installer to meet the quality assurance requirements on or before the date of the project bid shall render the Manufacturer or Installer unacceptable for this project.
- B. Manufacturer: Company specializing in manufacturing the products specified with a minimum 5 years documented experience.
- C. Installer - General:
 1. Company or person installing system must specialize in and have been actively engaged in the business of selling, installing, and servicing the system type with a minimum five (5) years documented experience going back from the date the project bid.
 2. The Installer shall maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24 hours a day.
 3. The Installer shall be a direct sales division of, or the authorized and designated distributor for, the equipment manufacturer whose product he intends to install.
 4. The Installer shall own and maintain tools and equipment necessary for successful installation and testing of the system and have personnel who are adequately trained in the use of such tools and equipment.
 5. The Installer shall be currently licensed by the Electrical Contractors' Licensing Board as a Statewide Low Voltage System Specialty Contractor (ES-069) unless specifically noted otherwise within individual Division 167XX sections.
 6. The Installer's technical staff shall be certified by the equipment manufacturer as qualified to install, program, test, adjust, and service the equipment to be installed.
- D. Cabling
 1. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less for all cables

- b. Smoke-Developed Index: 50 or less for Category 6 cables; 450 or less for other cables.
- E. Contractor Responsibilities: In addition to other requirements outlined within the contract documents, the Contractor shall be responsible for the following:
1. Where the Contractor has questions or there are inconsistencies between Divisions or Sections or where information appears to be incomplete or incorrect, it shall be the Contractor's responsibility to confirm the requirements prior to submission of a bid.
 2. Unspecified Equipment and Materials: Any item of equipment or material not specifically addressed within the contract documents and required to provide a complete and functional system shall be provided by the Contractor at a level of quality consistent with other specified items.
 3. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including patching and painting, shall be included as necessary.
 4. Where devices, cable terminations, or boxes are installed above inaccessible ceilings or behind walls, the Contractor shall provide and install an appropriately sized access panel matching the fire rating of the ceiling or wall where installed.
- F. The systems shall be of modular design to facilitate both expansion and service and shall use only solid state circuitry.

1.9 SUBMITTALS

A. General

1. Submit in accordance with Division 1 section "Submittals" and specific requirements outlined in individual Division 167XX sections. The Contractor shall provide submittals as outlined herein to the Designer for review. Failure of the Contractor to provide submittals for review in timely manner shall result in the Contractor being solely responsible for any remedial work necessary to meet the intent or requirements of the contract documents.
2. The Contractor shall assemble submittal requirements for each individual section as a single package. This package shall include all Qualifications data, Product data, and Shop Drawings as outlined below. Partial submittals shall not be reviewed and shall be returned to the Contractor for completion. Individual section submittal packages shall not be combined with submittals for other specification sections. Individual section submittal packages shall be tailored to the specific requirements of the individual section.
3. The Contractor shall provide submittals in electronic format for review. Submittals shall be in PDF format. The use of other electronic formats shall not be acceptable.

- a. Where the Authority Having Jurisdiction requires approved Shop Drawings to be provided with the permit application in a format other than PDF (e.g. DWF), the Contractor, upon receipt of approved Shop Drawings (i.e. those that are stamped as "Reviewed" by the Designer with no outstanding comments), shall provide the Designer with a copy in the AHJ's preferred format for the Designer to stamp.
4. Electronic submittals shall comply with the following:
 - a. Two files shall be provided. One file shall contain Qualifications data and Product data (e.g. all cutsheets and documentation that are typically 8-1/2 x 11" in size). One file shall include Shop Drawings of the same size as the contract drawings.
 - b. The Qualifications and Product data file shall be in full color and shall include fully legible literature as provided by the equipment manufacturers.
 - c. The Shop Drawings file shall be in black and white. The use of colors (e.g. layer colors resulting from AutoCAD) shall not be acceptable. Including multiple systems in a single Shop Drawing file shall not be acceptable.
 5. The Contractor shall provide submittals based on the requirements of the contract documents. Requests for Information (RFI), suggestions for design changes, or other issues pertaining to equipment or installation of the system shall not delay the Contractor's timely submission of submittal data. Issues identified by the Contractor, Installer, or Designer shall be addressed separate from the submittals and the submittal process.
 6. The Contractor shall submit Shop Drawings prepared by the Installer to demonstrate the Installer understands the scope of work and project requirements. Submission of the contract drawings in an attempt to meet the requirement for submittal shop drawings shall not be acceptable.
 7. Basic electrical materials shall be as specified in Section 16. Submittals for Division 167XX systems are not required to include information on materials specified in other Division 16 sections. However, any basic electrical materials required for Division 167XX systems and not specifically called out in other Division 16 section or where specifically called out in Division 167XX sections shall be included with the submittals for the individual Division 167XX system where required.
 8. The Contractor shall refer to the individual Division 167XX sections for additional submittal requirements.

B. Qualifications

1. Submit a notarized letter signed by an officer of the installing company that includes the following statements (do not change wording except to insert information noted in brackets):

- a. As of the time of bid and currently:
 - 1) [Company Name] did and does specialize in and has been actively engaged in the business of selling, installing, and servicing [System Name] systems with a minimum of five (5) years documented experience going back from the date the project bid.
 - 2) [Company Name] did and does maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24 hour days. [Company Name]'s office is located at [Company Office Address].
 - 3) [Company Name] was and is the authorized distributor for the equipment submitted.
 - 4) [Company Name] did and does own all necessary test equipment required to test the system at the completion of the installation.
2. Submit a letter from the major equipment manufacturers confirming the Installer is currently an authorized distributor in good standing with the ability to provide sales and service.
3. Submit a list of all test equipment owned including the manufacturer, model number, serial number, and last calibration date that will be used to test the system.
4. Submit a copy of the Installer's current Florida Statewide Low Voltage System Specialty Contractor (ES-069) license or other license specifically called for within individual Division 167XX sections.
5. Submit a technical resume of experience for the Installer's Field Supervisor who will be assigned to this project.
6. Submit a list of at least three (3) system projects completed within the last two (2) years of similar type and size with contact names and telephone numbers for each.
7. Submit one (1) copy of each manufacturer's certification of successful completion of factory training for each member of the Installer's staff who will install, program, test, or adjust the system to be installed.

C. Product Data

1. Submit a narrative for each system outlining the sequence of operation.
2. Submit original cutsheets, as provided by the manufacturer, for each piece of equipment, material, cable, etc. to be provided and installed as part of the system.
 - a. Cutsheets shall provide full technical specifications for each piece of equipment being submitted on.
 - b. Scanned documents that are faded, skewed or illegible shall not be acceptable.

- c. Copies of non-technical information, cutsheets from distributor's catalogs, or screen prints from web site pages, etc. shall not be acceptable.
 - d. Each cutsheet shall clearly identify, either through highlighting or a stamped arrow, the exact model number of each piece of equipment or material to be provided and installed.
 - e. Each cutsheet shall clearly identify the specification section number and associated paragraph number that the individual piece of equipment is being submitted for.
3. In addition to the above, the Contractor shall, prior to submitting, verify the following are included:
- a. Flush grade pull boxes.
 - b. Specialty terminal cabinets.
 - c. Each type of wire and cable to be installed as part of the system. Cable cutsheets shall be labeled with the same identifier used in the Matrix to be included in the Shop Drawings to ensure clarity in regard to which cable(s) is required for each device.
 - d. Connectors and required tooling.
 - e. Terminations system components for each cable type.
 - f. Cable suspension J-hooks, cable fasteners, etc.
 - g. Grounding and surge suppression system components for the system portion of the project.
 - h. Installation manuals for each active (i.e. powered) piece of equipment to be installed as part of the system.
 - i. Operations manuals for each active piece of equipment or software application to be installed as part of the system.
- D. Shop Drawings
1. Submit complete shop drawings showing how the Contractor intends to install the system. Shop drawings shall, as a minimum, include the following:
 - a. Symbol Legend showing:
 - 1) Unique symbols for all system racks, cabinets, panels, equipment, and devices to be installed.
 - b. Cable matrix showing:
 - 1) All system cables to be installed as part of the system.
 - 2) A unique identifier for each cable
 - 3) Each cable's type, manufacturer, and model number.
 - c. Site Plans showing:

- 1) Backbone conduits with quantity and sizes shown for each run.
 - 2) Pull boxes (i.e. Flush Grade, Rack Mounted, Wall Mounted, etc.) with dimensions
 - 3) Backbone cables (either in conduit or direct buried) with cable type and quantities.
- d. Phasing Plan showing:
- 1) The order in which work will be accomplished. Identify phases as planned for construction.
 - 2) Temporary infrastructure (conduit and cabling sizes and quantities) for each system affected. Clearly note how the Contractor plans on maintaining existing systems in a functional condition in areas that the Owner will continue to occupy during construction.
- e. Floor Plans showing:
- 1) System equipment racks, cabinets, panels, terminal cabinets, and major pull boxes.
 - 2) System devices
 - 3) Conduit or J-Hook runs connecting devices to termination equipment. Contractor shall accomplish preliminary coordination with other trades and shall show conduit and J-hook runs as he intends on installing them.
 - 4) Conduit sleeves including quantities and sizes.
 - 5) Required interconnections to other systems.
 - 6) Major Termination Equipment (i.e. equipment racks, equipment cabinets, equipment panels, terminal cabinets, etc. as shown on the floor plans): Prior to submitting Shop Drawings, the Contractor shall coordinate the termination equipment for each system such that there are no conflicts between building systems. Whether in Communications Rooms or other building spaces the Contractor's Shop Drawings shall show each piece of equipment as he intends to install it. Any conflicts with other building systems shall be identified and resolved prior to the starting the submittal process.
- f. Elevations showing:
- 1) All four walls of each Communication Room showing the coordination of all wall and floor mounted equipment for all systems in the space. Submittals for each system shall show all equipment regardless of system with the equipment for the system being submitted on printing in

black and all other systems equipment printing 50% screened.

g. Details showing:

- 1) System Block Diagram: The Contractor shall include in his Shop Drawings a Block Diagram that includes all equipment, devices, cabling, and interconnections to other systems or equipment as necessary to show a logical diagram of how the system's parts and pieces are interconnected. The Block Diagram shall identify all system cables identified by quantity and type outlined in the Cable Matrix noted above.
- 2) Front Elevations: of system equipment racks and cabinets showing all equipment, shelves, wire management, etc. as the Installer intends on assembling the cabinets.
- 3) Rear Elevations: of system equipment rack and cabinets showing any system equipment not shown on the front elevations.
- 4) Details of any special or field fabricated assemblies to be installed as part of the system.
- 5) Submit calculations in Microsoft Excel spreadsheet format for sizing of UPS's including:
 - a) A matrix showing a line item for each piece of equipment to be powered by the UPS. This shall include manufacturer, model number and description in separate columns.
 - b) Quantities for each piece of equipment
 - c) The voltage for each piece of equipment
 - d) The start-up power requirements for each piece of equipment
 - e) The extended total power requirements for each piece of equipment
 - f) The total power requirements for all equipment.
 - g) The total power capacity of each UPS showing a minimum of twenty (20) minutes of full load run time for the total calculated wattage plus fifty percent spare capacity.

1.10 REQUESTS FOR SUBSTITUTION

- A. Submit requests for substitution in accordance with Division 1.
- B. Where only a single manufacturer is listed for an individual product substitution shall not be allowed without written approval from the Designer. If the Contractor wishes to submit a Request for Substitution for any item he shall submit a written explanation in detail giving the reasons why and how the proposed items will meet the specifications and will not be considered an exception, and submit adequate information to support this claim. The Designer reserves the right to be the sole judge of what is equal or equivalent.

Changes, if approved by the Designer, must be issued in a written addendum not later than seven (7) days prior to bid-opening date.

- C. Where the Contractor proposes to substitute the specified cable (either copper or fiber optic) he shall provide to the Designer a complete copy of the U.L. Test report for that product. Proposed cable substitutions that are not accompanied by the appropriate U.L. test report shall be rejected.
- D. The Contractor, if requested to do so by the Designer, shall be prepared to show by "proof-of-performance" test that the equipment being furnished on the job is equal to or better than the equipment specifications listed herein. This proof shall be shown by actual tests and not by printed sales literature. To this end, the Contractor shall provide qualified technicians and such test equipment as required to perform this function.

1.11 REQUESTS FOR INFORMATION

- A. Due to the complexity of the system it is understood that the Contractor may need to submit Requests for Information (RFI) to the Designer in order to obtain clarifications of project requirements, advise the Designer of potential problems, or suggest methods to improve the installed system. In any instance where the Contractor feels it is necessary to submit an RFI he shall do so in a manner that allows the Designer to review and comment on the issue identified within the RFI in a timely manner. The Contractor shall include in his RFI the following information:
 - 1. A reference to the specific drawing number and note number or specification section and paragraph number, and
 - 2. A narrative that clearly identifies the potential issue, and
 - 3. The Contractor's proposed solution, and
 - 4. Costs or credits, if any, associated with implementing the Contractor's proposed solution.
- B. It shall be incumbent upon the Contractor when submitting an RFI to provide any additional information (equipment cutsheets, sketches, etc.) as necessary to ensure that the Designer fully understands the issue and the proposed solution.
- C. Submitted RFI's that do not include the information outlined above shall not be reviewed and shall be returned to the Contractor for correction.

1.12 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Do not deliver or install equipment, frames, cabinets, etc. until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.
 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
 3. Test each pair of UTP, STP, or multi-conductor cable for open and short circuits.
 4. Document in spreadsheet format the date, time, name of Installer personnel accomplishing test, tests accomplished, and initials of Installer's Supervisor confirming testing was completed. The Contractor shall send a copy of the test results to the Designer and shall maintain electronic and hard copy of documentation on site.

1.14 COORDINATION

- A. Comply with the requirements of Division 1 section "Project Coordination".
- B. Coordinate arrangement, mounting, and support of communications materials and equipment:
 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide code required clearances and working room in front of and around equipment, cabinets, and racks. Exceed code requirements where noted within contract documents.
 3. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 4. To allow right of way for piping and conduit installed at required slope.
 5. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- C. Coordinate layout and installation of equipment, pathways, and cabling.
 1. Coordinate installation of equipment and materials with that of other trades on the project.
 2. Coordinate location of power raceways, circuits and receptacles with locations of equipment requiring electrical power to operate.
 3. Coordinate service entrance arrangement with local utilities.

4. Adjust arrangements and locations of equipment with equipment and materials of other communications, electronic safety and security, and related systems that share space.
 5. Modify as-built drawings to reflect adjustments.
- D. Coordinate installation of required supporting devices, set sleeves, raceways, outlet boxes and other flush devices in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- E. Coordinate location of access panels and doors for equipment that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08311 Section "Access Doors"
- F. Coordinate work with other trades and Owner provided equipment as necessary.

1.15 CLOSE-OUT DOCUMENTS

- A. Submit close-out documents in accordance with Division 1 section "Closeout Procedures" and specific requirements outlined in individual Division 167XX sections.
- B. In addition to requirements outlined in Division 1 section "Project Closeout" comply with the following:
1. Submit cable routings for backbone, tie, and riser cable terminations.
 2. Submit an original copy, on CD, as provided by the original manufacturer, of each software program provided as part of a system.
 3. Submit a hard copy and an electronic copy of the final system programming for each system as accomplished by the Installer. The hard copy shall be a printout of the software programming code accomplished by the Installer.
 4. Submit a documented list of all system passwords for each system. The Contractor shall provide the Owner with all system passwords. The use of master or backdoor passwords known only to the Contractor or Installer shall not be acceptable.
 5. Submit a "Sequence of Operation" for each system.
 6. For those systems with active controls or equipment with functions and features that can be adjusted as part of the normal operation, submit detailed, written documentation of all system settings and adjustments at the time of project completion including but not limited to:
 - a. Level settings for all potentiometers, switches, and other settings on all system equipment.
 - b. Photographs of all equipment knob, button, rheostat, slider control, switch, and other settings necessary to document the original system configuration and settings at the completion of construction. Photographs shall clearly indicate the equipment and settings. The Contractor may utilize digital photography for

documentation purposes. In the event that digital photography is used, the Contractor shall provide one (1) electronic copy and one (1) color hard copy of all photographs.

- c. Other applicable equipment settings as may be required by the Owner.
- d. The documentation shall be formatted and presented in a manner that will allow the Owner to return the system to its original settings without assistance.

1.16 WARRANTY

- A. Submit warranties in accordance with Division 1 section "Products, Materials, and Equipment" and specific requirements outlined in individual Division 167XX sections.
- B. Where a manufacturer's stated warranty exceeds that called for in these specifications, the Contractor shall honor the manufacturer's warranty as if it had been specified herein.

1.17 MAINTENANCE SERVICE

- A. Comply with the requirements of individual Division 167XX sections

1.18 SPARE CAPACITY

- A. Comply with requirements of individual Division 176XX sections

1.19 EXTRA MATERIALS

- A. Comply with requirements of individual Division 176XX sections.
- B. Keys: Provide a minimum of three (3) sets of keys, identified by system and lock, for each different type of lock installed for each system. Keys sets shall be on individual key rings with permanent plastic or metal tag identifying the system, lock location, and key number.

1.20 TESTING

- A. Accomplishing system testing as called for herein. Comply with additional requirements where called for in an individual Division 176XX sections.

1.21 OWNER'S TRAINING

- A. The Contractor shall, after Substantial Completion but prior to Final Completion, provide the Owner with training on the systems within in Division 176XX. Individual training sessions shall be provided for each system. Combining training systems into a single training session shall not be acceptable.
- B. Training shall be comprised of:

1. A walk-through of the facility to identify all system equipment and equipment locations.
2. A review of:
 - a. The system's Close-Out documents
 - b. The system's final documented test results
 - c. The system's Manufacturer's warranties
 - d. The system's software, programming, and passwords
 - e. The system's equipment settings and adjustments

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall provide and install all equipment and materials necessary for complete, operational, and fully functional systems whether or not specifically shown on the drawings or specified herein.
- B. The Contractor shall provide all labor, programming, and testing necessary to complete the work related to the Division 167XX systems and provide the Owner, at the completion of the project, with fully functional and properly operating systems in accordance with the manufacturer's recommendations, the requirements of the contract documents, and applicable industry standards.
- C. The Contractor shall install, program, and test Owner furnished equipment where required by the contract documents.
- D. Equipment and components installed by the Contractor shall be new, and the manufacturer's current model, unless specifically noted otherwise within an individual Division 167XX section or shown on the drawings. All equipment and materials shall be suitable for use intended, and meet all stated performance requirements for the system configurations specified herein.
- E. Equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- F. Unless specifically noted otherwise, equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load by a factor of five (5).

2.2 GENERAL PATHWAY REQUIREMENTS

- A. General:

1. Pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of Division 16.

B. Conduit:

1. EMT fittings shall be steel, compression type connectors, with insulated bushings and separate lock nuts on conduits entering panel cabinets.
2. Bushings: Provide insulated bushings on ends of all raceway. All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
3. Pull Cords: Install pull cords in all raceway runs that are installed without cable.
4. Size:
 - a. Minimum conduit size and quantities shall be as shown on the drawings.
 - b. The Contractor shall increase size of raceways in accordance with the NEC where necessary for the quantity of cables to be installed.

C. Boxes:

1. Boxes shall be sized as required by NEC for cables, conduit and device installed unless noted otherwise.

2.3 SERVICE ENTRANCE PATHWAYS

- A. Comply with applicable requirements of Divisions 16.
- B. Service entrance pathways shall be installed, including quantities and sizes, as shown on the drawings.

2.4 FLUSH GRADE PULL BOXES

- A. Shall be a rectangular, stackable style with dimensions as noted on the drawings.
- B. Shall be UL listed.
- C. Pull Box loadings shall comply with ANSI/SCTE 77.
 1. Shall have a Box Vertical Design/Test Load of 22,500 lbs. or greater.
 2. Shall include a Cover with a Design/Test Load of 15,000 lbs. or greater.
- D. The Contractor shall provide and install a rock based beneath the pull box comprised of medium size stone that is 24" deep and at least 6" wider than the pull box dimensions to provide a stable base for drainage.

- E. Manufacturers
 - 1. Basis of Design:
 - a. Quazite PQ Style Enclosure or acceptable substitution

2.5 TERMINAL CABINETS

- A. Comply with applicable requirements of Division 16.
- B. Provide and install terminal cabinets where shown on the drawings. Provide terminal cabinets for all surge suppression equipment and associated terminations including 120VAC power surge suppressor as required in Division 16. Terminal cabinets in exterior applications or in non-conditioned spaces shall be weatherproof.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Interior
 - a. Hoffman
 - b. Square "D".
 - c. Bud
 - 2. Exterior
 - a. Hoffman
 - b. Carlon
 - c. BUD

2.6 SLEEVES FOR PATHWAYS AND CABLES

- A. Provide and install conduit sleeves for cable penetrations through rated walls and floors. Sleeves shall be provided in sizes and quantities necessary for 200 percent of the cables being installed. At a minimum, one (1) spare sleeve equal in size to the smallest sleeve in use at each location shall be provided empty as a spare for the Owner's future use. All sleeves shall be firestopped after cables have been installed.

2.7 CONDUIT BUSHINGS

- A. Grounding Bushings: All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
- B. Insulation Bushings: Provide insulated bushings on ends of all raceway.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Basis of Design: Arlington EMT Series Insulating Bushings or acceptable substitution

2.8 PULL STRINGS

- A. Install pull strings in all raceway runs that are installed without cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Basis of Design: Jet Line #232 or acceptable substitution

2.9 SURGE SUPPRESSION EQUIPMENT

- A. For Power Circuits (120 volt):
 1. UL 1449 listed.
 2. 15 amp, 120V rated.
 3. Suppressors shall be tested per IEEE, C62.41-1991 for Categories A and B.
 4. Normal mode (L-N), and common mode (L+N-G) protection.
 5. Internal fusing.
 6. Hybrid design.
 7. Indicators for normal operation and failure indication.
 8. Enclosure:
 - a. Fire retardant high impact, phenolic or plastic housing or metal enclosure.
 9. Clamping voltage UL 1449, Line to Neutral, Category B Impulse At (3KA, 8 x 20 μ s): 385V @ 120V.
 10. Maximum Surge Capacity: 20,000 amps.
 11. Maximum Continuous Operating Voltage: 115% of line voltage.
 12. Provide hardwire connection or add 15 amp receptacle device to hardwired devices to match equipment being protected and maintain UL listing.
 13. Provide additional 15 amp in-line fusing as required to comply with UL and the NEC when connected to a 20 amp, 120V circuit.
 14. Manufacturers:
 - a. Leviton #51020-WM (hardwired).
 - b. EDCO #HSP-121BL2.

2.10 LABELS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 16 Section "Identification for Electrical Systems."

- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation
 - 2. HellermannTyton.
 - 3. Kroy LLC.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with NECA 1.
- B. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The Contractor shall provide and install raceways, wiring and cabling required for complete and fully functional systems as intended by these specifications.
- C. The Contractor shall provide and install a properly sized, flush mounted outlet box for every floor, wall, and ceiling mounted device.
- D. In locations where pathways are not accessible after completion of the project, raceway shall be extended from device to device or fire rated access panels shall be installed to provide access to pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device.
- E. Contractor shall properly terminate each device according to the manufacturer's recommendations. Unless specifically noted otherwise, the Contractor shall provide and install cabling to connect all circuitry associated with a device.
- F. Equipment shall be installed in accordance with manufacturer's instructions.
- G. Install electrical basic materials per applicable sections of Division 16.
- H. Equipment, other than portable equipment, shall be held firmly in place. The exception shall be when the Contractor is required to use resilient shock mounting to decouple equipment from the structure it is being mounted to.
- I. Support raceways, backboards, and cabinets per applicable sections of these specifications, as shown on the drawings, and as recommended by the manufacturer. Fastenings and supports shall be adequate to support their loads with a safety factor of five (5).
- J. Switches, connectors, outlets, etc., shall be clearly, logically, and permanently marked during installation. Where the equipment manufacturer does not

provide markings or for fabricated and installed equipment the Contractor shall provide and install permanent, engraved labels for proper identification.

- K. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- L. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- M. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- N. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07920 Section "Joint Sealants."
- I. Seal penetrations of rated assemblies under Division 07842 Section "Firestopping."

- J. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work. The use of pitch pockets is not acceptable.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 PATHWAYS

- A. Raceway systems for individual systems shall not be shared by power or any other electrical wiring that is not part of the system.
- B. Backbone cables shall be in a complete raceway system. Refer to the drawings for additional information.
- C. Conduits, raceways, duct bank systems run underground shall be installed a minimum of 24" below grade. Provide and install magnetic tape above underground runs to allow the Owner to easily locate in the future.
- D. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
- E. Bend raceway with minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.
- F. Install raceways so no more than two 90o bends are in any raceway section without a pullbox. Install additional pullboxes as required to maintain maximum of two 90o bends between pullboxes and/or termination points.
- G. Install interior raceways so no more than one hundred (100) feet of raceway are in any raceway section without a pullbox. Install additional pullboxes as required to maintain a maximum of one hundred (100) feet between pullboxes and termination points.
- H. Install Outside Plant (OSP) raceways and ductbanks so that no more than three hundred (300) feet of raceway are in any raceway section without a pullbox. Install additional pullboxes as required to maintain a maximum of three hundred (300) feet between pullboxes and termination points.
- I. In installations where the electrical contractor does not provide a counterpoise system in conjunction with the underground raceway system, the fire alarm

contractor shall provide a coupling conductor within the underground raceway system to run along side copper conductors. Coupling conductors shall be sized according to applicable codes and standards.

- J. Label raceways at both ends to indicate destination and source. Also indicate length of raceway. This labeling/identification shall be fully documented in as-built (record) drawings.
- K. Install pull string in each empty conduit over 10 feet in length or containing a bend.
- L. Properly support cables/wire not installed in raceways.
- M. Special Raceway Systems: Special raceway systems may be specified for some portions of the system. Refer to the drawings and other sections of these specifications to determine where or if such systems are used.
- N. Use of ceiling tiles, grid or hanger wires for the support cables shall be prohibited.
- O. Service entrance pathways shall be installed, including quantities and sizes, as shown on the drawings.
- P. Contractor shall coordinate with the utility companies prior to rough-in. Service entrance raceways shall be installed in accordance with the local utility company's requirements in addition to the requirements outlined herein. Service Entrance cables and demarcation equipment shall be provided and installed by the utility companies.
- Q. Comply with requirements for demarcation point, pathways, cabinets, and racks specified herein. Drawings indicate general arrangement of pathways and fittings.
- R. Comply with requirements in Division 16 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- S. Pathway Installation in Communications Rooms:
 - 1. Comply with the requirements of Section 16740

3.4 GROUNDING

- A. Provide and install complete grounding system as required to comply with the drawings, other Division 167XX sections, Division 16, and applicable codes.
- B. Communications bonding and grounding shall be in accordance with the National Electrical Code (NEC) and NFPA as well as EIA/TIA grounding and bonding standards. Backbone and entrance cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices.

- C. A #6 AWG stranded copper wire cable shall be extended between new ground bars located at each IDF and the building main electrical service ground point or secondary transformer ground point. Building steel, equipment racks and cabinets, cable tray, and surge suppressor devices shall be bonded to the ground bar via a #6 AWG stranded copper cable and UL approved connecting hardware.
- D. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- E. Comply with ANSI-J-STD-607-A.
- F. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- G. Connect cable shields to "systems" ground bus bar in an industry approved manner. Connections shall be soldered or crimped.
- H. The Contractor shall take such precautions as are necessary to guard against electromagnetic and electrostatic hum, and to install all equipment so as to provide maximum safety to the person who operates it.

3.5 TERMINAL BOXES, JUNCTION BOXES AND CABINETS

- A. Boxes and cabinets shall be UL listed for their use and purpose.
- B. Install boxes and cabinets plumb and square with wall. Where flush mounted boxes and cabinets shall be flush with wall surface.

3.6 CABLES/WIRES

- A. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
- B. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
- C. Cables shall not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- D. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
- E. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

- F. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
- G. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- H. All cable and wire shall be new.
- I. Install cables/wires in accordance with manufacturer's instructions.
- J. Cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles. Major deviations from the illustrated path must be accepted in advance by the Designer. Where illustrated path is not show on the drawings, Contractor shall include intended, general routing path within his submittals.
- K. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- L. Install cables in raceways (refer to drawings) and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 16 Section "Raceway and Boxes for Electrical Systems."
- M. The Contractor shall provide and install all copper and fiber optic cable required to complete the scope of work of this project. Refer to individual Division 167XX sections for specific cabling requirements.
- N. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- O. All cable terminations and testing of cable installed under this project shall be accomplished by the Contractor unless specifically noted otherwise.
- P. Cable runs shall include a service slack prior to the termination point. Provide for a 12-inch service slack in the ceiling above each outlet. Service slack Communications Rooms shall consist of a 10-foot slack section for all station cables located and placed neatly in the cable tray above the equipment rack or cabinet.
- Q. Cables placed under ground, below slab on grade, or in slab on grade, whether in conduit or direct buried, shall be gel-filled or water blocking type.
- R. Interior backbone cables shall be Riser rated unless otherwise stated or required by code.

- S. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- T. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- U. Install system wiring and/or raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
- V. Maintain proper separation between system cables and all power and/or unshielded cables, as required to prevent noise, crosstalk, etc.
 - 1. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in the National Electric Code (NEC). Increase separation if so required to comply with referenced standards.
 - 2. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors.
 - 3. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
 - 4. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
 - 5. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
6. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
7. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).
- W. The majority of the system wiring will be installed above ceilings. Cabling used throughout this project shall comply with the requirements outlined in the National Electric Code (NEC) Article 760. Cabling shall bear CMP and/or appropriate markings for the environment in which they are installed.
- X. Provide a minimum of two cable support hangers at corners and 90 degree turns. Attachment shall be to the building structure and framework at a maximum of five (5) foot intervals. Where cable is routed above the ceiling in areas where there are no walls, all-thread shall be used (minimum ¼"; sized to support the intended weight) with the appropriate hanger for cross-room support. Support rods shall be level and plumb after cable installation. Requirements for bending radius and pulling tension of cables shall be adhered to.
- Y. Above suspended ceilings and below raised floor areas where duct, cable trays, or conduits are not available, cables shall be bundled in groups of 40 or less. Secure loosely with cable ties. Cables shall be loose enough to be rotated easily by hand. Cable ties used in plenum areas shall be plenum rated.
- Z. Cables shall not be spliced unless specifically noted on the drawings.
- AA. Provide adequate cable size and length for each run.
- BB. Install system cables no closer than 12" from any wire/cable installed for power system cable/raceway or fluorescent/ballasted light fixtures.
- CC. Provide protection for exposed cables.
- DD. The Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable unless specifically required by the equipment manufacturer for proper operation of the equipment.
- EE. Each outlet and device shall have splice-free cables homerun to its respective equipment as indicated on the drawings.
- FF. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

3.7 SURGE SUPPRESSION

- A. Provide and install surge suppression devices on:
 1. Each copper cable (unshielded twisted pair, shielded twisted pair, coaxial, etc.) entering or leaving a building. Install surge suppression devices at system terminal board or in a cabinet.
 2. In other locations where required by the manufacturer or required to properly protect the equipment and the system.
 3. Install surge suppression device on all 120 volt power sources to equipment. Surge suppression on 120 VAC circuits shall be provided and installed by the electrical sub-contractor. Coordinate with Division 16 to ensure that surge suppression for 120 VAC power circuit and surge suppression required by this section for each system are installed in same terminal cabinet and bonded together.
- B. Bond surge and suppression device to building ground system as called for in Division 16.
- C. Contractor shall take extreme care to ensure a properly surge protected system.
- D. Surge protection equipment must be selected by contractor to match the equipment being protected including wire sizes, operating volts, amps, and circuit impedance.
- E. Installation of surge protection equipment and its grounding must be per manufacturer's recommendations to assure short and proper ground paths.
- F. Terminal Cabinets
 1. Surge suppression devices shall be installed in terminal cabinets whether or not shown on the drawings. Where required, install surge suppression terminal cabinet in termination area of individual system being protected.
 2. Size terminal cabinets as required to facilitate installation of terminations and surge suppression in a neat and workmanlike manner.

3. Coordinate location of terminal cabinets with adjacent equipment and materials.
- G. Equipment Installation
1. Install surge suppression equipment per manufacturer's recommendation
 2. Install surge suppression equipment terminal cabinets, etc. as required to facilitate installation of surge protection equipment and terminal points. Size terminal cabinets as required to facilitate installation of surge suppression equipment and terminal blocks.
- H. Ground Installation
1. Ground Bus Connections
 - a. Provide "local" ground bus in each terminal cabinet housing surge protection equipment (with lugs, etc. as required).
 - b. Bond "local" ground bus to terminal cabinet with minimum #6 copper wire.
 - c. Connect terminal cabinet "local" ground bus to "systems" ground bus installed per with minimum #6 copper insulated wire (unless otherwise noted) in conduit.
 - d. Note that "systems" ground bar is also to be used for power transformation ground (480V to 208V) where applicable.
 2. Surge suppression equipment grounding
 - a. Connect each surge suppressor to local ground bus in terminal cabinet with wire sized as recommended by manufacturer.
 - b. Coordinate with Division 16 to ensure that 120 VAC power source/supply surge suppressor is also grounded to same local ground bus as surge suppressors provided in these criteria.
 3. Conductors
 - a. Bends in excess of 90 degrees in any grounding conductor shall not be permitted.
 - b. Do not bundle unprotected conductors with protected conductors.
 - c. Conductors shall be kept as short as possible.
 - d. Conductors shall be secured at 12" intervals with an accepted copper clamp
 - e. Grounding conductors shall be properly connected to the building service ground by accepted clamps.
 4. Grounding Connectors

- a. Connectors, splicers, and other fittings used to interconnect grounding conductors, bond to equipment or grounding bars, shall be UL Listed for the purpose.
 - b. All connectors and fittings are to be of the Nicopress crimp or compression set screw type.
 - c. Special treatment to fittings lugs, or other connectors of dissimilar materials are to be applied to prevent electro-galvanic action.
- I. Isolation of cable shields
 1. Cable shields shall be suitably protected at each termination point to avoid incidental contact with grounded elements of the building structure. Shield continuity shall be maintained throughout the entire cabling system. Ground reference of the building ground system shall be matched at the Communications Rooms Ground Bus Bar.
 2. Isolation of the shields shall be individually verified by resistance measurements as connections are made.

3.8 OUTLETS

- A. The Contractor shall provide and install an outlet plate with appropriate connectors for each device whether or not shown on the drawings.
- B. Install devices/inserts in outlets so that same orientation is used throughout project.
- C. Install wall plates with all inserts required to properly connect all equipment circuits and complete the installation in a professional manner.

3.9 LABELS

- A. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.
- B. Custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to Designer for review and approval prior to fabrication or final installation. The Contractor shall modify labeling as required by the Designer.
- C. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:
 1. System identifier
 2. Room number where other end of cable is terminated

- a. Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
 - b. Room numbers shall coincide with numbering scheme included in contract documents.
3. Device identifier where other end of cable is terminated
- a. Device identifier shall provide a clear indication of device connected to.
4. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
5. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
6. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
7. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
- a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
8. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- D. Equipment, control, and system cabling shall be provided with permanent descriptive labels.
- E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables shall use flexible vinyl or polyester that flexes as cables are bent.

3.10 PROTECTION AND CLEANING

- A. The Contractor shall ensure that all system equipment is fully protected from damage, work of other trades, construction material, dirt, and dust to the point that upon occupancy by the Owner the equipment shall appear new and as if it had just been removed from the manufacturer's original packing.

- B. The Contractor shall be responsible for ensuring that all system enclosures and equipment is clean and in like new condition prior to requesting Substantial Completion. As a minimum, this shall include:
1. The interior of equipment cabinets, terminal cabinets, and all other system enclosures shall be free of installation remnants, construction materials, dust, dirt, and other evidence of construction.
 2. The exterior of equipment cabinets, terminal cabinets, and all other system enclosures shall be free of scrapes, nicks, dents, discoloration, abrasions, excess construction materials, or other evidence of damage.
 3. System equipment backboxes, outlet boxes shall be free of damage and excess construction materials that hinder the installation of equipment or reduce the interior volume of the box.
 4. Equipment exteriors shall be clean and free of fingerprints, dust, stains, scratches, abrasions, marks, excess construction materials, or other contaminants.
 5. All system devices shall be clean and free of damage or visible markings.
- C. Field touch-up painting of racks, cabinets, and system enclosures to hide the evidence of damage shall not be acceptable. The Contractor shall replace racks, cabinets, or system enclosures that have visible exterior damage.
- D. In the event that the Designer determines that the equipment has not been protected properly, evidence of damage is visible, or the degree of installation remnants, construction material intrusion, dust, dirt, or other evidence of construction appears excessive, the Contractor shall clean the equipment and enclosures to the satisfaction of the Designer or shall, at the direction of the Designer, replace the equipment with new.

3.11 TESTING

- A. Perform testing as necessary or specified to verify fully functional systems with no visual, audible, or operational degradation. Replace and/or repair and retest components that fail performance standards. Test cables, outlets, devices, and equipment in accordance with industry acceptable practices for each individual system.
- B. Provide factory trained personnel to perform the tests and adjust the system.
- C. Test Equipment
1. Provide all required test equipment and associated apparatus necessary to successfully complete the system testing.
 2. Kits, home-built, and other nonprofessional test equipment shall not be acceptable.
 3. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex,

complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

D. Cable

1. General

- a. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
- b. Visually inspect cable placement, cable termination, equipment and patch cords, and labeling of all components.
- c. Visually confirm cables and outlets have been properly labeled.
- d. Visually inspect grounding and bonding for completeness and termination tightness.
- e. Test operation of shorting bars in connection blocks.

2. UTP and Multi-Conductor Cable

- a. Test each cable. Perform the following tests:
- b. DC loop resistance
- c. Shorts
- d. Opens
- e. Intermittent faults
- f. Polarity between conductors.

E. Corrective Action

1. The Contractor shall submit to the Designer, within five (5) business days of accomplishing the initial testing, a list identifying cables that do not meet the testing requirements. The Designer shall review the documentation and determine corrective action to be taken. This may include replacement of defective materials at no additional expense to the Owner.
2. The Contractor shall be responsible for repairing or replacement of defective equipment, materials, and cable as necessary to provide 100% satisfactory testing.
3. Remove and replace cabling where test results indicate that they do not comply with specified requirements. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Documentation of Tests, Measurements, and Adjustments Performed:

1. Provide system verification and acceptance documentation signed and dated by the Contractor at the completion of testing. Document the following:

- a. List of personnel in attendance during testing including the name of the Technician who performed each individual test.
 - b. List of certified test equipment used with serial numbers
 - c. List date of last calibration for each piece of test equipment
 - d. Date of each test
 - e. List reference settings of test equipment used for tests
 - f. Submit testing results in hard copy and native electronic format.
2. System verification and acceptance documentation shall be provided with the Contractor's request for Substantial Completion.

3.12 DEMONSTRATION

- A. Demonstrate system to designated Owner personnel as required by applicable sections of these specifications. Accomplish Owner's training as described in Part 1.
- B. Complete operation of the system shall be demonstrated. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- C. The Contractor shall provide a typewritten "Sequence of Operation" for each system.

END OF SECTION 16701

SECTION 16740
VOICE/DATA CABLE INFRASTRUCTURE (EMPTY RACEWAY)

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Division 16 Section 16701 "Common Work Results for Communications".
- B. In addition to the requirements of Section 16701 comply with the following additional requirements:

- 1. STANDARDS, CODES, REFERENCES AND REGULATORY REQUIREMENTS

- a. The equipment and installation shall comply with the current and applicable provisions of the following standards, codes, references, and regulatory requirements including all ratified addenda:
 - 1)
 - 2) ANSI/EIA/TIA-569-B, Commercial Building Standard for Telecommunication Pathways and Spaces
 - 3) ANSI/TIA/EIA-606-A, Administration Standard for The Telecommunications Infrastructure of Commercial Buildings
 - 4) ANSI/TIA/EIA-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 5) ANSI/TIA/EIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard
 - 6) Building Industry Consulting Service International (BICSI), Telecommunications Distribution Methods Manual, (Latest Revision)
 - 7) Building Industry Consulting Service International (BICSI), Customer-Owned Outside Plant Design Manual, (Latest Revision)
 - 8) Building Industry Consulting Service International (BICSI), Telecommunications Cabling Installation Manual, (Latest Revision)

1.2 ALTERNATES

- A. Not used.

1.3 SPECIAL REQUIREMENTS

- A. The Voice/Data Cable Infrastructure (i.e. Cable, Outlets, Patch Panels, etc.) will be provided and installed by the Owner's Vendor. The Contractor shall provide and install raceways, power, grounding, equipment racks, and cable

tray as noted herein or shown on the drawings. The Contractor shall be responsible for all coordination necessary with the Owner and the Owner's Vendor to ensure a complete and fully function system.

1.4 DESCRIPTION OF SYSTEM

- A. Provide and install a complete Voice/Data Cable Infrastructure System, as described herein and shown on the drawings, providing the following:
 - 1. Transport of voice, data, and video signals.
- B. Section Includes:
 - 1. Service Entrance Pathways
 - 2. Cable Tray – Ladder Type
 - 3. Floor Mounted Equipment Racks and Frames
 - 4. Terminal Cabinets
 - 5. Rack and Frame Equipment
 - 6. Cable Support Systems
 - 7. “Systems” and “Local Ground Bus Bars
 - 8. Termination Backboards
 - 9. Sleeves for Pathways and Cables
 - 10. Conduit bushings
 - 11. Pull strings
 - 12. Copper Termination Equipment
 - 13. Surge Suppression Equipment
 - 14. Labels

1.5 FUNCTIONS AND OBJECTIVES

- A. Installation of a complete Voice/Data Cable Infrastructure empty raceway system.

PART 2 - PRODUCTS

2.1 FLOOR BOXES

- A. Comply with applicable requirements of Division 16

2.2 CABLE TRAY – LADDER TYPE

- A. Tray shall be 12 inches wide with 6 inch rung spacing, have a minimum of 24 square inches of cable pathway and minimum 24 inch radius.
- B. Adjustable splice connectors are acceptable where needed to accommodate non-standard vertical and horizontal bends. Each straight section, and fitting, shall be provided with two “heavy duty” splice connectors and appurtenant hardware. The splice, when bolted together to form a tray joint, is to be designed to have the same strength (or better) than the tray when placed mid-span.

- C. The tray system shall be capable of carrying 50 lb/linear foot without exceeding a 1.5 inch mid-span deflection (in accordance with NEMA Class 8A) when supported every 4 foot.
- D. 3/8" x 1-1/2" x 0.065" wall rectangular tubing.
- E. Cross members welded at maximum 9" intervals, 3/8" x 1-1/2".
- F. UL Classified for suitability as an equipment-grounding conductor.
- G. Edges, fittings and hardware shall be finished free from burrs and sharp edges.
- H. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius unless otherwise indicated.
- I. Provide grounding kit bond to bond together sections of cable tray and to bond to rack.
- J. Provide all warning labels as required by U.L., NEC and NEMA.
- K. Gold chem. film over zinc plating
- L. Provided with heavy-duty splice kits.
- M. Provided with Wall Support Bracket Kit
- N. Made of cold rolled steel
- O. Weight capacity of 400 lbs.
- P. Kit shall include vertical wall mounting bracket, runway support channel, angle support channel, clevis pins, cotter pins, J-bolts, hex nuts, and washers.
- Q. Ladder type cable tray shall be installed in MDF and IDF spaces.
- R. Manufacturers
 - 1. Basis of Design
 - a. Chatsworth
 - 2. Acceptable Substitutions
 - a. B-Line
 - b. Hubbell

2.3 FLOOR MOUNT EQUIPMENT RACKS AND FRAMES

- A. Universal EIA self-supporting EIA aluminum rack. 84" H. x 19" W. x 6" D.

- B. EIA standard for 19" rack mounted equipment.
- C. EIA standard 3" x 1.25" aluminum upright channels, .125" thick.
- D. Heavy-duty assembly hardware
- E. Base Angles: 3-1/2" x 6" x 3/8" thick (pair) for bolting to floor.
- F. Top Cross Angles: 1-1/2" x 1-1/2" x 1/4" (pair) compatible with overhead cable tray.
- G. Mounting holes both sides (front and rear) of upright channels.
- H. Finish: Black Powder Coat Finish
- I. Panel Mounting Holes: #12-24 rolled threads in 5/8" - 5/8" x 1/2" hole pattern meeting EIA/TIA-568 mounting space requirements.
- J. One double-sided vented shelf (21" deep) in bottom for UPS equipment for each rack section.
- K. Minimum of one (1) additional single-sided ventilated shelves for each rack section. Contractor shall coordinate with Owner prior to installation of system equipment to confirm equipment arrangement in equipment racks. If all shelves will not fit in equipment racks Contractor shall turn over shelves to Owner for future use.
- L. Provide cable management devices (clamps, guides, supports, etc. as required to neatly dress/organize cables in and out of rack (or enclosure). With the exception of wire management devices specified below, devices shall be installed per requirements to be determined in the field. As a minimum, Contractor shall provide horizontal and vertical (full rack height) cable management as shown on the drawings. Wire management fill rate shall not exceed 50% condition when all provided jacks are in use. Contractor shall provide wire management sized as necessary for the number of cables installed and for the type of installation (i.e. rack or cabinet).
 - 1. Each copper patch panel shall have one (1) horizontal wire manager (2 RU) above and one (1) horizontal wire manager (2 RU) below. One additional 2RU wire manager shall be installed at the bottom of the equipment rack.
 - 2. Each equipment rack shall have one vertical wire manager installed on each side of the equipment rack. Multiple contiguously installed equipment racks shall have a vertical wire manager installed between the adjoining equipment racks.
- M. When mounting in another enclosure or millwork, provide width, height, hardware, etc. as required for complete and coordinated installation.
- N. Provide all panels as required to mount equipment, including panel for power strip.

- O. Provide ground bus full height minus six (6) inches. Mount to back of equipment rack. Connect to Systems ground bus bar.
- P. Provide all brackets to mount non-rack mountable equipment such as termination blocker (where called for.)
- Q. Provide all hardware, supports, etc. as required to mount/house all equipment called for and/or shown at each location.
- R. Provide additional shelves as required for each piece of equipment mounted in rack that requires a shelf.
- S. Equipment rack shall be provided with isolation pad utilizing non-conductive washers.
- T. Rack area to include two (2) 20 amp, 120V duplex receptacles, each connected to separate 20 amp, 120V dedicated circuit. Mount in bottom area of rack. Refer to power drawings.
- U. Rack to include two (2) power strips. Power strip to plug into UPS power back-up system which will be plugged into power outlet provided within equipment rack.
- V. Power Strips: Comply with UL 1363.
 - 1. Rack mounting.
 - 2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - 3. LED indicator lights for power and protection status.
 - 4. LED indicator lights for reverse polarity and open outlet ground.
 - 5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 - 6. Cord connected with 15-foot (4.5-m) line cord.
 - 7. Rocker-type on-off switch, illuminated when in on position.
 - 8. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 - 9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.
- W. Manufacturers:
 - 1. Basis of Design
 - a. Chatsworth Universal Equipment Racks
 - 2. Acceptable Substitution
 - a. B-Line
 - b. Hubbell

2.4 RACK AND FRAME EQUIPMENT

- A. Network Electronics:
 - 1. Provided and installed by Owner.
- B. Uninterruptible Power Supply (UPS):
 - 1. Provided and installed by Owner.
- C. Cable, patch panels, and outlets
 - 1. Provided and installed by Owner's Vendor.

2.5 "SYSTEMS" AND "LOCAL" GROUND BUS BARS

- A. Communications systems ground bus bar shall be installed where shown on the drawings.
- B. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- C. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) and 12 inches long with fifteen (15) 5/8" hole center lugs and three (3) 1" hole center lugs. Shall be UL Listed. Shall be a BICSI & ANSI/EIA/TIA-607 standard 12" TBGM Pattern Grounding Busbar.
- D. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- E. Manufacturers:
 - 1. Basis of Design
 - a. Chatsworth #40153-012 Grounding Busbar or acceptable substitution

2.6 TERMINATION BACKBOARDS

- A. Backboards shall be installed to a height of 8'-0" AFF. Plywood shall be installed with the best side out. Imperfections and voids shall be filled, sealed and sanded prior to being primed and painted with 2 coats of UL Classified, gray fire retardant intumescent paint on the front, back and all four sides of the plywood. Fire retardant coating is to be tested to UL723, "Test for Surface Burning Characteristics of Building Materials". Backboards are to be clearly labeled with the name of the backboard manufacturer, UL Classification of the Fire Retardant Coating, NFPA 255 Coating Flame Spread Index Class and the APA Grade of the plywood.
- B. Contractor may field fabricate to all the specifications listed above. The Contractor shall provide proof that AC Grade Plywood and UL Classified paint

was used in making the backboards. The Contractor shall also verify that backboards were primed, and painted on all sides (front, back and all sides) with two coats of the required paint with all voids filled and sanded prior to being primed and painted.

- C. Material: 3/4" A/C grade, Class A Flame Spread plywood.
- D. Manufacturers:
 - 1. Basis of Design: Pathways & Spaces, Inc. ReadySpec #RB-AD4896G or acceptable substitution

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the requirements of Section 16701.

3.2 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install pathways, as shown on the drawings. Comply with recommendations in TIA-569-C.
- C. Install entrance pathway complying with Division 16 Section "Raceway and Boxes for Electrical Systems."
- D. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.3 CABLE TRAY – GENERAL

- A. Bond cable tray sections together to form an electrically continuous path.
- B. Bond cable tray to equipment racks in Communications Rooms.
- C. Cable trays shall be a minimum of eighteen (18) inches from any source of EMI or other sources of electrical interference.
- D. Cable tray, where installed under raised floor assemblies, shall be supported by kindorf, uni-strut or other approved supporting mechanism. Cable tray shall be mounted at least $\frac{3}{4}$ " above the base floor.
- E. Provide and install accessories necessary to properly mount cable tray.
- F. Support from structure where installed in above ceiling spaces. Install above ceiling structural supports as required to prevent lateral movement.

- G. Edges, fittings and hardware shall be finished free from burrs and sharp edges.
- H. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius unless otherwise indicated.

3.4 CABLE TRAY – LADDER TYPE

- A. Where installed above equipment racks and cabinets cable tray shall be permanently mounted to top of enclosure
- B. Where installed in locations other than above equipment racks and cabinets cable tray shall be permanently installed to a permanent wall using Wall support brackets. Wall support brackets shall be installed at spacing no greater than every four (4) feet.
- C. Support the cable tray from wall studs or suspend from the structure above. Do not suspend the tray system from the roof deck.

3.5 TERMINATION BACKBOARDS

- A. Comply with requirements in Division 09900 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.6 EQUIPMENT RACKS AND CABINETS

- A. Install cabinets/racks in locations shown on drawings; arrange to provide adequate ventilation and access.
- B. Install all rack mountable equipment in equipment cabinet or rack as shown on the drawings.
- C. Equipment racks and frames shall provide a path for equipment ground.
- D. Where multiple enclosures are configured as one continuous enclosure, they shall be installed with six inches (6") of clearance from any other structure to ensure adequate airflow for circulation fans.
- E. In installations where it is not possible to maintain six inches (6") of clearance from a structure, or where specifically noted in the drawings and specifications, the Contractor shall provide a fan assembly to provide adequate airflow to the satisfaction of the Designer.

3.7 LABELS

- A. Comply with the requirements of Section 16701.

- B. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- C. Cabling Administration Drawings: Identify labeling convention and show labels for telecommunications closets, backbone pathways, entrance pathways, terminal hardware and positions, , , grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A.

END OF SECTION 16740

SECTION 16741
BALLROOM COMBINING SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 "Common Work Results for Communications".
- B. In addition to the requirements of Section 16701 comply with the following requirements:
 - 1. Standards, Codes, References, And Regulatory Requirements
 - a. The equipment and installation shall comply with the current or applicable provisions of the following standards, codes, references, and regulatory requirements:
 - b. Sound System Engineering by Don & Carolyn Davis (2nd Edition, Published by Howard W. Sams & Co., Inc.)
 - 1) UL 813 - Commercial Audio Equipment
 - 2) UL 1419 - Professional Video and Audio Equipment
 - 3) UL 1492 - Audio-Video Products and Accessories
 - 4) UL 1971 - Signaling Devices for the Hearing Impaired
 - 2. Submittals
 - a. Shop Drawings: The Contractor shall provide complete shop drawings showing how he intends to install the Sound Reinforcement System (hereinafter referred to as the "system"). Shop drawings shall, as a minimum, include the following:
 - 1) A point-to-point wiring diagram showing:
 - a) All system equipment, cabling, interconnections to other systems, etc.
 - b) Identifiers for the various types of cable to be used. This shall include a matrix that identifies the manufacturer, model number and descriptive identifier for each cable
 - c) Quantity of cables in each conduit
 - d) Signal type: Provide signal type designation on all cables. Signal type shall be identified in a fashion similar to that on the contract drawings (e.g. mic, line, 70V, etc.).

- 2) A block diagram for the system showing all equipment and the intended installation location for each as outlined below.
- 3) A plan showing how the Contractor intends on installing system conduits to provide an organized layout coordinated with the Video System, for separation of conduits by signal type and signal level.
- 4) A front elevation view of the Equipment Cabinets showing all rack mounted and shelf mounted equipment. A rear elevation view of the Equipment Cabinets showing all non-rack mounted and shelf mounted equipment. The Contractor shall show full coordination of the system equipment with equipment and materials provided as part of another section (e.g. Section 16751 – Video System, etc.)
- 5) Plan view drawings for the Equipment Cabinets showing cable entrance areas for the various signal types and levels (i.e. microphone level, line level, speaker level, etc.). If necessary, the Contractor shall show both bottom and top plan views in order to clearly show how cables enter cabinets and maintain proper separation.
- 6) Completed forms prepared by the Contractor and ready to be sent to the manufacturer for engraving requirements for all system outlet plate (wall and floor box) modular connector inserts.

b. Audio Calculations

- 1) The Contractor shall provide Enhanced Acoustic Simulator for Engineers (EASE) software plots for each sound reinforcement system showing all pertinent calculations. The plots shall show all applicable information regarding the system speakers, their aiming, and coverage in order to confirm, that the actual installation will function properly.
- 2) EASE plots shall include a room modeled by the Contractor based on information provided within the contract documents. The Contractor shall, if required by the Designer, be prepared to meet and demonstrate how the EASE calculations were derived and adjust speaker parameters as necessary to ensure optimal system operation.
- 3) All work associated with the EASE plots shall be completed by the Contractor prior to completion of the rough-in phase for the space(s) housing the sound system(s). Otherwise, any changes required for proper location and mounting of the speakers shall be at the Contractor's sole expense.

- 4) All plots shall be printed on 8-1/2" x 11" semi-gloss paper, in full color, and at a resolution that makes all information easily readable. At a minimum Contractor shall provide calculations for:
 - a) STI
 - b) Direct SPL
 - c) Alcons
 - d) RASTI
 - e) Total SPL
 - f) Direct/Reflected Sound Ratios
 - g) Critical Distance
 - h) C Measures
 - i) Arrival Times
 - j) Loudspeaker Coverage Overlap
 - k) Loudspeaker Aiming
 - l) Initial Time Delay (ITD) Gap

3. Spare Capacity

- a. The Contractor shall provide and install the system equipment and materials in quantities that will provide the Owner with twenty percent (20%) spare capacity (e.g. termination points, jacks, ports, etc.) after connection of all circuits as required by the contract documents.

4. Extra Materials

- a. Provide two (2) extra of each type of system patch cord.

1.2 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete system, as described herein and shown on the drawings, providing the following:
 1. The pickup, amplification, distribution, and reproduction of voice and/or other audio program material from various audio and video sources.
- B. System to include but not be limited to:
 1. Equipment Cabinets
 2. Audio
 - a. Wireless Microphones
 - b. Handheld Microphones
 - c. Microphone Floor Stands
 - d. Microphone Desk Stands
 - e. Mic and Line Level Input Plates

- f. Line Level Mixers
- g. CD/MP3 Players
- h. Audio Mixers
- i. Room Combining System
- j. Digital Signal Processors (DSP)
- k. Assisted Listening System
- l. Power Amplifiers
- m. Speakers
- n. Cables

1.3 FUNCTIONS AND OBJECTIVES

- A. Provide audio distribution to various locations both local and remote.
- B. Provide audio distribution to remote locations as indicated in the drawings and outlined within these specifications.
- C. Provide audio reinforcement on the room floor.
 - 1. Provide even distribution of the reinforced audio throughout the seating area, typically plus or minus 3 dB front to back and side to side for the one octave band centered at 4000 Hz. Total variation from the worst to best seats shall not exceed plus or minus 4 dB.
 - 2. Provide uniform frequency response throughout the audience area. Typically, plus or minus 3 dB as measured with 1/3-octave bands of pink noise at positions across the main seating area.
 - 3. Provide adequate dynamic range at an acoustic distortion level sufficiently low to ensure minimum listening fatigue. The system shall be capable of delivering 75 dB average program level with additional 10 dB peaking margin to any seat in the audience area at an acoustic distortion level below 5% THD.
- D. The Contractor shall adjust the equipment of the audio system such that there shall be no discernible difference in audio levels when switching from one audio source to another.
- E. The system as shown on the drawings and described herein may interconnect to a variety of systems either outlined in other specification sections or provided and installed by the owner. The Installer shall be responsible for providing all equipment, cabling, patch cords and other materials necessary to transfer signals from those other systems to this system, and visa versa, at the other system's primary equipment location unless specifically noted otherwise. The Installer shall coordinate the work of this section for the location where required signals of other systems are to be obtained or sent and provide all equipment and materials necessary to do so. The documents describe as fully as possible the signal types and locations for these other systems. However, the Installer is ultimately responsible for providing the interconnection and processing of signals as necessary for the proper operation of the system.

- F. Accomplish complete coordination of system equipment with Video System equipment where installed in the same equipment cabinets.

PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT AND MATERIALS

A. Floor Mount Equipment Cabinets

- 1. Shall be provided under Section 16751 – Video System

2.2 AUDIO SYSTEM

A. Wireless Microphone System

1. Functions and Features

- a. 42 MHz bandwidth: 1680 tunable UHF frequencies.
- b. Enhanced frequency bank system with up to 24 compatible frequencies
- c. Ethernet port for connecting to the Wireless Systems Manager (WSM) software for control via computer.
- d. High-quality true diversity reception.
- e. Pilot tone squelch for eliminating RF interference when transmitter is turned off
- f. Automatic frequency scan feature.
- g. Enhanced AF frequency range.
- h. Increased range for audio sensitivity.
- i. Wireless synchronization of transmitter parameter from receiver.
- j. Illuminated graphic display.
- k. Auto-Lock function
- l. HDX Comander
- m. Programmable Mute function
- n. Integrated Equalizer and Soundcheck mode
- o. Contacts for recharging BA 2015 accupack directly in the transmitter

2. Technical

- a. RF frequency range: 516 - 865 MHz
- b. Transmission/receiving frequencies: 1680
- c. Presets: 24
- d. Switching bandwidth: 42 MHz
- e. Peak deviation: ± 48 kHz
- f. Comander: HDX
- g. Frequency response (microphone): 80 - 18,000 Hz
- h. Signal-to-noise-ratio: > 115 dB(A)

- i. Total harmonic distortion (THD): <0.9%
 - j. In compliance with: ETS 300422 , ETS 300445 , CE , FCC
 - k. Antenna connector: 2 BNC, 50Ω
 - l. XLR connector: 6.3 mm
 - m. Audio output level (balanced): XLR: +18 dBu max
 - n. Audio output level (unbalanced): Jack: +12 dBu max
 - o. RF output power: 10/30 mW
 - p. Operating time (transmitter): > 8 hours
 - q. Input voltage range: 1.8 V, line / 2.4 V, line
 - r. Transducer / microphone type: electrets
 - s. AF sensitivity: 40 mV/Pa
 - t. Sound pressure level (SPL): 120 dB(SPL) max.
 - u. Pick-up pattern: cardioid
3. Each Wireless Microphone system shall be provided with rack mount.
 4. The Contractor shall provide and install the Wireless Microphone System with all accessories required for the complete and fully functional system within this specific facility. The accessories shall include but not be limited to an Antenna Splitter and Mounting package and Boosters for proper receipt of signals from remote antennas. The Contractor shall provide a block diagram as part of his Submittals that identifies all equipment and materials, as well as the specific installed location for each, to confirm the system configuration to be installed as part of this project. The Contractor shall coordinate with the Manufacturer prior to providing Submittals for review.
 5. The Contractor shall determine the initial frequencies to be used by each Wireless Microphone system and shall provide that information as part of his submittals. Upon completion of the installation, but prior to requesting the Substantial Completion review, the Contractor shall accomplish final verification of the permanent frequencies for each system necessary for proper system operation without interference and shall annotate his final as-built documents.
 6. Each Wireless Microphone system shall be provided with one (1) lavalier microphone and one (1) handheld microphone.
 7. Manufacturers
 - a. Basis of Design
 - 1) Sennheiser EW 322 G3 Wireless Microphone System
 - b. Acceptable Substitutions
 - 1) Telex
 - 2) Shure

B. Handheld Microphones

1. The microphone shall be a unidirectional (cardioid) dynamic vocal microphone designed for professional vocal use in sound reinforcement and studio recording applications. The microphone shall include a built-in spherical filter to minimize wind and breath "pop" noise. The microphone shall be of rugged construction with a proven shock mount system, and a steel mesh grille to ensure consistent performance.
2. The microphone shall be provided with a windscreen and 25 foot cable.
3. The microphone shall include the following minimum features:
4. Frequency response tailored for vocals with brightened midrange and bass rolloff
5. Uniform cardioid pickup pattern that isolates the main sound source and minimizes background noise.
6. Pneumatic shock-mount system to reduce handling noise
7. Effective, built-in spherical wind and pop filter
8. Included break-resistant stand adapter which rotates 180 degrees
9. Technical
 - a. Frequency Response: 50 to 15,000 Hz
 - b. Polar Pattern: Unidirectional (cardioid), rotationally symmetrical about the microphone axis, uniform with frequency.
 - c. Sensitivity (at 1,000 Hz, open circuit voltage): -54.5 dBV/Pa (1.85 mV)
 - d. Rated Impedance: 150 Ohms actual (300 Ohms actual)
10. Provide quantity of four (4)
11. Manufacturers
 - a. Basis of Design
 - 1) Shure SM58 Series Handheld Microphones
 - b. Acceptable Manufacturers
 - 1) AKG
 - 2) EV

C. Microphone Floor Stands:

1. The microphone floor stand shall be a professional full-height microphone stand designed for commercial audio applications. It shall feature a low profile base, be of rugged construction, and include a wearproof clutch with positive locking control for microphone height placement.
2. The stand shall be constructed of heavy-duty welded cold rolled steel tubing with a cast iron base that includes anti-tip stabilizers.
3. The microphone stand base and tubing shall be ebony in color.
4. Provide quantity of four (4).
5. Manufacturers

- a. Basis of Design
 - 1) Atlas Soundolier MS-12CE
 - b. Acceptable Substitutions
 - 1) Konig & Meyer
 - 2) Hercules
- D. Microphone Desk Stands:
- 1. The microphone desk stand shall be a fixed height stand with a circular cast iron base and steel tubing for application with any standard microphone.
 - 2. The microphone stand base and tubing shall be ebony in color.
 - 3. Provide quantity of two (2).
 - 4. Manufacturers
 - a. Basis of Design
 - 1) Atlas Soundolier DS-5
 - b. Acceptable Substitutions
 - 1) Konig & Meyer
 - 2) AKG
- E. Microphone and Line Level Input Plates
- 1. Stainless steel single-gang faceplates with quantity and type of XLR connectors as shown on the drawings.
 - 2. Provide one (1) 25 foot microphone cable for each jack.
 - 3. Manufacturers
 - a. Basis of Design
 - 1) Atlas Soundolier
 - b. Acceptable Substitutions
 - 1) Pro Co Sound
 - 2) Whirlwind
- F. CD/MP3 Player
- 1. The CD Player shall include the following functions and features:
 - a. Play finalized CD-R/RW discs containing MP3 or WMA audio files.

- b. Utilize a multi-level noise shaping DAC.
 - c. Have 8-times oversampling digital filter
 - d. Include synchronized recording functions
 - e. Include full random, program random, and disk sequential random playback modes.
 - f. Utilize intelligent disk scan
 - g. Have a 20-selection music calendar display
 - h. Include both coaxial and optical digital outputs.
 - i. Include a headphone jack.
2. Technical
- a. Frequency Response: 2 Hz- 20 kHz
 - b. Dynamic Range: 98 dB
 - c. Signal-to-Noise Ratio: 108 dB
 - d. Total Harmonic Distortion: 0.003%
 - e. Channel Separation: 98 dB
 - f. Line Out Level: Fixed 2.0 V (10 kohms)
3. Shall include a rack mount kit.
4. Shall include an IR remote control
5. Manufacturers
- a. Basis of Design
 - 1) Denon Professional DCM-290P
 - b. Acceptable Substitutions
 - 1) Tascam
 - 2) Gemini
- G. Line Level Mixer
- 1. The Line Level Mixer shall be a two input, two output device design for mixing two audio sources. It shall allow two mic or line level source to be combined and output as either a mic or line level signal.
 - 2. Technical
 - a. Inputs: Two (2) selectable mic or line
 - b. Input Level for +4 dBu Output:
 - 1) Mic: -45 dBu to =65 dBu; Max input -28 dBu
 - 2) Line: -18 dBv to +1- dBu; Max input +22 dBu
 - c. Input Impedance: Mic 200 Ohm; Line 20 k Ohm bridging
 - d. Input or Output Configuration: Balanced or unbalanced
 - e. Outputs: Two (2); mic or line

- f. Output impedance: 150 Ohms (mic or line)
 - g. Frequency Response:
 - 1) Mic: 25 Hz to 50 kHz (± 1 dB)
 - 2) Line: 10 Hz to 30 kHz (± 0.25 dB)
 - h. THD+N:
 - 1) Mic: < 0.05% 25 to 20 kHz
 - 2) Line: < 0.005%
 - 3) IMD: < 0.004%
 - i. Output Level: Mic: -45 dBu; Line +4 dBu
 - j. Headroom:
 - 1) Mic Input: >22 dB
 - 2) Line Input: >32 dB
 - 3) Output: > 20 dB
 - k. Noise: Mic: <-70 dB; Line <-90 dB
 - l. CMRR: Mic: > 65 dB; Line >45 dB
- 3. The Mixer shall be provided with a power supply
 - 4. Manufacturers
 - a. Basis of Design
 - 1) Radio Design Labs St-MS2 Line Level Mixer or acceptable substitution

H. Audio Mixers

- 1. The mixer shall have four studio-grade mono mic/line inputs each with XLR input jack, 15 V phantom power, line pad, A / A+B / B mix assign switch, level control and signal/overload indicator. A single switch shall make phantom power available to all four microphone inputs. Phantom power shall be removed automatically from an mic/line input set for line input. For ease of use, mic/line preamplifiers shall use a single control for input gain trim and mix level.
- 2. The mixer shall feature four stereo line inputs each with ¼" TRS input jack, level control and pre-level control mono switch. The inputs shall provide four dual mono operation with four mono signals available for the A mix and four mono inputs available for the B mix.
- 3. A and B mix outputs shall feature overload indicators, independent A/B level controls, internally selected 40 dB pad for microphone level output and XLR output jacks.
- 4. Security features shall include placement of the phantom power and line switches on the rear panel, recessed assign switches, internally located

pad switch for selecting line or microphone output level and recessed stereo line input mono switches with position indicators. In addition, each of the front panel level control knobs may be removed and replaced with a security plug. Four security plugs shall be provided for this purpose.

5. The unit shall be capable of operation by means of its own building-in universal power supply operating at 100-240 VAC and meet CD requirements. The unit shall be UL listed.

6. Technical

- a. Mic Inputs: Type Active balanced

- 1) Connectors (Mic/Line) XLR
- 2) Input Imped. (Mic/Line) 1k/96k $\pm 1\%$
- 3) Gain Range (Mic): off to +60 ± 1.5 dB
- 4) Gain Range (Line): off to +20 ± 1.5 dB
- 5) Frequency Response 30 Hz-35 kHz, -3 dB
- 6) Equivalent Input Noise -128 max dBu
- 7) THD+N 0.02 typ
- 8) Maximum Input: 11.9 dBu; 38.6 dBu at Mic Level

- b. Balanced Outputs: Type Active balanced ¼" TRS and XLR connectors

- 1) Output Imped. (Mic/Line) 200/100
- 2) Gain Range: off to +6
- 3) Drive Level: +24 dBu

- c. Phantom Power: +15 VDC

- d. Crosstalk: -75 @ 1 kHz

- e. Unit: Agency Listing UL/cUL/CE

7. Manufacturers

- a. Basis of Design

- 1) Rane MLM 82S Mic/Line Mixer

- b. Acceptable Substitutions

- 1) Ashly
- 2) Biamp

- I. Room Combining System

1. General

- a. The Room Combining System shall be designed for Conference Centers, Hotels, Country Clubs, and any facility where user control of program and background audio is required. It shall control up to sixteen (16) rooms and be controlled via 3 gang wall mounted plates. The wall plates shall fit in standard wall boxes that accommodate a 2.5" maximum depth.
 - b. The Room Combining System shall be provided with all equipment and materials necessary for a complete and fully functional system including but not limited to:
 - 1) Audio Control Unit w/ Custom Graphic Panel
 - 2) Music/Page Module
 - 3) Wall Plates in each Meeting and Exhibition Hall Room
 - 4) Power Supplies
 - 5) Monitor/VU Panel Assembly
 - 6) Monitor Relay Cards
 - 7) Head Table Speaker Assembly
 - 8) Head Table Relay Card
 - 9) Other equipment and materials as necessary
 - c. The system shall feature in-room control wall plates to operate microphone (on or off), background music (on or off), and a volume control for the mic and music audio levels.
 - d. A standard 19" rack mountable main control unit shall be provided and shall be the central wiring point for the wall plates, preamplifiers, amplifiers and power supply.
 - e. The main control unit shall be provided with a custom graphic control panel including room names, colored LED indicators or mic and music status, and switches to accomplishing the room combining functions.
2. Features
- a. Choose from 1 to 4 background music sources
 - b. One audio control rack unit is capable of combining 16-rooms of audio with the touch of a button
 - c. Membrane-type wall plates
 - d. Complete paging capability
 - e. Operates with any mixer and amplifier
3. Technical
- a. Audio Control Unit (ACU)
 - 1) Audio Connections RA2 Module (one per two rooms)
 - a) Inputs: Electronically balanced 20K Impedance (unbalanced 10K) 3-pin screw terminals

- b) Outputs: 600 Ohm transformer coupled (balanced 3-pin screw terminals)
 - 2) Audio Connections: MP Module (music/page module)
 - a) Inputs: 600 Ohm transformer coupled (balanced 3-pin screw terminals)
 - b) System Level Adjust Range: +7 dB to -20 dB
 - 3) Input Trim Level Adjust Range: (Page and Music input level adjust trim pots) +2.5 to -7.5 dB
 - 4) Tie Line Output: 600 Ohm transformer coupled (balanced 3-pin screw terminals)
 - 5) Audio Gain:
 - a) Music Volume Reset: 0 dB \pm 1 dB
 - b) Music Full Down: -18 dB \pm 1 dB
 - c) Music Full Up: +4 dB \pm 0.5 dB
 - d) Local Input Volume Reset: 0 dB \pm 1 dB
 - e) Local Full Down: -18 dB \pm 1 dB
 - f) Local Full Up: +4 dB \pm 0.5 dB
 - g) Page Input: 0 dB \pm 1 dB
 - h) Maximum Output Level: +20dBm
 - 6) Noise Floor: -75 dBm typical
 - 7) Crosstalk: -85 dB typical
 - 8) Rack Mountable
- b. Wall Plates
 - 1) Fits standard 2 or 3 gang electrical wall box with four or six screws
 - 2) Switches: Membrane
 - 3) Connector: 5-pin connector
 - 4) Cable: 2-pair Shielded
- c. Power Supply:
 - 1) Mounting: Rear Rack Rail
 - 2) Output: +15 volts, +25 volts, -25 volts nom.
 - 3) Fuse: 2 amp
 - 4) Switch: Power On/Off (lighted rocker switch)
 - 5) Indicators: Three (3) LED indicators
- d. Monitor/VU Panel
 - 1) Input: 70 V speaker level

4. The Contractor shall provide a draft of the custom graphic control panel from the equipment manufacturer for review prior to ordering any equipment. The draft shall be provided in PDF format and shall include information indicating that it is specifically for this project. The draft will be reviewed by the Designer and the Owner. The Contractor shall not order equipment until he has received approval in writing from the Designer that the draft is acceptable. The Contractor shall submit the draft of the custom panel no later than with his submittals as outlined above.
 5. Manufacturers
 - a. Basis of Design
 - 1) FSR ML-116 Ballroom Combining System or acceptable substitution
 - b. Acceptable Substitution
 - 1) Biamp with a Crestron Control System
- J. Digital Signal Processor (DSP)
1. The DSP speaker processor shall provide four balanced line inputs and eight balanced line outputs on plug-in barrier-strip connectors. Inputs and outputs shall be analog, with internal 24-bit A/D & D/A converters operating at a sample rate of 48kHz. All internal processing shall be digital (DSP). Connections shall allow sharing of digital audio within multi-unit systems. Software shall be provided for creating/connecting DSP system components within each hardware unit. Available system components shall include (but not be limited to) various forms of: mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, and diagnostics. Ethernet communications shall be utilized for software control and configuration. After initial programming, processors may be controlled via dedicated software screens, third-party RS-232 control systems, and/or optional remote control devices. Software shall operate on a PC computer, with network card installed, running Windows® XP Professional/Vista. The DSP speaker processor shall be CE marked, UL listed, and shall incorporate AES48-2005 Grounding & EMC practices. The DSP speaker processor shall be compliant with EU Directive 2002/95/EC, the RoHS directive. Warranty shall be 5 years.
 2. Features
 - a. 4 balanced line inputs on plug-in barrier strips
 - b. 8 balanced outputs on plug-in barrier strips
 - c. Ethernet port for software configuration/control
 - d. Serial port for third-party RS-232 remote control
 - e. Remote control bus for dedicated control panels

- f. Link ports for multi-unit system design
- g. Software for Windows® XP Professional/Vista
- h. Pre-configured I/O with definable processing
- i. Mix, route, combine, EQ, delay, control, etc.
- j. RoHS compliance and AES grounding practices
- k. CE marked and UL listed
- l. Five-year warranty
- m. Ability to select, view, and calibrate:
 - 1) Mixers: standard, automatic, matrix, combiners
 - 2) Equalizers: graphic, parametric, feedback
 - 3) Filters: HPF, LPF, high shelf, low shelf, all-pass
 - 4) Crossovers: 2-Way, 3-Way and 4-way
 - 5) Dynamics: leveler, comp/limiter, ducker, ANC
 - 6) Routers: 2x1 ~ 32x32
 - 7) Delays: 0 ~ 2000 ms
 - 8) Controls: levels, presets, logic, RS-232, etc.
 - 9) Meters: signal present, peak, RMS
 - 10) Generators: tone, pink-noise, white-noise
 - 11) Diagnostics: transfer function

3. Technical

- a. Frequency Response (20 Hz ~ 20 kHz @ +4 dBu): +0/-0.4 dB
- b. THD +N (20 Hz ~ 20 kHz @ +4 dBu): <0.007%
- c. Dynamic Range (20 Hz ~ 20 kHz, 0 dB): >105 dB
- d. Maximum Gain (mic Input to line output): 18 dB
- e. Crosstalk (channel-to-channel @ 1 kHz): <-80 dB
- f. Input Impedance: 15k Ohms
- g. Maximum Input +24 dBu
- h. Input Gain Range (variable): 0 dB ~ +18 dB
- i. Output Impedance (balanced): 200 ohms
- j. Maximum Output (balanced): +24 dBu
- k. Full Scale Output Level (five selections): 0 dBu ~ +24 dBu
- l. Sampling Rate: 48 kHz
- m. A/D – D/A Converters: 24-bit
- n. Phantom Power: +48 VDC (7 mA/input)
- o. Power Consumption: 65 watts
- p. Compliance:
 - 1) AES 48-2005 Grounding & EMC practices
 - 2) EU Directive 2002/95/EC, RoHS directive
 - 3) CE Marked
 - 4) UL Listed.

4. Manufacturers

- a. Basis of Design

- 1) Biamp Nexia SP Speaker Processor
- b. Acceptable Substitutions
 - 1) Soundweb
 - 2) Peavey Mediamatrix
- K. Assisted Listening System
 1. Transmitter
 - a. The FM Transmitter shall be designed to provide auditory assistance in both personal and group situations. It operates on the 17 narrow-band channels in the 72-76 MHz band. The base FM transmitter is rack mountable and accepts balanced and unbalanced audio inputs. It runs from a wall plug 12 VAC transformer and includes a detachable telescoping ¼ wave antenna.
 - b. System Components
 - 1) The FM Transmitter shall transmit 17 FCC-approved narrow band frequencies (in the 72-76 MHz radio band) available for the transmitter. The transmitter must identify numerically with a back lit LCD indicator the designated radio channel being transmitted.
 - 2) The FM Transmitter shall accept unbalanced line level, balanced microphone level and 70 Volt distributed audio sources.
 - 3) The transmitter shall have Enhanced Dynamic Range (E.D.R.) feature to improve Signal to Noise and audio quality when used with the SR-400 in E.D.R. mode.
 - 4) The FM Transmitter shall have Normal and High RF transmitter settings.
 - 5) The FM Transmitter shall have an on/off power switch.
 - 6) The FM Transmitter LCD shall be backlit to indicate "on" status.
 - 7) The FM Transmitter shall be mountable in a 19 inch equipment rack.
 - 8) The FM Transmitter shall have a three year parts and labor warranty.
 - c. Technical
 - 1) Audio Input Characteristics: XLR-3F Balanced, ¼ inch unbalanced.
 - 2) Antenna: detachable ¼ wave telescoping
 - 3) Modulation: FM, +/- 25 KHz deviation
 - 4) Frequency Response (System): 100 Hz to 10,000 Hz

- 5) Automatic Gain Control Range: 30 dB
- 6) System Signal to Noise: 58 dB, > 77 dB with E.D.R.
- 7) Preemphasis: 100 micro seconds
- 8) Maximum Power: 80K micro Volt/m @ 3 m (25K micro V/m in Normal)
- 9) Power Requirements: 13-20 Vdc or 12 Vac; 115Vac 60 Hz @ 300 mA plug-in wallpack power supply

2. Receiver

a. General Description

- 1) The Personal FM Receiver shall be designed for use in auditory assistance and personal communication applications. The Personal FM Receiver provides amplification for mild to severe hearing losses. Persons with normal hearing, when used with an appropriate listening accessory may also use the Personal FM receiver.
- 2) The Multi-Channel Personal FM Receiver shall feature an advanced digital PLL synthesizer which makes 17 narrow band hearing assistance channels in the 72-76 MHz range available in one unit. The current channel must be displayed on a back lit LCD display.

b. Multi-Channel Personal FM Receiver

- 1) Shall have seventeen-channel synthesized user adjustable.
- 2) Shall have a high frequency boost filter accessible by a push button switch. This filter shall increase intelligibility of the audio signal, providing additional assistance for individuals with reduced high frequency sensitivity and for users wearing earphones with limited audio response.
- 3) Shall have Enhanced Dynamic Range (E.D.R.) feature to improve the signal to noise ratio and audio quality.
- 4) Shall have an advanced synthesized design which eliminates channel drift.
- 5) Shall have top mounted, tactile-feel controls to make operating any function easy.
- 6) Shall have power saving feature which automatically shuts off power when the earphone, headset, or neckloop is removed.
- 7) The Personal FM Receiver shall run on 2 AA-size alkaline batteries (20 hrs. continuous use), or 2 Ni-MH batteries (14 hrs. continuous use).
- 8) Earphone jack shall accept any standard 3.5 mm (0.138 inch) mini stereo or mono earphone/headphone.

- 9) The Personal FM Receiver shall have a three year parts and labor warranty.

c. Technical

- 1) RF Frequency Range: 72.1 - 75.9 MHz
- 2) Audio Response: 100 - 10,000 Hz +/- 3 dB
- 3) Modulation: FM, +/- 25 KHz deviation
- 4) Harmonic & Spurious Emissions: Meets FCC part 15
- 5) Sensitivity: 0.5 μ v typical, 1.0 μ v maximum, 12 dB SINAD @ 25 KHz deviation
- 6) Image Rejection: >65 dB
- 7) Signal-to-Noise Ratio: >65 dB, >77 dB with E.D.R.
- 8) Distortion: <2% T.H.D.
- 9) Audio Output: @10% distortion ----- Into 8 Ohms--48 mW
Into 32 Ohms--30 mW
- 10) Antenna Type: 1/4 wave omni-directional, in earphone cord
- 11) Batteries: 2 AA-size alkaline (20 hrs. continuous use), or 2 Ni-MH (14 hrs. continuous use)
- 12) Audio Controls: Volume, On/Off, High Frequency Boost (push-on type)
- 13) Earphone Connector Type: 3.5 mm (0.138 inch) mini stereo or mono
- 14) Channels Tuned: 72.1, 72.2, 72.3, 72.4, 72.5, 72.6, 72.7, 72.8, 72.9, 74.7, 75.3, 75.4, 75.5, 75.6, 75.7, 75.8, 75.9

3. The system shall be provided with

- a. An antenna connector kit that the Installer can use to field assemble the antenna cable using coaxial cable as specified by the equipment manufacturer.
- b. An antenna.
- c. All required cables.
- d. One (1) minimum twelve (12) receiver charging unit.

4. The Contractor shall accomplish a factory scan of the installation site to determine the proper frequencies for the system (transmitter and receiver).

5. The Contractor shall provide and install the Assisted Listening System with all accessories required for the complete and fully functional system within this specific facility. The accessories shall include but not be limited to an Antenna Splitter and Mounting package and Boosters for proper receipt of signals from remote antennas. The Contractor shall provide a block diagram as part of his Submittals that identifies all equipment and materials, as well as the specific installed location for each, to confirm the system configuration to be installed as part of this

project. The Contractor shall coordinate with the Manufacturer prior to providing Submittals for review.

6. Provide and install two (2) transmitters.
7. Provide and install ten (10) receivers.
8. Manufacturers

a. Basis of Design

- 1) Telex Soundmate Personal Listening System with ST-300 Transmitter and SR-400 Receivers

b. Acceptable Substitutions

- 1) Williams Sound
- 2) Phonic Ear

L. Power Audio Amplifiers:

1. The power amplifier shall be a solid-state eight-channel model employing Multi-Mode® (AB+B) output circuitry.
2. The amplifier shall contain protection from shorted, open and mismatched loads, general overheating, DC, high-frequency overloads, under/over voltage, and internal faults.
3. The amplifier shall contain FIT (Fault Isolation Topology), which isolates channel-specific faults and prevents them from affecting remaining channels.
4. If an amplifier channel starts to overheat, the Thermal Level Control (TLC) circuit shall engage that channel's input compressor in an amount proportional to the amount of overheating, in order to generate less heat. If the channel becomes too hot for safe operation, the channel shall shut off, and the Thermal Indicator for that channel shall flash brightly to alert the user that a state of thermal stress or overload has caused the channel to shut down.
5. The front-panel control shall be a power switch.
6. Rear-mounted controls shall include Channel Level Controls and a Mode Switch. The Mode Switch (used on each consecutive pair of channels) is a four-position switch which selects among Dual 8/4 ohms, Dual 70V, Bridge-Mono 16/8 ohms, and Bridge-Mono 100V.
7. The recommended load impedance in Dual mode shall be 4/8 and 25 ohms (70V). The load impedance in Bridge-Mono mode shall be 8/16 ohms and 50 ohms (100V). The amplifier shall be safe when driving any kind of load, including highly reactive ones.
8. Rear-mounted output connectors shall be one four-pole terminal strip for every two channels with a touch-proof cover. Rear-mounted input connectors shall be removable Phoenix-style barrier connectors for balanced input.
9. Front panel indicators shall include a yellow Bridge-Mode Indicator (one per channel pair) that illuminates when the channel pair's Mode Switch

is set to the "Bridge" position (and flashes if the Mode Switch is changed while the amplifier is powered up, indicating that the amplifier must be powered off and on to reset the Mode), a green Ready Indicator (one per channel) that illuminates when the channel is initialized and ready to produce audio output, a green Signal Indicator (one per channel) that illuminates to indicate the presence of input signals above -40 dBu, a red Clip Indicator that illuminates when the THD of the channel's output signal rises to a level typically considered as the onset of audible clipping (and illuminates during Thermal Level Control or input overload), a red Thermal Indicator (one per channel) that flashes when a state of thermal stress or overload has caused the channel to shut down (and flashes in all channels if the power supply goes into thermal overload), a red Fault Indicator (one per channel) that flashes when a fault condition has occurred in the channel, and a blue Power Indicator that illuminates when the amplifier has been turned on and AC power is available (and illuminates when the amplifier shuts off due to an under-/over-voltage condition on the AC mains).

10. The power amplifier shall meet or exceed the following performance criteria. Input sensitivity for rated output: 1.4 V. Rated output with eight channels driven in Dual mode with 0.1% THD (20 Hz to 20 kHz): 175 watts per channel into 4 ohms; 155 watts per channel into 8 ohms, and 185 watts per channel (70V). Rated output in Bridge-Mono mode with four channel pairs driven at 0.1% THD (20 Hz to 20 kHz): 350 watts per channel pair into 8 ohms; 310 watts per channel pair into 16 ohms, and 185 watts per channel pair (100V). Signal to Noise Ratio below rated power (20 Hz to 20 kHz): 100 dB unweighted. Phase Response: ± 35 degrees from 10 Hz to 20 kHz at 1 watt. Frequency Response: 20 Hz to 20 kHz, ± 0.5 dB at 1 watt into 8 ohms per channel in Dual mode. Damping Factor: greater than 180 from 10 to 400 Hz. Crosstalk (below rated power, 20 Hz to 1 kHz): greater than 80 dB. Intermodulation Distortion (60 Hz and 7 kHz at 4:1, from 163 milliwatts to full bandwidth power): less than 0.05% typical. Total Harmonic Distortion at 1 watt from 20 Hz to 20 kHz: less than 0.05%. Common Mode Rejection (20 Hz to 1 kHz): greater than 50 dB. DC Output Offset (shorted input): less than 5 mV. Maximum Input Level (before input compression): + 22 dBu rms. Power Draw at Idle (120 VAC mains, all channels in 4/8 ohm mode): 58 watts. Power Draw at Idle (120 VAC mains, all channels in 70V mode): 77 watts.
11. The amplifier chassis shall be constructed of steel with a durable black finish and shall be designed for continuously variable-speed forced-air ventilation from the front panel to the back panel.
12. The dimensions of the amplifier shall allow for 19 inch (48.3 cm) EIA standard (RS-310-B) rack mounting.
13. The amplifier shall be 5.25 inches (13.3 cm) tall, and 16.25 inches (41.3 cm) deep behind the rack-mounting surface.
14. Manufacturers
 - a. Basis of Design

1) Crown CTs 8200 eight channel Power Audio Amplifier

b. Acceptable Substitution

1) QSC

2) EV

M. Flush Interior Ceiling Speakers

1. System shall include a high performance 4" coaxial loudspeaker, ported bass reflex enclosure and press-fit grille for conventional ceiling installation.
2. Frequency response for the system shall be 75Hz – 20kHz (± 7 dB). Sensitivity shall be 88dB average. Loudspeaker shall be comprised of a 4" coaxial cone driver constructed of polypropylene with a butyl rubber surround. The 19mm tweeter shall be constructed of PEI. Magnet shall be a minimum of 10oz. (283g) and the voice coil diameter shall be 1" (25mm).
3. Transformer shall be a 70.7V / 100V type with 1, 2, 4, 8, and 16 watt primary taps (@70.7V) with a front mounted tap selector switch to include a transformer bypass setting for 8 Ω / direct coupled operation.
4. Enclosure shall be a deep drawn steel enclosure design. Internal volume shall be 285 in³. To facilitate connection in conduit systems, enclosure shall be equipped with an access panel covering a recessed terminal cup. This cover shall provide a combination 3/4" (19mm inside diameter) / 1" (25mm inside diameter) knock-out on the side access and a top access compression fitting / strain relief to facilitate flexible conduit up to 22mm outside diameter or 1" (25mm inside diameter) conduit when the compression fitting is removed.
5. External wiring shall be accomplished via a removable lockable wiring connector with screw-down terminals to provide both secure wire termination and pre-wiring capability before loudspeaker installation. The 4-pole locking connector shall facilitate in / out connections and shall be located in the recessed area behind the conduit access panel.
6. Seismic support eye shall be provided on top of enclosure for additional suspension point when used in drop tile ceilings. Construction of enclosure shall be a minimum of 18-gauge, deep drawn galvanized metal.
7. The system shall include a support backing plate to reinforce the ceiling material and tile support rails for use on either 2' x 4' (609mm x 1219mm) or 2' x 2' (609mm x 609mm) suspended ceiling tiles. This assembly can all be installed from beneath the ceiling tile.
8. Overall front face diameter shall not exceed 10 1/2" (267mm); overall depth from the bottom of the ceiling shall not exceed 8 7/8" (225mm). Grilles shall be press-fit, manufactured from 24-gauge perforated steel mesh and finished in white epoxy. Round grille shall be 8 7/16" (214mm) diameter.
9. Technical

- a. Woofer Size: 4"
- b. Power Handling: 24 Watts
- c. Sensitivity (1W/1M): 88 dB Average
- d. Frequency Response: 75 Hz to 20 kHs (+/- 3 dB)
- e. Magnet Weight: 10 oz.
- f. Woofer: 4" Poly Cone with Butyl Rubber Surround
- g. HF Driver: Coaxially Mounted PEI Dome Tweeter

10. Manufacturers

- a. Basis of Design
 - 1) Atlas Sound FAP42T Series
- b. Acceptable Substitution
 - 1) JBL
 - 2) EV

2.3 CABLE

A. Microphone Cable:

- 1. Two (2) conductor, 20 (7 x 28) AWG, tinned copper, 10.5 ohm per 1000 feet, PVC jacket with nominal O.D. of .245 inch, Tinned copper braid (95%) shield (8.5 ohm per 1000 feet).
- 2. Manufacturers
 - a. Basis of Design
 - 1) West Penn #535
 - b. Acceptable Substitutions
 - 1) Belden
 - 2) CommScope

B. Line Level Cable:

- 1. The line level cable shall be a power-limited type suitable for sound and audio applications.
- 2. Two (2) conductor, 22 AWG Solid, tinned copper, 17.5 ohm per 1000 feet, overall 75 degree PVC jacket with a nominal O.D. of .118 inch, 22 AWG solid drain wire. UL Listed NEC Type CM; constructed in accordance with UL Standard 444; complies with UL 1581 Vertical Tray Flame Test; meets 300 volt requirements as specified in Section 800-51 of the NEC.
- 3. Manufacturers

- a. Basis of Design
 - 1) West Penn #450
 - b. Acceptable Substitutions
 - 1) Belden
 - 2) CommScope
- C. Speaker Cable:
- 1. The speaker cable shall be a power-limited type suitable for sound and audio applications.
 - 2. Two (2) conductor minimum 16 AWG, UL Listed NEC type CL2, complying with UL 1581 Vertical Tray Flame Test, bare copper, nominal DCR of 4.2 Ohms per 1000 feet, with PVC insulation with nylon, and short overall twist lengths.
 - 3. The Contractor shall increase the size of speaker cables as necessary for the connected speaker load.
 - 4. Manufacturers
 - a. Basis of Design
 - 1) West Penn #C205
 - b. Acceptable Substitutions
 - 1) Belden
 - 2) CommScope
- D. Control (Room Combining System)
- 1. The Room Combining System Control cable shall be an 18 AW, 2 Pair stranded bare copper conductor, shielded with an overall jacket. The cable shall be CMR rated in accordance with NEC Article 800. The cable shall be UL listed and shall be suitable for Sound, Audio, and Power Limited Control circuits.
 - 2. Construction
 - a. Conductor: 18 AWG bare copper
 - b. Stranding: 7x 26
 - c. Insulation Material: PCC
 - d. Insulation Thickness: 0.008" nom.
 - e. Number of Conductors: Four (4) – 2 pairs
 - f. Shield: Overall 100% Aluminum Foil
 - g. Drain: Stranded Tinned Copper
 - h. Jacket Material: PVC
 - i. Jacket Thickness: 0.017" nom.

- j. Overall Cable Diameter: 0.261" nom.
 - k. Flame Rating: UL 1666 Riser Flame Test.
3. Electrical Properties
- a. Temperature Rating: -20°C to +60°C
 - b. Operating Voltage: 300 V RMS
 - c. Max. Capacitance between Conductors; 68 pF/ft nom.
 - d. DC Resistance per Conductor +20°C: 10.5 Ohms/1 M' nom.
 - e. RoHS Compliant: Yes.
4. Mechanical Properties
- a. Max Recommended Pull Tension: 103.6 lbs.
 - b. Min Bend Radius (Install): 2.5"
5. Where installed in plenum spaces cable shall be plenum rated.
6. Where installed in wet locations cable shall be rated for wet locations.
7. Manufacturers
- a. Basis of Design
 - 1) West Penn #3571
 - b. Acceptable Substitutions
 - 1) Belden
 - 2) CommScope

PART 3 - EXECUTION

3.1 Comply with the requirements of Section 16701.

3.2 Labels

A. General

- 1. All equipment, control and system cabling shall be provided with permanent descriptive labels.
- 2. The Contractor shall provide samples of labeling with his submittals for review by the Designer.
- 3. Equipment and cable labels shall be noted on the Contractor's as-built drawings exactly as they are installed on the equipment or cables.

B. Equipment

1. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.
 2. All custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to Designer for review and approval prior to fabrication or final installation. The Contractor shall modify labeling as required by the Designer.
- C. Outlet Plates
1. Shall be installed level and flush with the mounting surface.
- D. Cables
1. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:
 - a. Signal type shall be either plain English or represented by the following designators
 - 1) M = microphone level audio
 - 2) L = line level audio
 - 3) S = speaker level audio
 - 4) +C = Control
 - b. Room number where other end of cable is terminated
 - c. Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
 - d. Room numbers shall coincide with numbering scheme included in contract documents.
 - e. Device identifier where other end of cable is terminated
 - f. Device identifier shall provide a clear indication of device connected to (i.e. VCR 1, slide-to-video, projector 1, speaker zone A, microphone outlet 5, etc.)

3.3 TESTING

- A. Comply with Section 16701 "Common Work Results for Communications"
- B. Audio
 1. Equalization
 - a. The purpose of the equalization is to adjust the acoustic amplitude response of the Audio system to a specified uniformity

- measured throughout the entire audience area. This adjustment is made to realize maximum acoustic gain and optimum tonal balance from the Audio system throughout the audience area and stage monitoring area.
- b. Instrumentation: Provide the following minimal standard laboratory test equipment. Any substitutions or additions to the following list must be accepted by the Designer.
- 1) Impedance Bridge.
 - 2) Audio Oscillator.
 - 3) Random-noise generator.
 - 4) Precision sound level meter.
 - 5) Octave real-time audio frequency analyzer.
 - 6) Oscilloscope.
 - 7) Sound level calibrator.
 - 8) Master equalizer set with broad band (i.e. full octave) and narrow band (i.e. 1/3 octave), high-pass, and low-pass filters, plus comparator switch and attenuator.
 - 9) Digital camera.
- c. Inspection of Audio System Prior to Equalization:
- 1) Prior to undertaking equalization of the Audio System, perform the following inspections on the Audio System, and submit to the Designer the written results of each inspection for inclusion on the permanent records of the Audio System.
 - 2) Measure and record the impedance of each loudspeaker line before connecting it to the output of its respective amplifier. The load impedance shall be equal to or greater than the rated impedance. Record the total impedance.
 - 3) Measure and record the output impedance of each active device operating as a source to any passive device or series of passive devices. Record the dc resistance of any buildout resistor used.
 - 4) Measure and record the input impedance of any active device used to terminate passive devices, and record the total impedance of all such devices. Record the dc resistance of any terminating resistor used.
 - 5) Measure and record the acoustic distribution of the loudspeakers in the Audio System throughout the entire seating area. Record the location of all positions in the seating area where any 1/3 octave band, from 250 to 5000 Hz. deviates more than #3 dB from the desired house curve.
 - 6) Measure and record the polarity of all microphones to be used in the system.

- 7) Measure and record, with an oscilloscope, the output of each power amplifier. The input source to each amplifier being measured shall be a sinewave oscillator with less than 0.5% THD adjusted to 10 dB less than full power output of the amplifier. Inspect the output sinewave appearing on the oscilloscope of complete freedom from hum, noise, parasitic oscillation and RF interference.
 - 8) Measure and record the frequency response of each mixer preamplifier and power amplifier in the system.
- d. House-Curve Equalization: Temporarily install the master equalizer set in the appropriate link circuit in the Audio System. Use pink noise as a source signal, and place a calibrated measuring microphone in the radiation area at twice the critical distance (2dc). (Critical distance is defined as that distance from the sound source at which the direct sound from the source and the reverberation sound are in a ratio of one to one.) The acoustic amplitude response that appears on the screen to the real-time spectrum analyzer shall be recorded. Point-to-point measurements, averaging estimates, and other non-real-time dynamic measurements shall be unacceptable under this specification. After the unequalized acoustic amplitude response is recorded, the master equalizer set shall be used to bring the observed acoustic amplitude with +3 dB uniformity (or better, if possible) and to conform to the predetermined high frequency roll-off detected by the combination effect of humidity, air absorption, and the random incidence of the measuring microphone. The equalized house curve shall be recorded.
- 1) Control of Microphone Characteristics and Preferred Feedback Frequencies: Install the required filters in the link circuit ahead of the power amplifier input; then reconnect the master equalizer set in the link circuit following the microphone mixer amplifier. The Audio System gain shall be adjusted until it reaches regeneration (feedback). Determine the frequency of regeneration by observing the response of the real-time audio spectrum analyzer, and adjust the appropriate filter until the observed regeneration ceases.
 - 2) Microphone Proximity Instability: Suppress the tendency of the Audio system microphone to become unstable when approached by a talker. Identify the 1/3 octave band affected by the approach of a person, and provide enough attenuation to ensure stability. Records shall be made of additional attenuation provided.
- e. Documentation of Tests, Measurements, and Adjustments Performed:

- 1) List of personnel and certified test equipment used.
- 2) Impedance of all loudspeaker lines.
- 3) Output impedance of all active sources connected to passive devices and the value of any buildout resistor used.
- 4) The input impedance of all active devices used to terminate passive devices and the value of any termination resistor used.
- 5) The variation of acoustic distribution throughout the seating area above and below a reference level at each 1/3 octave center frequency from 20 to 5000 Hz.
- 6) The recorded polarity of the loudspeakers.
- 7) The documented information for all settings in the audio mixer / processor.
- 8) The list of microphones tested.
- 9) The recorded inspection results observed for hum, noise, parasitic oscillation, and RF interference from the output of each power amplifier.
- 10) The unequalized house curve made with the measuring microphone.
- 11) The electrical response of the house-curve filters without the microphone filters.
- 12) The electrical response of the house-curve filters with the microphone filters.
- 13) The unequalized house curve made with the Audio System microphone.
- 14) The proximity frequencies and attenuations
- 15) All filter settings.
- 16) The factors Dc, %ALcons, D1, Ds, D2, D0, NAG, PAG, EAD and EPR for the Audio System and the room:
- 17) Dc = Critical distance
- 18) %ALcons = $656D22RT602/VQ$
- 19) D0 = Distance from the talker to the farthest listener
- 20) D1 = Distance from the microphone to the nearest loudspeaker
- 21) Ds = Distance from the microphone to the talker
- 22) D2 = Distance from the loudspeaker to the farthest listener
- 23) NAG = Needed acoustic gain
- 24) PAG = Potential acoustic gain
- 25) EAD = Equivalent acoustic distance
- 26) EPR = Electrical power required
- 27) Q = Directivity of the loudspeaker
- 28) RT60 = Reverberation time
- 29) V = Volume of room in cubic feet

f. Equalization Filters:

- 1) No filters shall be accepted that are not constant-K, 600 ohm filters. Any filter whose impedance changes at its resonant frequency will not be accepted.
 - 2) Active circuit equalizers of the minimum phase band rejection type may be substituted for the constant K passive type.
- g. Upon completion of all equalization adjustments the Contractor shall permanently, in a highly professional manner, mark the equalizer with the final settings. This marking shall be permanent, highly visible and shall not damage the surface of the equalizer.

C. Control

1. Accomplish full operational test of the system to verify all system programming is correct and functions as intended.

END OF SECTION 16741

SECTION 16751
VIDEO SYSTEMS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 "Common Work Results for Communications".
- B. In addition to the requirements of Section 16701 comply with the following requirements:
 - 1. Standards, Codes, References, And Regulatory Requirements
 - a. The equipment and installation shall comply with the current or applicable provisions of the following standards, codes, references, and regulatory requirements:
 - b. Sound System Engineering by Don & Carolyn Davis (2nd Edition, Published by Howard W. Sams & Co., Inc.)
 - 1) UL 813 - Commercial Audio Equipment
 - 2) UL 1410 - Television Receivers and High-Voltage Video Products
 - 3) UL 1419 - Professional Video and Audio Equipment
 - 4) UL 1492 - Audio-Video Products and Accessories
 - 2. Submittals
 - a. Shop Drawings: The Contractor shall provide complete shop drawings showing how he intends to install the Video System (hereinafter referred to as the "system"). Shop drawings shall, as a minimum, include the following:
 - 1) A point-to-point wiring diagram showing:
 - a) All system equipment, cabling, interconnections to other systems, etc.
 - b) Identifiers for the various types of cable to be used. This shall include a matrix that identifies the manufacturer, model number and descriptive identifier for each cable
 - c) Quantity of cables in each conduit
 - d) Signal type: Provide signal type designation on all cables. Signal type shall be identified in a fashion similar to that on the contract drawings (e.g.

RGBHV, S-Video, Composite, etc. for video, and data, RS-232, etc. for control).

- 2) A block diagram for the system showing all equipment and the intended installation location for each as outlined below.
- 3) A plan showing how the Contractor intends on installing system conduits to provide an organized layout for separation of conduits by signal type and signal level.
- 4) A front elevation view of the Equipment Cabinets showing all rack mounted and shelf mounted equipment. A rear elevation view of the Equipment Cabinets showing all non-rack mounted and shelf mounted equipment. The Contractor shall show full coordination of the system equipment with equipment and materials provided as part of another section (e.g. Section 16741 – Sound Reinforcement System, etc.)
- 5) Plan view drawings for the Equipment Cabinets showing cable entrance areas for the various signal types and levels (i.e. video, control, etc.). If necessary, the Contractor shall show both bottom and top plan views in order to clearly show how cables enter cabinets and maintain proper separation.
- 6) Draft of the custom graphic control panel for the Room Combining System. Draft shall be provided with both hard-copy and PDF electronic copy.
- 7) Completed forms prepared by the Contractor and ready to be sent to the manufacturer for engraving requirements for all system outlet plate (wall and floor box) modular connector inserts.

3. Spare Capacity

- a. The Contractor shall provide and install system equipment and materials in quantities that will provide the Owner with twenty percent (20%) spare capacity (e.g. termination points, jacks, ports, etc.) after connection of all circuits as required by the contract documents.

4. Extra Materials

- a. Provide two (2) extra of each type of system patch cord.

1.2 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete Video System, as described herein and shown on the drawings, providing the following:

1. The pickup, routing, and distribution of audio program material from various audio and video sources.
2. The pickup, processing, distribution, and reproduction of video program material from various video sources.

1.3 FUNCTIONS AND OBJECTIVES

- A. The design and configuration of the system as installed shall allow all source signals to be routed to all target devices. The contractor shall program the system in a manner that allows all control points in the system to view any source in the system.
1. Video
 - a. Provide video capture from source devices
 - b. Provide video distribution to target devices
 - c. Provide routing and switching as necessary to send video signals through system to and from various points to meet the design intent.
 - d. Provide video distribution to remote locations as indicated in the drawings and outlined within these specifications.
 - e. Provide routing and switching of audio signals as required for interfacing the Video System with the Audio System.
 2. Audio
 - a. Provide audio routing and distribution to various locations both local and remote.
- B. The system as shown on the drawings and described herein interconnects to a variety of systems either outlined in other specification sections or provided and installed by the owner. The Installer shall be responsible for providing all equipment, cabling, patch cords and other materials necessary to transfer signals from those other systems to this system at the other system's primary equipment location unless specifically noted otherwise. The Installer shall coordinate the work of this section for the location where required signals of other systems are to be obtained and provide all equipment and materials necessary to do so. The documents describe as fully as possible the signal types and locations for these other systems. However, the Installer is ultimately responsible for providing the interconnection and processing of signals as necessary for the proper operation of the system.

PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT AND MATERIALS

- A. Floor Mount Equipment Cabinet

1. Base shall be constructed of double formed front and rear sections; MIG welded and reinforced with 11 gauge CRS corner caster gussets. Vertical columns shall interlock with frame top and base.
2. Base shall include four (4) 3/8-16 threaded sockets for installation of levelers. Base shall also have provisions to be permanently secured to the floor.
3. Mounting rail channel support members shall be multi-formed and MIG welded for interlocking support.
4. Panel mounting rails shall be fully adjustable front to rear. Rails shall be formed from 14 gauge CRS, zinc plated and punched on EIA pattern with .281 diameter holes on 5/8" - 5/8" - 1/2" continuous centers (2 pair supplied).
5. Manufactured to EIA standards.
6. 22.31" Width by 25" Depth by 83.125" Height with 61.25" panel mounting space.
7. Front and rear access to equipment.
8. Shall include side panels.
9. Shall include metal louvered rear door.
10. Shall include surface mount plexi-glass front door.
11. Door shall include cylinder lock, lift-pull handle, and quick release hinges.
12. Color shall be black.
13. Provide all panels as required to mount equipment, including panel for power strip and filler panels. Filler panels shall be installed to allow future addition of equipment without the need for the Owner to maintain a stock of filler panels in a separate location. Filler panels larger than three (3) racks spaces shall not be acceptable.
14. Top and bottom rack units shall be vent panels. Other spaces shall be provided with blank or vent panels as shown on the drawings.
15. Provide, in each equipment cabinet, one (1) fan tray assembly with two (2) 115 CFM fans.
16. Provide ground bus full height minus six (6) inches. Mount to back of equipment cabinet. Connect to Systems ground bus bar.
17. Provide all brackets to mount non-rack mountable equipment.
18. Provide all hardware, supports, etc. as required to mount/house all equipment called for and/or shown at each location.
19. Provide additional shelves as required for each piece of equipment mounted in cabinet that requires a shelf.
20. Cabinet to include two (2) multi-outlet power strips.
 - a. Comply with UL 1363.
 - b. Rack mounting.
 - c. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - d. LED indicator lights for power and protection status.
 - e. LED indicator lights for reverse polarity and open outlet ground.
 - f. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.

- g. Cord connected with 15-foot (4.5-m) line cord.
 - h. Rocker-type on-off switch, illuminated when in on position.
 - i. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 - j. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.
21. Provide casters to allow equipment cabinets to be moved out of installation space far enough to gain access to rear of cabinets with adequate working space. Contractor shall provide cabling to cabinets with enough slack to allow cabinets to be properly moved.
22. Equipment Cabinets shall have 44 Rack Units (RU) of usable space.
23. Manufacturers
- a. Basis of Design
 - 1) Atlas Soundolier #544-25 equipment cabinet with top panel, side panels, plexiglass front door, rear doors, SVP19 Series Vent Panels, S19 Series Filler Panels, CFT-0 Fan Tray and CFM-2-120 Fan Assembly; Leviton #5500-192 Power Strips
 - b. Acceptable Substitutions
 - 1) Newton
 - 2) Chatsworth
 - 3) Middle Atlantic

2.2 BALLROOM VIDEO SYSTEM

A. DVD Player

1. General

- a. Power requirements: AC 120 V ~ 60 Hz
- b. Power consumption: 9 W
- c. Dimensions (Approx.): 430 x 39 x 192 mm (17 x 1.5 x 7.6 inches) (W x H x D) without foot
- d. Net weight (Approx.): 1.5 kg (3.3 lbs)
- e. Operating temperature: 5 °C to 35 °C (41 °F to 95 °F)
- f. Operating humidity: 5 % to 90 %

2. Outputs

- a. Video Output: 1.0 V (p-p), 75 Ω , sync negative, RCA jack x 1
- b. S-Video Output: (Y) 1.0 V (p-p), 75 Ω , negative sync, Mini DIN 4-pin x 1 (C) 0.3 V (p-p) 75 Ω

- c. Component Video Output: (Y) 1.0 V (p-p), 75 Ω , negative sync, RCA jack x 1 (Pb)/(Pr) 0.7 V (p-p), 75 Ω , RCA jack x 2
- d. HDMI Output (Video/Audio): 19 pin (HDMI standard, Type A)
- e. Audio Output: 2.0 Vrms (1 KHz, 0 dB), 600 Ω , RCA jack (L, R) x 1
- f. Digital Audio Output:
 - 1) Coaxial: 0.5 V (p-p), 75 Ω , RCA jack x 1
 - 2) Optical: 3 V (p-p), Optical jack x 1
- g. System
 - 1) Laser: Semiconductor laser, wavelength 650 nm
 - 2) Signal system: NTSC
 - 3) Frequency response:
 - a) DVD (PCM 96 kHz): 8 Hz to 44 kHz
 - b) DVD (PCM 48 kHz): 8 Hz to 22 kHz
 - c) CD: 8 Hz to 20 kHz
 - 4) Signal-to-noise ratio: More than 90 dB (ANALOG OUT connectors only)
 - 5) Harmonic distortion: Less than 0.02%
 - 6) Dynamic range: More than 95 dB (DVD/CD)
- h. Included Accessories: Video cable (1), Audio cable (1), Remote control (1), Batteries (2)

3. Manufacturers

- a. Basis of Design
 - 1) JVC XV-N682S
- b. Acceptable Substitutions
 - 1) Sony DVP-SR510H
 - 2) Toshiba SD7300

B. Universal Twisted Pair Transmitter

- 1. Shall be a universal twisted pair transmitter for digital and analog video sources. It shall meet the needs of AV presentation environments and shall have dedicated inputs provided to accommodate HDMI, VGA, HD component video, S-video, composite video, audio, and bidirectional RS-232 or IR signals. The signals shall be transmitted long distances over Category 5 or greater cabling to remote receiver locations.
- 2. Features

- a. Support EDID and DDC transmission
 - b. HDMI Digital Input:
 - 1) Transmit HDMI and RS-232 signals over two Category 5 or greater cables
 - 2) HDCP compliant
 - 3) Transmit additional stereo audio signals
 - 4) Bidirectional RS-232/IR pass-through
 - c. Analog Inputs
 - 1) Auto-input switching
 - 2) EDID emulation mode to allow proper source operation when no local monitor is present
 - 3) Contact closure remote control
3. Manufacturers
- a. Basis of Design
 - 1) Extron MTP/HDMI U T A D or acceptable substitution
- C. Universal Twisted Pair Receiver
- 1. Shall be a universal twisted pair receiver for digital and analog video sources. It shall meet the needs of AV presentation environments and shall have dedicated inputs provided to accommodate HDMI, VGA, HD component video, S-video, composite video, audio, and bidirectional RS-232 or IR signals. The signals shall be transmitted long distances over Category 5 or greater cabling to remote receiver locations.
 - 2. Features
 - a. Automatically routes incoming video signals to appropriate output connectors
 - b. Digital Output
 - 1) HDCP compliant
 - 2) HDMI compatible – Supports data rates up to 1.65 Gbps per color
 - 3) Supports DDC transmission
 - 4) Supports bidirectional RS-232 or IR signals
 - c. Analog Output
 - 1) Separate variable level and peaking controls
 - 2) Supports bidirectional RS-232 signals
 - 3) Compatible with HDTV component video, bi-level or tri-level sync

- 4) Dual mono audio output; Outputs balanced or unbalanced dual mono audio signals
 3. Manufacturers
 - a. Basis of Design
 - 1) Extron MTP/HDMI U R
- D. TV Tuner
 1. Shall be a compact, high performance analog cable and closed circuit TV tuner designed to provide maximum performance and control in professional AV environments.
 2. Features
 - a. Front panel, RS-232, and modulated IR control
 - b. Save and recall configuration files via RS-232
 - c. Preset channel memories
 - d. Includes remote control
 - e. Rack-mountable
 - f. Includes energy-efficient external universal power supply.
 3. Manufactures
 - a. Basis of Design
 - 1) Extron AVT 100
- E. HDMI Scaler
 1. Shall be a compact video scaler that accepts a wide variety of video formats including HDMI, HDTV, RGB, and standard definition video. Audio from any of three stereo inputs may be selectively embedded onto the HDMI output. Designed for professional integration that requires scaling and format conversion in a low profile enclosure that enables quick and simple installation.
 2. Features
 - a. HDMI, RGB, HDTV, and video scaling to HDMI
 - b. Auto-switching between inputs
 - c. HDMI audio embedding
 - d. Advanced scaling engine with 30-bit processing and 1080i de-interlacing
 - e. HDCP compliant
 - f. Supports HDMI specification feature including data rates up to 6.75 Gbps, Deep Color, and HD lossless audio formats

- g. Automatically manages EDID communication between connected devices
- h. Aspect ratio control
- i. HDCP visual confirmation providing a green signal when encrypted content is sent to a non-compliant display
- j. Seamless switching
- k. Image freeze control
- l. Auto-image setup
- m. Output standby mode
- n. Power save mode
- o. Automatic 3:2 and 2:2 pulldown detection
- p. Quad standard, 3D composite video decoding
- q. Internal test patterns for calibration and setup
- r. Audio switching transitions
- s. Front panel security lockout
- t. RS-232 control port
- u. Front panel USB configuration port

3. Manufacturers

a. Basis of Design

- 1) Extron DSC 301 HD or acceptable substitution

F. **HDMI Matrix Switcher**

- 1. Shall be a high performance, 8 x 8 digital matrix switcher for HDMI signals. It shall be HDCP compliant, HDMI 1.3 compatible, and support resolutions up to 1920 x 1200 and HDTV 1080p/60, enabling simultaneous distribution of content-protected signal sources to one or more compliant displays.

2. Features

- a. HDMI 1.3 compatible
- b. HDCP compliant
- c. Continuously verifies HDCP compliance for quick, reliable switching
- d. Automatically manages EDID communication between connected devices
- e. Automatic cable equalization for each input to 100 feet at 1920 x 1200 / 8-bit color

3. Manufacturers

a. Basis of Design

- 1) Extron DCP HDMI Series Matrix Switchers or acceptable substitution

G. HDMI Cable Equalizer

1. Shall be an HDMI equalizer for extending HDMI signals beyond suggested maximum distance limit of 45 feet for HDMI cables.
2. Shall be used in conjunction with cables up to 200 feet in length to provide signals at 1080p/60 with 8-bit color minimum. It shall automatically provide the necessary active equalization to ensure optimal image quality with HDTV signals 1080p/60 and high resolution computer-video signals up to 1920 x 1200.
3. Shall be HDCP compliant ensuring display of content-protected media and interoperability with other HDP-compliant devices.
4. Features
 - a. HDMI 1.3 compatible
 - b. Powered by device at distances up to 125 feet.
 - c. LED indicator for source signal presence and power
 - d. Cable lacing brackets
5. Contractor shall provide and install an HDMI Cable Equalizer on each HDMI cable that exceeds 75 feet in length.
6. Manufacturers
 - a. Extron HDMI 101 Plus or acceptable substitution

H. Video Projector Lift

1. Type: Electrically operated, scissor type projector lift to lower projector from ceiling storage position for use or service and then retract projector.
2. Lift shall consist of housing, ceiling closure, scissor operating mechanism, motor, controls, limit switches, and other components necessary for complete installation. Lift shall be capable of extending seventeen feet (17').
3. Operating pan: 3-1/4 by 24 by 26 inches, 11 gauge steel pan with grey powder coat paint finish for attachment of suspended projector.
4. Housing: Fabricated from steel panels for recessing projector lift in ceiling space used as Environmental Airspace. Provide with universal closure and metal trim to finish ceiling opening.
5. Operating mechanism: Operating pan to be lowered and raised by 3 sets of stabilizing scissors positioned on sides and rear of pan and two 3/16 inch diameter cables with 4,200 foot-pounds tensile strength per cable. Mechanism operated by 110 VAC, 60 HZ, instantly reversible, thermally protected, lifetime lubricated, right angle gear motor and chain drive system.
6. Safety belt: Provide lift with fail-safe inertial safety belt system.
7. Cable management system: Provide lift with means for attachment of cables to rear scissor to eliminate cord tangles. Include 110 V pre-wired

power cable and prewired hookups for video cables as shown on the drawings.

8. Closure panel: Steel closure panel suspended below projector from rods attached to operating pan. Closure mounted flush with adjacent ceiling surface and finished with white powder coat paint finish.
9. Operation: Projector bolted to operating pan. Projector automatically lowered from ceiling store position to show position. Projector lowered to service position by key-operated, momentary switch. Projector raised from show and service positions to store position. Travel automatically stopped by factory set limit switches.
10. Access door: Provide ceiling access door with white finish to be installed in architectural enclosure and allow access to projector and mount.
11. Show position: To be field adjusted based on the installation of the projection screens and the height above floor of the lift.
12. Maximum lift capacity: 350 pounds.
13. Approximate travel speed: 1 foot in 9 seconds.
14. The projector lifts shall be interfaced with the video projectors to automatically turn on the projector when the lift is lowered and turn off the projector when the lift is returned to the stored position.
15. Manufacturers

- a. Basis of Design

- 1) Draper, Inc. SLX Series Motorized Scissor Lift or acceptable substitution.

- I. Video Projector

1. The Video Projector shall be a high-performance video processing/scaling device utilizing the Hollywood Quality Video processor designed for computer signals as well as standard or high-definition video. The Projector shall be a 6000 ANSI lumens projector designed for permanent installations.
2. Features
 - a. Integrated RJ45 connection for connection to a LAN (10/100 base-T capability)
 - b. High-speed wireless LAN IEEE 802.11b/g/n capability
 - c. Extended lamp life with eco mode technology to increase lamp life up to 4000 hours.
 - d. Power management enabling Projector to automatically turn off when an incoming signal is not detected from any of the inputs.
 - e. Auto Power On via the RGB (15-pin) input connector when a signal is detected.
 - f. Carbon savings meter
3. Technical

a. Optical

- 1) Display Technology: 0.79" LCD with MLA
- 2) Resolution: XGA 1024 x 768 (native); WUXGA 1920 x 1200 (maximum)
- 3) Light Output (lumens): 6000
- 4) Contrast Ratio: 2000:1 with auto iris
- 5) Lamp Type: 330W AC / 264W economy

b. Signal Compatibility / Connectivity

- 1) Scan Rate: Horizontal 15-108 kHz / Vertical 48-120 Hz
- 2) Supported Video Standards: NTSC, NTSC4.43, PAL, PAL-60, PAL-M, PAL-N, SECAM
- 3) SD/HD Video Signal Compatibility: 1080p, 1080i, 720p, 576p, 576i, 480p, 480i.
- 4) PC Signal Compatibility: VGA, SVGA, XGA, SXGA, SXGA+, UXGA, WUXGA.
- 5) Macintosh Compatible: Yes
- 6) Input/Output Terminals: RGB1 (15 pin; analog), RGB 2 (15 pin; analog), RGB3 (5 BNC, analog), RGB4 (HDMI w/ HDCP; digital), RGB5 (DisplayPort w/ HDCP), Video 1 (RCA), Video 2 (S/Video), Audio (mini stereo), Audio Out, Monitor Out (15 pin)
- 7) External Control: RS-232, IR, Wired LAN, DDC/CI, USB, Wireless LAN
- 8) Sync Compatibility: Separate Sync; Composite Sync; Sync on G
- 9) Networking: RJ-45 and Wireless LAN
- 10) Screen Trigger: Yes

4. Shall be provided with a lens sized for the installed location
5. Shall be provided with a remote control
6. Manufacturers

a. Basis of Design

- 1) NEC PA600X Digital Video Projector

b. Acceptable Substitution

- 1) Proxima
- 2) Mitsubishi

J. Motorized Projector Screen

1. Silhouette/Series V: Electric motor operated, extruded aluminum case, tab tensioned. Wall mounted. Contoured aluminum case with removable

- front cover, which conceals all mounting devices and fasteners including viewing surfaces that retract completely inside the case.
2. Quiet Motor mounted inside screen roller on rubber isolation insulators. Motor UL certified, rated 110-120V AC, 60 Hz, three wire, instantly reversible, lifetime lubricated with pre-set accessible limit switches.
 3. Motor Screen Controls, UL certified.
 4. Key operated 3-position control switch rated 115V AC, 60 Hz to stop or reverse screen at any point.
 5. Video Interface control for use with equipment with a 115V switched outlet.
 6. Contoured aluminum case finished in a light grey color.
 7. Wall Mount: Z-clip.
 8. Projection Viewing Surface:
 - a. Grey projection surface, HiDef Grey.
 9. Viewing Area: Audio Visual Format sized as shown on the drawings.
 10. Manufacturers
 - a. Basis of Design
 - 1) Draper, Inc. Silhouette Series V
 - b. Acceptable Substitutions
 - 1) Stewart Filmscreen
 - 2) Da-Lite, Inc.
- K. Rack Mount Video Monitor
1. Shall be a 7" HD LCD Monitor in a 3 RU rack mount assembly.
 2. Features
 - a. HD compatible (supports 480p/l, 576 p/l, 720p, 1080p/i)
 - b. LED backlight
 - c. Underscan capability
 - d. Blue gun feature
 - e. Anti-glare treatment
 - f. Can display either 16:9 or 4:3
 - g. Front controls for menu, up, down, on/off, mode
 - h. IR remote control
 - i. Includes AC adapter
 - j. Response Time: 22 mS (rising)
 3. Technical
 - a. Resolution: 800 x 480
 - b. Brightness: 350 cd/m2 nit

- c. PC compatibility: VGA, SVGA, XGA, SXGA, WXGA
- d. Dot Pitch: 0.19 x 0.19
- e. Contrast Ratio: 300:1
- f. Display: 7" TFT LCD active matrix
- g. Number of Pixels: 1.2 M
- h. Input Signal: NTSC/PAL (auto-sensing)
- i. Video Input Level: 1.0 V P-P; 75 Ohm
- j. Inputs
 - 1) Composite: BNC video In/Out
 - 2) Component: BNC In/Out
 - 3) S-Video: In/Out
 - 4) HDMI: In

4. Manufacturers

- a. Basis of Design
 - 1) ToteVision LCD-703HD1 or acceptable substitution

L. Cable

- 1. Shall comply with the equipment manufacturer's requirements.
- 2. HDMI
 - a. Shall be designed for high performance transmission of HDMI digital video and audio signals.
 - b. Shall conform to HDMI Standard Speed Cable Specifications and shall support 1920 x 1200 @ 60 Hz and 1080p/60 up to 75 feet within a cable equalizer.
 - c. Shall be pre-connectorized by the manufacturer and shall be available in 3, 6, 12, 25, 35, 50, 75, 100, 125, 150, 175, and 200 foot lengths. Shall be by the same manufacturer and fully compatible with the system's HDMI equipment.
 - d. Manufacturers
 - 1) Basis of Design
 - a) Extron Electronics HDMI Pro Series cables or acceptable substitution
- 3. Twisted Pair Universal Transmitter/Receiver Cable
 - a. Comply with the requirements of Section 16710 for Category 6 cable.
- 4. Audio CABLE

- a. Comply with Section 16744 – Ballroom Combining System

2.3 CONFERENCE, CLASSROOM, AND COMPUTER LAB VIDEO SYSTEMS

A. Video System

1. System shall include the following core components
 - a. One (1) IP Switcher/Amplifier
 - b. One (1) System Controller
 - c. Two (2) plenum-rated flush ceiling mounted flat field speakers
 - d. 35' of plenum Speaker Cable
 - e. 50' of plenum Projector Communication Cable
 - f. 50' of plenum Switcher Communications Cable
 - g. One (1) 6' composite video cable
 - h. One (1) 6' MVGA M-M male to Male Micro VGA Cable
 - i. 35' Cat 5 twisted pair cables for network switch access
 - j. AV input wall plates
 - k. Multiple 35' lengths of plenum Cat 5 cable for AV input wall plates
2. System Switcher
 - a. Features
 - 1) Receives VGA computer video, composite video, Ethernet, and stereo audio signals from AV input wallplates.
 - 2) Integrated 50 watt RMS audio amplifier for stereo or dual mono sound reinforcement.
 - 3) Receives audio and video signals and provides power to AV input wallplates over Cat 6 UTP cable.
 - 4) Integrated four-port network switch allowing three classroom devices to share a single network drop.
 - 5) Switched auxiliary audio input providing support for audio from an HDMI/DVI video source or MP3 player
 - 6) Independent input sensitivity adjustments provided for program and microphone audio.
 - 7) Configurable audio line output for podcast recording, assistive listening systems, or adding an additional amplifier.
 - 8) Paging sensor input mutes program audio when a public address system announcement is detected by the priority paging sensor.
 - 9) Software-based tone and dynamics for audio adjustments to meet the needs of the acoustic environment.
 - 10) Auto power save and Standby modes
 - 11) External power supply included.

3. System Controller

a. Features

- 1) Bidirectional RS-232 port for universal display control
- 2) Three digital I/O ports configurable as a digital input or digital output for sensors, switches, LED's and relays.
- 3) Dedicated IR port for control of IR-controllable display devices and source equipment.
- 4) IR learning capability for capturing IR remote codes from a devices handheld remote control.
- 5) Adjustable timer controls for automatic shutdown to preserve energy and extend projector lamp life.
- 6) Front panel security lockout preventing unauthorized tampering
- 7) Tri-color, backlit, easy-to-label buttons
- 8) Volume control knob with volume indication.
- 9) Ethernet monitoring and control
- 10) Internal high performance web server with 7.25 MB flash memory for stroing device drivers, control software, and custom user web pages.

4. Technical

a. System Switcher

- 1) Video Bandwidth: RGB: 200 MHz (-3 dB) @ 50' of cable; Composite Video: 100 MHz (-3 dB)
- 2) Video Input
 - a) Number/Signal Type: Inputs 1 and 2: VGA-UXGA RGBHC, RGBS; Inputs 3 and 4 (configurable: VGA-UXGA RGHCB, RGBS, or composite video
 - b) Connectors: 4 pairs female RJ-45
- 3) Video output
 - a) Number/Signal Type: One (1) VGA-UXGA RGBHV, RGBS (follows input type); 1 composite video
 - b) Connectors: One (1) female 15-pin HD; 1 female RCA
- 4) Audio input
 - a) Number/Signal Type: Four (4) signals from wallplates and transmitters; One (1) stereo, balanced/unbalanced (input 5)

- b) Connectors: Four (4) female RJ-45 (2 shared with RGB inputs, 2 shared with configurable RGB/composite video inputs); One (1) female 3.5 mm captive screw connector, 5 pole (input 5)
 - c) Voice Receiver Input: One (1) female RJ-45, -10 dBV (316 mVrms) nominal level
- 5) Audio output
- a) Number/Signal Type: One (1) line output, stereo/mono, balanced/unbalanced; One (1) power amplifier, stereo or dual mono (default), 2 channels total
 - b) Connectors: One (1) 3.5 mm captive screw connector, 5 pole; One (1) 5.0 mm captive screw connector, 4 pole
- 6) Power amplifier
- a) Amplifier Type: Class D
 - b) Impedance: 2/4/8 ohms (single channel); 2/4/8 ohms (stereo)
 - c) Output Power: 25 watts (rms) per channel (1 watt tolerance) at 2/4/8 ohms, 20 Hz to 20 kHz; 1% THD
- 7) Ethernet control interface
- a) Switch Type: Unmanaged
 - b) Ethernet Ports: Four (4) female RJ-45 with built-in link/speed and activity LEDs
 - c) Ethernet Data Rate: 10/100Base-T (10/100 Mbps) with autodetect
- 8) General
- a) Power Supply: External
 - (1) Input: 100-240 VAC, 50-60 Hz
 - (2) Output: 12 VDC, 5 A
 - b) Mounting
 - (1) Surface Mount: Yes, with optional surface mounting enclosure kit
 - c) Regulatory compliance

- (1) Safety: CE, c-UL, UL
- (2) UL rated for use in plenum airspaces: meets UL 2043 for heat and smoke release, excluding the power supply; meets UL 60065 for safety.
- (3) EMI/EMC: CE, C-tick, FCC Class A, ICES, VCCI
- (4) Environmental: Complies with the appropriate requirements of RoHS, WEEE

b. System Controller

1) Control — Host Ports

- a) Serial Host Port: One (1) bidirectional RS-232 front panel 2.5 mm mini stereo jack
- b) Baud Rate and Protocol: 38400, 8 data bits, 1 stop bit, no parity
- c) Ethernet Host Port: One (1) RJ-45 female
- d) Ethernet Data Rate: 10/100Base-T, half/full duplex with autodetect
- e) Ethernet Protocol: ARP, ICMP (ping), IP, TCP, DHCP, HTTP, SMTP, Telnet
- f) Web Server: Up to 200 simultaneous sessions; 7.25 MB nonvolatile user memory
- g) Secondary Control Panel (SCP): One (1) 3.5 mm 5-pole direct insertion captive screw connector

2) Control — Serial Ports

- a) Display Control Port: One (1) 3.5 mm direct insertion captive screw connector, 3 pole, for bidirectional; RS-232 control (± 5 V)
- b) Switcher Control Port: One (1) 3.5 mm direct insertion captive screw connector, 3 pole, for bidirectional; RS-232 control (± 5 V)

3) Control — IR Port

- a) IR Control Port: One (1) 3.5 mm direct insertion captive screw connector, 2 pole; TTL level (0 to 5 V) infrared control up to 1 MHz

4) Digital I/O Control

- a) Number/Type: Three (3) digital input/output (configurable)

- b) Connector: One (1) 3.5 mm direct insertion captive screw connector, 4 pole
- 5) General
- a) Power: Supplied by switcher
 - b) Power Input Requirements: 12 VDC, 0.285 A (0.305 A if used with an optional IRCM-DV+)
 - c) Mounting: Wall and furniture mountable
 - d) Enclosure Type: High-impact plastic faceplate, metal rear enclosure
 - e) Regulatory compliance
 - (1) Safety: CE, c-UL, UL
 - (2) EMI/EMC: CE, C-tick, FCC Class A, ICES, VCCI
 - (3) Accessibility: Complies with the appropriate requirements of Section 508 of the Rehabilitation Act (29U.S.C.794d).
- c. System Speakers
- 1) Power Capacity: 16 W (rms) continuous pink noise; 32 W (rms) continuous program
 - 2) Nominal Coverage Angle: 170° conical coverage
 - 3) Nominal Impedance: 8 ohms per speaker
 - 4) Mounting: Drops into a 2' x 2' (61 cm x 61 cm) or 2' x 4' (61 cm x 122 cm) suspended tile.
 - 5) Regulatory Compliance
 - a) Safety: NFPA90A, NFPA70;UL listed for use in plenum airspaces: meets UL 2043 for heat and smoke release; meets UL 1480 for commercial and professional audio systems.
- d. Wall Plates/Transmitters
- 1) Video
 - a) Gain: Unity
 - 2) Video input and loop-through
 - a) Number/Signal Type
 - (1) PVT RGB D: One (1) VGA-UXGA RGBHV, RGBS

- (2) PVT RGB D Plus: One (1) VGA-UXGA RGBHV, RGBS: One (1) buffered RGBHV, RGBS local monitor loop-through
- (3) PVT CV D: One (1) composite video
- b) Connectors
 - (1) PVT RGB D: One (1) female 15-pin HD
 - (2) PVT RGB D Plus: Two (2) female 15-pin HD (1 for input, 1 for loop-through)
 - (3) PVT CV D: One (1) female RCA
- 3) Video output
 - a) Number/Signal Type
 - (1) PVT RGB D, PVT RGB D Plus: Two (2) analog signals
 - (2) PVT CV D: One (1) analog proprietary signal
 - b) Connectors
 - (1) PVT RGB D, PVT RGB D Plus: Two (2) female RJ-45
 - (2) PVT CV D: One (1) female RJ-45
 - c) Audio input
 - (1) Number/Signal Type
 - i. PVT RGB D Plus: Two (2) stereo, unbalanced: 1 input, 1 pass-through
 - ii. PVT RGB D, PVT CV D: One (1) stereo, unbalanced
 - (2) Connectors
 - iii. PVT RGB D, PVT RGB D Plus: One (1) 3.5 mm mini audio jack (tip, ring, sleeve)
 - iv. PVT CV D: One (1) pair female RCA
 - d) Audio Output to Switcher

- (1) Number/Signal Type: One (1) analog signal
- (2) Connector: One (1) female RJ-45
- e) Audio Output, Pass-Through
 - (1) PVT RGB D Plus only: 1 stereo, unbalanced
 - (2) Connector: One (1) 3.5 mm captive screw connector, 3 pole
- f) General
 - (1) Power: Supplied by system switcher
 - (2) Power input requirements
 - v. PVT RGB: 5.5 VDC, 260 mA
 - vi. PVT RGB D Plus: 5.5 VDC, 150 mA
 - vii. PVT CV D: 5.5 VDC, 110 mA
- g) Mounting
 - (1) Furniture or Wall Mount: Yes, with the included Decora® wall plate
- h) Regulatory compliance
 - (1) Safety: CE, c-UL, UL
 - (2) EMI/EMC: CE, C-tick, FCC Class A, ICES, VCCI
- 5. Cable
 - a. Shall comply with the equipment manufacturer's requirements.
- 6. Manufacturers
 - a. Basis of Design
 - 1) Extron Pole Vault IP System with VoiceLift and MLC 104 IP Plus Media Link Controller, and FF 120 Flat Field Speakers or acceptable substitution

B. Video Projector

- 1. The Video Projector shall be a high-performance video processing/scaling device utilizing the Hollywood Quality Video

processor designed for computer signals as well as standard or high-definition video. The Projector shall be a 6000 ANSI lumens projector designed for permanent installations.

2. Features

- a. Integrated RJ45 connection for connection to a LAN (10/100 base-T capability)
- b. High-speed wireless LAN IEEE 802.11b/g/n capability
- c. Extended lamp life with eco mode technology to increase lamp life up to 4000 hours.
- d. Power management enabling Projector to automatically turn off when an incoming signal is not detected from any of the inputs.
- e. Auto Power On via the RGB (15-pin) input connector when a signal is detected.
- f. Carbon savings meter

3. Technical

a. Optical

- 1) Display Technology: 0.79" LCD with MLA
- 2) Resolution: XGA 1024 x 768 (native); WUXGA 1920 x 1200 (maximum)
- 3) Light Output (lumens): 6000
- 4) Contrast Ratio: 2000:1 with auto iris
- 5) Lamp Type: 330W AC / 264W economy

b. Signal Compatibility / Connectivity

- 1) Scan Rate: Horizontal 15-108 kHz / Vertical 48-120 Hz
- 2) Supported Video Standards: NTSC, NTSC4.43, PAL, PAL-60, PAL-M, PAL-N, SECAM
- 3) SD/HD Video Signal Compatibility: 1080p, 1080i, 720p, 576p, 576i, 480p, 480i.
- 4) PC Signal Compatibility: VGA, SVGA, XGA, SXGA, SXGA+, UXGA, WUXGA.
- 5) Macintosh Compatible: Yes
- 6) Input/Output Terminals: RGB1 (15 pin; analog), RGB 2 (15 pin; analog), RGB3 (5 BNC, analog), RGB4 (HDMI w/ HDCP; digital), RGB5 (DisplayPort w/ HDCP), Video 1 (RCA), Video 2 (S/Video), Audio (mini stereo), Audio Out, Monitor Out (15 pin)
- 7) External Control: RS-232, IR, Wired LAN, DDC/CI, USB, Wireless LAN
- 8) Sync Compatibility: Separate Sync; Composite Sync; Sync on G
- 9) Networking: RJ-45 and Wireless LAN
- 10) Screen Trigger: Yes

4. Shall be provided with a lens sized for the installed location
5. Shall be provided with a remote control
6. Manufacturers

- a. Basis of Design

- 1) NEC PA600X Digital Video Projector

- b. Acceptable Substitution

- 1) Proxima
- 2) Mitsubishi

C. Projection Screen

1. To be provided and installed by Contractor where shown on the drawings.
2. Size: As shown on the drawings
3. Operation : Manual with metal-pull on the bottom rail
4. Installation: Wall mounted using the manufacturer's wall bracket. The wall bracket is to allow the screen to be pulled down with clearance for wall mounted marker board. Mounting height is to be 6" from the ceiling and centered on the instructional wall.
5. Media:

- a. Matte White, Fiberglass
- b. Flame retardant, mildew resistant seamless fabric
- c. Black masking border

6. Manufacturers

- a. Basis of Design

- 1) Da-Lite Screen Co. Lumina

- b. Acceptable Substitutions

- 1) Draper Screen Co.
- 2) Stewart Filmscreen

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the requirements of Section 16701.

3.2 LABELS

A. General

1. All equipment, control and system cabling shall be provided with permanent descriptive labels.
2. The Contractor shall provide samples of labeling with his submittals for review by the Designer.
3. Equipment and cable labels shall be noted on the Contractor's as-built drawings exactly as they are installed on the equipment or cables.

B. Equipment

1. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.
2. All custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to Designer for review and approval prior to fabrication or final installation. The Contractor shall modify labeling as required by the Designer.

C. Outlet Plates

1. Shall be installed level and flush with the mounting surface.

D. Cables

1. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:
 - a. Signal type shall be either plain English or represented by the following designators
 - 1) R = RGBHV video
 - 2) V = S-Video
 - 3) C = Composite video
 - 4) +C = Control
 - b. Room number where other end of cable is terminated
 - c. Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
 - d. Room numbers shall coincide with numbering scheme included in contract documents.
 - e. Device identifier where other end of cable is terminated
 - f. Device identifier shall provide a clear indication of device connected to (i.e. DVR 1, Projector 1, etc.)

3.3 TESTING

- A. Comply with Section 16701 "Common Work Results for Communications"
- B. Video
 - 1. Test all cables for shorts, opens, and grounds. Record results.
 - 2. Accomplish an operational test of the video signals utilizing color bars, still pictures, and motion video to demonstrate proper video signal to all video targets.
 - 3. Visible evidence of banding, bending, blooming, chroma delay, improper convergence, hum bars, ground loops, jaggies, jitter, luma delay, retrace, signal loss, smearing, horizontal double images, vertical double images, or wrap around shall not be acceptable. The Contractor shall make system adjustments as necessary to eliminate any of these abnormalities.
- C. Control
 - 1. Accomplish full operational test of the system to verify all system programming is correct and functions as intended.

END OF SECTION 16751

SECTION 16780
TV DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 "Common Work Results for Communications"
- B. In addition to the requirements of Section 16701 comply with the following additional requirements:
 - 1. Quality Assurance
 - a. The Installer shall have personnel on staff trained and certified by the equipment manufacturer in adjusting and balancing TV Distribution Systems.
 - 2. Submittals
 - a. Submit one (1) copy of each manufacturer's certification of successful completion of factory training for each member of the Installer's staff who will be involved in the building, installation, and balancing of the system head-end.
 - b. Submit a point-to-point block diagram with system signal level calculations showing:
 - 1) The logical connection of all equipment, devices, and cabling in the system
 - 2) The rated value for each splitter and directional coupler used in the system.
 - 3) The system slope as calculated on the lowest and highest transmitted channels.
 - 4) The signal level (dB) for the high and low channels at:
 - a) The input and output of each system splitter, and
 - b) The input and output of each distribution amplifier, and
 - c) The input and output of each directional coupler, and
 - d) The input to each system outlet, and
 - e) The overall loss of each section of cable (both backbone and outlet)
 - 3. System calculations shall show a minimum of +5 dB at the lowest channel and +2 dB at the highest channel to each outlet in the system.
 - 4. Extra Materials

- a. Provide ten percent (10%) spare TV-to-outlet jumper cables.

1.2 ALTERNATES

- A. Not used.

1.3 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete and satisfactorily functioning system providing the following:

1. A complete and fully functional TV Distribution system providing transmission of video and associated audio signals for individual channels. In general terms, the system shall utilize an incoming cable TV feed from the local Cable TV Company, shall process source signals as necessary and as shown in the drawings, and then distribute the combined signals through a distributed cable infrastructure to the various locations throughout the facility. Distributed signals shall be maintained through the use of distribution amplifiers, splitters, taps, and a cable system designed to provide an optimal signal level at each system outlet in the facility.
 - a. The TV Distribution system shall employ a cabling system providing a system of directional couplers with either two or four taps each for feeding outlets throughout the building. The Contractor shall determine the feeder cable routing and directional coupler sizing as necessary to provide the appropriate signal levels to all outlets in the project.
 - b. Provide a video signal to each TV Distribution Outlet between 5 and 10 dbmV at the television input for all channels.
 - c. The system bandwidth shall include all frequencies from the sub-band through the hyper-band (5 MHz to 750 MHz)
2. Provide and install broadband distribution amplifiers, with return channel option, in locations shown on the drawings as required to provide the proper signal levels to all system outlets.

- B. Section includes:

1. Monitors/Receivers
2. Broadband Distribution Amplifier
3. Radiation Proof Hybrid Splitters
4. Radiation Proof Directional Couplers
5. Outlets
6. Grounding Blocks, Terminators And Attenuators

1.4 FUNCTIONS AND OBJECTIVES

- A. The system shall provide for the reception and display of both black and white and color signals and associated audio at every outlet in the facility
- B. The system shall:
 - 1. Meet or exceed all requirements in FCC Rules Part 76.
 - 2. Provide a minimum signal level of +5 dBmv at each outlet for EIA Channels 02 through 116 inclusive.
 - a. The system shall be cable of transmitting all system signals within the 5 MHz to 750 MHz bandwidth.
 - b. The difference between any two adjacent outlets shall not exceed 2 dB. Isolation between any two outlets shall be better than 28 dB in the sub-band through the super-band range (7 MHz – 300 MHz). Isolation in the hyper-band (300 MHz to 750 MHz) shall be greater than 20 dB.
 - 3. Be capable of transmitting sub-band (7 MHz to 49 MHz) to the head-end equipment from any outlet in the facility.
 - 4. Be designed to provide a minimum of +15 dB at the input to each system amplifier (head-end or remote).
 - 5. Be designed to provide a minimum of 43 dB carrier-to-noise ratio and –45 dB (0.5%) cross-modulation level at the output of the last amplifier in the distribution system.
 - 6. Not exceed radiation levels promulgated by the FCC.
- C. System equipment is to be installed in its own equipment cabinets.

PART 2 - PRODUCTS

2.1 MONITORS/RECEIVERS

- A. Provided and installed by Owner.

2.2 BROADBAND HYBRID DISTRIBUTION AMPLIFIER

- A. The amplifier shall utilize Power Doubling hybrid technology and shall have a minimum of 30 db of operational gain and still retain low distortion characteristics. The Contractor shall size the amplifier for each location where installed.
- B. The amplifier shall have -30 db input and -30 db output test points. The amplifier shall have optional plug-in flat attenuators and/or plug-in cable equalizer pads.
- C. The amplifier shall have the following minimum electrical specifications:

1. Frequency Range: 40-750 Mhz
2. Gain: 32 Db
3. Flatness: +/- 1.0 Db
4. Gain Control Range: 15 Db
5. Slope Control Range: 10 Db
6. Return Loss Input: 14 Db
7. Return Loss Output: 14 Db
8. Noise Figure: 9.0 Db
9. Hum Mod: -65 Db
10. Output Level: 44 Dbmv
11. Ctb: -55 Db
12. X-Mod: -58 Db
13. 2nd Order Intermod: -68 Db

D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Basis of Design: Blonder-Tongue BIDA 5800/5900 Series.

2.3 RADIATION PROOF HYBRID SPLITTERS

A. Splitters used in systems, which obtain their signals from a CATV feed, shall comply with FCC specifications concerning radiation shielding. Housings shall be sealed and weatherproofed. Splitters may be two, four, or eight port devices.

B. Specifications:

1. 2 Port
 - a. Bandwidth: 5 – 750 MHz
 - b. Thru loss (Max): 3.5 dB (5-500 MHz); 4.5 dB (600-750 MHz)
 - c. Isolation (Min.): 27 dB
 - d. Return Loss: 17 dB
 - e. Radiation Shielding: >-80 dB
2. 4 Port
 - a. Bandwidth: 5 – 750 MHz
 - b. Thru loss (Max): 7.2 dB (5-500 MHz); 8.5 dB (600-750 MHz)
 - c. Isolation (Min.): 27 dB
 - d. Return Loss: 18 dB
 - e. Radiation Shielding: >-80 dB
3. 8 Port
 - a. Bandwidth: 5 – 750 MHz
 - b. Thru loss (Max): 12.0 dB (5-500 MHz); 14.0 dB (600-750 MHz)
 - c. Isolation (Min.): 27 dB
 - d. Return Loss: 14 dB

- e. Radiation Shielding: >-80 dB
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design: Blonder-Tongue model CVS-2 #4082, CVS-4 #4084, or CVS-8 #4088.

2.4 RADIATION PROOF DIRECTIONAL COUPLERS

- A. Directional couplers used in systems which obtain their signals from a CATV feed shall comply with FCC specifications concerning radiation shielding. Housings shall be sealed and weatherproofed.
- B. Specifications:
 - 1. Frequency Range: 5 - 1000 MHz
 - 2. Tap Values: 4-6-9-12-16-20-24-27 and 30 dB
 - 3. Thru loss: 3.5 - 0.5 dB dependent upon tap value
 - 4. Isolation: 18 - 40 dB dependent upon tap value
 - 5. Input Return Loss: 12 - 18 dB dependent upon tap value
 - 6. Tap Down Loss: 3 - 30 dB dependent upon tap value
 - 7. Radiation Shielding: > -80 dB
- C. Manufacturers: : Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis of Design: Blonder-Tongue model CRT Series

2.5 OUTLETS

- A. Wall Taps
 - 1. Taps shall be capable of mounting in a standard electrical wall outlet box.
 - 2. Stainless steel, feed thru.
 - 3. Outlets to have 'F' connector for television distribution system.
- B. Jumper Cable
 - 1. Contractor/Installer shall provide one fabricated jumper cable for each outlet to the following specification. Transformer not required for cable-ready TV's.
 - 2. Receiving Outlets -- length 8 ft.
 - 3. Cable: Type RG/6.
 - 4. Connectors: Two "F" male connectors
 - 5. Transformer: 75 to 300 ohm
 - 6. Provide one (1) jumper cable and one transformer at each TV outlet.

- C. Test points -- Tests points are to be configured by drilling supplied blank rack panels and mounting "F" barrels on them. These test points shall be terminated.
- D. Manufacturers
 - 1. Basis of Design
 - a. "F" Connectors: Blonder-Tongue #BTF-56, 110, or 591 Hex; Transformer Blonder Tongue #4005; "F" Barrel: Blonder-Tongue #GF-81C (3689) or acceptable substitution

2.6 GROUNDING BLOCKS, TERMINATORS AND ATTENUATORS

- A. Grounding Blocks: Grounding blocks shall be "F" female type and accept 18-22 AWG center conductors:
- B. Terminators:
 - 1. Male "F" type with DC block
- C. In-Line Attenuators:
 - 1. Frequency Range: 10 to 890 MHz
 - 2. Attenuation Values: 3, 6, 10, 12, 20 dB
 - 3. Impedance: 75 ohm
 - 4. Return Loss: 28 dB @ 10-50 MHz, 22 dB @ 50-300 MHz, 20 dB @ 300-470 MHz, 18 dB @ 470-890 MHz,
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Blonder-Tongue
 - 2. King Electronics, Inc.
 - 3. Aim Electronics
 - 4. Trompeter
 - 5. Amp

2.7 COAXIAL CABLE (BACKBONE)

- A. All cables shall be 100% factory swept tested to 1GHz. Certification shall be available for each reel.
- B. Technical
 - 1. RG-11: NFPA 70, Type CATV or CM
 - 2. 15 AWG, solid, 0.064" bare copper covered steel conductor; gas-injected, foam-PE insulation
 - 3. Duobond Plus +77% Aluminum Braid Shield
 - 4. Jacketed with black PVC or PE

5. Nom. DCR: 3.8 Ohms per 1000 feet
 6. Nom. Impedance: 75 Ohms
 7. Nom. Velocity of Propagation: 80%
 8. Nom. Capacitance: 16.2 pF per foot
- C. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 2. CATV Riser Rated: Type CATVR, complying with UL 1666.
- D. Manufacturers:
1. Basis of Design
 - a. Belden #9764
 2. Acceptable Substitutions
 - a. CommScope
 - b. West Penn

2.8 COAXIAL CABLE (DROP TO OUTLETS)

- A. All cables shall be 100% factory swept tested to 1GHz. Certification shall be available for each reel.
- B. Technical
1. RG-6/U: NFPA 70, Type CATV or CM.
 2. 18 AWG, 0.040" solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 3. Duobond II shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 4. Jacketed with black PVC or PE
 5. Nom. DCR: 9.0 Ohms per 1000 feet
 6. Nom. Impedance: 75 Ohms
 7. Nom. Velocity of Propagation: 83%
 8. Nom. Capacitance: 16.2 pF per foot
- C. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 2. CATV Riser Rated: Type CATVR, complying with UL 1666.

D. Manufacturers

1. Basis of Design
 - a. Belden #9116
2. Acceptable Substitutions
 - a. CommScope
 - b. West Penn

2.9 COAXIAL PATCH CORDS

- A. Provide one patch minimum six foot cord at each TV outlet.

PART 3 - EXECUTION

3.1 Comply with the requirements of Section 16701.

3.2 COAXIAL PATCH CORDS

- A. Provide one patch cord at each TV outlet.

3.3 TESTING

- A. Comply with Section 16701 "Common Work Results for Communications"

END OF SECTION 16780

SECTION 16791
INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 "Common Work Results for Communications"

1.2 DEFINITIONS

- A. Not used.

1.3 ALTERNATES

- A. Not used.

1.4 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete raceway and cabling system ready for the Owner's Vendor to install devices and activate the system.
- B. Section Includes:
 - 1. Intrusion Detection Panel including power supplies and battery backup
 - 2. Keypads
 - 3. Motion Detectors
 - 4. Door Contacts
 - 5. System wire and cabling

1.5 SPECIAL REQUIREMENTS

- A. Intrusion Detection System (IDS) shall be a stand-alone system monitored independently from the Owner's contracted central station. The Contractor shall coordinate with the Owner for information required to connect and test the system with the Owner's contracted central station.
- B. The Contractor shall be responsible for programming the system.

1.6 FUNCTIONS AND OBJECTIVES

- A. Provide and install a complete and satisfactorily functioning system providing the following:
 - 1. Interconnection and indication of the various protected spaces and devices included in the system as shown on the drawings and outlined herein.

2. The ability to arm or disarm the system or portions of the system through the use of keypads and other system devices, as shown on the drawings and outlined herein, as necessary to allow protection of the premises and personnel.
3. Monitoring and indication of the status of protected doors throughout the facility. Alarm indication of doors that have been opened during unauthorized times.
4. Reporting of system status and alarm signals to a remote location.

PART 2 - PRODUCTS

2.1 INTRUSION DETECTION SYSTEM

- A. The Intrusion Detection Panel shall be a multi-tasking hybrid control panel feature rich for security applications.
- B. Features
 1. Control Panel
 - a. Eight (8) end-of-line resistor burglary zones programmable for area, exit/entry delay, interior, follower, day zone, chime , fire option, sensor watch, swinger shutdown, zone adding and a variety of other features
 - b. Up to ninety-six (96) zones with optional zone-expansion modules and 4-zone keypads.
 - c. Up to ninety-six (96) individually coded users, each with a programmable authority level.
 - d. Exclusive RS232 panel-port for network integration for 9600 baud comprehensive communications.
 - e. Three (3) on-board relay outputs, expandable to ninety-six (96).
 - f. Three keypad panics: fire, police, and auxiliary.
 - g. Up to eight (8) independent area partitions.
 - h. Up to eight (8) separate access stations by up to 96 users.
 - i. Up to sixty-four (64) separately addressable X-10 devices with GEM-X10 kit.
 - j. English language prompts & system status messages from choice of keypad models.
 - k. User-customized zone descriptions, reprogrammable as required.
 - l. Reports alarms, restores, and troubles by zone.
 - m. 255 event schedule
 - n. 800 event log.
 - o. Overview mode permitting monitoring and control of total system from one keypad.
 - p. Support for up to four (4) RF receivers.

- q. Guard-tour programmable for start time, tour length, and check points.
 - r. Two (2) programmable entry delay times.
 - s. Two Interior bypass groups.
 - t. Dynamic battery test interrupts charging and places batter under load every four hours.
 - u. Chime by zone; programmable duration.
 - v. Non-volatile RAM to retain memory during power losses.
 - w. Auto-download log.
2. Communicator
- a. Compatible with all major receiver formats including BFSK, 4/2, modem 2, SIA, 4/3/1, \$ + 2 express and point ID
 - b. Rotary dial and touchtone with rotary backup
 - c. Three (3) 20-digit telephone numbers
 - d. Backup reporting; double reporting; split reporting
 - e. Ninety-six (96) user codes with opening/closing reporting by user.
 - f. AC failure reporting with programmable report delay
 - g. Supervised telephone line cut with programmable delay
 - h. Pager capability
 - i. SIA CP01 compliant
3. Specifications
- a. Loop current: 2.5 mA with 2.2 ohm end-of-line resistor
 - b. Loop resistance: 300W max
 - c. Relay outputs (burglary; reset; aux: wet, 12 VDC, 1.2A max; Dry, SPDT contacts 24 VDC regulated.
 - d. Remote power output: 12 VDC regulated.
 - e. 750 mA of combined standby current
 - f. Standby Time: 4 hours minimum.
4. System shall be provided with keypads in quantities as shown on the drawings.
5. Interface the Intrusion Detection Panel with the Access Control System in accordance with the manufacturer's recommendations for a complete and seamless integration. All Intrusion Detection signals and alarms shall appear on the Access Control system Alarm Workstation.
- C. Manufacturers
1. Basis of Design
- a. NAPCO Gemini P9600 Intrusion Detection Panel with GEMK1CA Keypads

2. Acceptable Substitutions

- a. DMP
- b. Ademco

2.2 MOTION DETECTORS

A. The Motion Detector shall be an adaptive, dual microwave/PIR detector that automatically adjusts to the environment. It shall be available in a broad range of angle coverage patterns. It shall utilize smart microprocessor-based false alarm discrimination. It shall have 12 automatically selected, dynamic detection modes. It shall have active automatic self-testing of all key components and circuits.

B. Technical:

1. Microprocessor: 2K ROM with A-D Converter
2. Operating Temperature: 14 to 122 degrees Fahrenheit
3. Mounting: Wall or corner
4. Output Relay: Form A; normally closed
5. Relay Time: Approximately 3 seconds
6. Alarm Relay: 100 mA, 24 VDC with internal 10 Ohm current limiting resistor.
7. Multi-mode Trouble Output (Open Collector)
8. Self-Test Interval: 11 – 16 hours
9. Power Supply Requirements: Filtered 10.6 to 16 VDC nominal with battery backup from the control panel.
10. Current Drain: 28 mA at 12 VDC (nominal)

C. Manufacturers

1. Basis of Design
 - a. NAPCO C100STE Series Adaptive Dual Microwave/PIR Detector
2. Acceptable Substitutions
 - a. DMP
 - b. Ademco

2.3 DOOR CONTACTS

A. Door contacts shall be balanced magnetic type contacts specifically designed for the location where installed.

B. Standard pedestrian style doors shall be provided with contacts that are flush mounted, design for ¾ or 1" diameter holes, and manufactured of a molded, flame-retardant ABS plastic. The Color of the door contact shall match the

door frame where installed. Metallic doors shall be provided with Rare Earth magnets. The magnet portion of the door contact shall be held in place with permanent adhesive that will not crack, dry out, or release the magnet over time.

- C. Door contacts for overhead doors shall be surface mounted and shall be traffic rated to withstand long-term abuse from trucks, forklifts, and other vehicles.
- D. Door contacts for curtain style doors shall be designed to protect the door contact from damage.
- E. Manufacturers:
 - 1. Basis of Design
 - a. Napco
 - 2. Acceptable Substitutions
 - a. DMP
 - b. Ademco

2.4 SYSTEM WIRE AND CABLE

- A. System wire and cable shall be in accordance with the equipment manufacturer's recommendations.

PART 3 - EXECUTION

- A. Comply with the requirements of Section 16701.

3.2 TESTING

- A. Comply with the requirements of Section 16701.

END OF SECTION 16791

SECTION 16795
CCTV SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 "Common Work Results for Communications"

1.2 DEFINITIONS

- A. Not used.

1.3 ALTERNATES

- A. Not used.

1.4 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete and satisfactorily functioning CCTV system.
- B. The system shall be of modular design to facilitate both expansion and service and shall use only solid state circuitry.
- C. All necessary hookup, installation, programming, and testing shall be by a factory trained and certified technician.
- D. Contractor shall provide and install patch cords for the system as necessary for all equipment and outlets including Owner provided, Contractor installed equipment.
- E. System to include but not be limited to:
 - 1. Digital Video Recorders
 - 2. Cameras with Housing, Mounts, Lens, and Power Supply
 - 3. Dome Assemblies
 - 4. Support
 - a. Equipment cabinets/racks including required fixed shelves, pull-out shelves, drawers, vent panels, blank panels, power strips, ground bus bars, etc. necessary for a complete and functional system.
 - b. Termination of all cabling and equipment.
 - c. Raceways, outlet boxes, pull boxes, cabinets, pull strings, identification, etc. Conform to applicable sections in these specifications. Provide/install complete with all required basic materials.
 - d. Flush grade pull boxes
 - e. Surface mounted pull boxes (exterior)

- f. Identification and labeling of all cabling.
- g. Fireproofing
- h. Grounding and bonding
- i. Surge Suppression
 - 1) Provide and install surge suppression devices on:
 - a) Each cable entering and leaving a building
 - b) In other locations where required by the manufacturer or required to properly protect the equipment and the system as a whole.
 - 2) Surge suppression on 120 VAC circuits shall be provided and installed by the electrical sub-contractor.
- j. System adjustments to provide a complete system with no audible, visible, or functional degradation.
- k. Complete system testing to the satisfaction of the Designer.
- l. As-Built drawings

F. Cable shall be installed in appropriate raceway where concealed (e.g. in walls), where above inaccessible ceilings, or where shown on the drawings. Cables run above accessible ceilings may be run in dedicated J-hook assemblies.

1.5 SPECIAL REQUIREMENTS

A. Not used

1.6 FUNCTIONS AND OBJECTIVES

- A. The system shall provide, through the use of CCTV cameras installed at strategic locations throughout the facility, for the observation of areas critical to the Owner's operation of the facility. This shall include connection of the various cameras to the system Digital Video Recorders (DVR) as well as control of the individual cameras zoom, focus, and other functionality. Monitoring of the system cameras shall be accomplished through remote client software installed by the Contractor on Owner furnished and installer computers in locations as shown on the drawings.
- B. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.
- C. Coordinate all work with other trades and Owner provided equipment as necessary.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall provide and install all equipment and materials necessary for a complete, operational system whether or not specifically shown on the drawings or specified herein.
- B. The Contractor shall provide all labor, programming, and testing necessary to complete the work related to this system and provide the Owner, at the completion of the project, with a fully functional and properly operating system in accordance with the manufacturer's recommendations, the requirements of the contract documents, and applicable industry standards.
- C. All equipment and materials shall be suitable for use intended, and meet all stated performance requirements for the system configurations specified in this section.

2.2 PATHWAYS

- A. General:
 - 1. All pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within Division 26 of these specifications.
- B. Conduit. (Comply with Division 21 except as noted below).
 - 1. Bushings: Provide insulated bushings on ends of all raceway. All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
 - 2. Pull Cords: Install pull cords in all raceway runs that are installed without cable.
 - a. Size:
 - 1) Minimum size shall be ¾".
 - 2) The Contractor shall size raceways in accordance with the National Electric Code unless noted otherwise.
- C. Boxes:
 - 1. All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable section of these specifications.
 - 2. Boxes shall be sized as required by NEC for cables, conduit and/or device installed.

2.3 CCTV CONSOLE

A. The CCTV System Equipment Rack shall be provided with a Monitor/Keyboard/Mouse Console consisting of a 17" LCD single rail Console with integral KVM Switch.

1. 17" LCD Single Rail Console shall have the following functions and features:

- a. Support for SunT Native Resolution
- b. Support for seventeen different keyboard languages
- c. Bright Active TFT Display
- d. OSD Functions for LCD Display and KVM Switch
- e. Durable Keyboard with Touchpad
- f. LCD Panel protected by tempered glass
- g. Integration with various KVM switches

2. The KVM Switch shall have the following functions and features:

- a. KVM Type: PS/2 and USB interface
- b. Console Port plus one Remote Module
- c. PC Port Connector: HDDB-15
- d. PC Ports: 8
- e. Max Distance (KVM Switch – Host): 32 feet
- f. Video Resolution: 1920 x 1440 (Local Console); 1280 x 1024 (IP-based remote console)
- g. IP-Based Remote Module: RJ-45 for 10/100M Ethernet, DB9 male for Modem; Null modem and serial power control; Mini USB 2.0 receptacle.
- h. Daisy Chaining: Support with both Bus (8-layer) and Tree (2-layer) topologies; DB15 female connector
- i. Computer Port Selection: On Screen Display (OSD) Menu, Hot Key
- j. Security: Access Control List (SCL) security function; up to 8 independent controllable computer lists.
- k. Auto-Scan Intercals: 5 ~ 99 sec.
- l. Keyboard Emulation: PS/2 or USB
- m. Mouse Emulation: PS/2 or USB

B. Manufacturers

1. Basis of Design:

- a. Atlas Soundolier MMK17-RM 17" LCD Console with MMK-KVM8 Modular KVM Switch

2.4 CAMERAS

- A. The Fixed Camera system shall integrate a camera and lens package into a small enclosure that can be mounted directly to, or recessed into, a ceiling or wall.
- B. The Camera System shall include the following:
1. A day/night wide dynamic range (WDR), high resolution (650 TVL) color camera with auto iris, varifocal lens, and auto back focus.
 2. True day/night option, which features a high resolution (540 TVL) color camera with auto iris and varifocal lens.
 3. 24 VAC or 12 VDC operation (autosensing).
 4. A manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.
 5. A service connector for video output.
 6. Adaptive black stretch (ABS) to provide optimal image quality in dark areas by increasing the visibility in those areas.
 7. An auto image stabilizer to compensate for external vibration.
 8. Auto back focus (ABF)
 9. Intelligent Motion Detection.
 10. Built-in video motion detector to detect motion within a targeted area.
 11. Motion detection, object abandonment/removal, and scene change detection.
- C. Technical
1. Construction
 - a. Enclosure: Aluminum die cast
 - b. Bubble: Polycarbonate resin
 - c. Finish: Light gray
 2. Unit Weight
 - a. Surface: 3.76 lb (1.71 kg)
 - b. Flush: 4.53 lb (2.05 kg)
 3. Multilingual On-Screen Display: English, French, Spanish, German, Portuguese, Russian, Japanese
 4. Image Sensor: 1/3-inch interline transfer CCD
 5. Effective Pixels
 - a. NTSC: 976 (H) x 494 (V)
 - b. PAL: 976 (H) x 582 (V)
 6. Scanning Area: 0.19-inch (H) x 0.14-inch (V) (4.8 x 3.6 mm)
 7. Scanning System: 2:1 interlace
 8. Scanning Lines:

- a. NTSC: 525 lines
 - b. PAL: 625 lines
9. Scanning Frequency
- a. NTSC: Horizontal, 15.734 kHz; vertical, 59.94 Hz
 - b. PAL: Horizontal, 15.625 kHz; vertical, 50.00 Hz
10. Synchronization: Internal; LL (phase adjustable power supply synchronization)
11. Horizontal Resolution: 650 TV lines, typical (color mode); 700 TV lines or more (B-W mode)
12. Minimum Illumination: 0.1 lux (color mode); 0.003 lux (sensitivity up x32); 0.01 lux (B-W mode); 0.0003 lux (sensitivity up x32)
13. Dynamic Range: 54 dB/128X
14. Day/Night Type: IR filter removal
15. Video Output: 1.0 Vp-p, NTSC/PAL composite, 75 ohms, BNC connector
16. White Balance: Autotracking white balance/automatic white balance control
17. Signal-to-Noise Ratio: 50 dB (equivalent to AGC off, weight on)
18. Lens: 2X varifocal lens
19. Focal Length: 3.8~8.0 mm
20. F-Number: f/1.4 (WIDE) to f/1.8 (TELE)
21. Focus Range: ∞ to 3.9 ft (1.2 m)
22. Angle of View
- a. Horizontal: 73.6° wide zoom; 35.6° telephoto zoom
 - b. Vertical: 53.4° wide zoom; 26.6° telephoto zoom
23. Adjusting Angle
- a. Panning Range: $\pm 170^\circ$
 - b. Tilting Range: $\pm 75^\circ$
 - c. Rotation Range: $\pm 100^\circ$
- D. Electrical Specifications
1. Power Source
 - a. NTSC: 24 VAC, 60 Hz; 12 VDC, 280 mA
 - b. PAL: 24 VAC, 50 Hz; 12 VDC, 280 mA
 2. Ambient Temperature: 14° to 122°F (-10° to 50°C)
 3. Ambient Humidity: Less than 90%
 4. Certifications
 - a. CE, Class A
 - b. FCC, Class A
 - c. UL/cUL Listed

- d. C-Tick
- E. Warranty: 36 months, parts and labor
- F. Exterior cameras shall be weatherproof.
- G. Manufacturers
 - 1. Basis of Design
 - a. Interior: Pelco IS20/IS21 DWS Series Camclosure 2 Cameras
 - b. Exterior Pelco IS50/51 DWS Series Camclosure 2 Cameras
 - 2. Acceptable Substitutions
 - a. Bosch
 - b. Vicon

2.5 DIGITAL VIDEO RECORDER (DVR)

- A. The Digital Video Recorder (DVR) shall provide a high-quality recorder capable of storage and playback of images from as many as 24 or 32 analog and IP camera inputs.
- B. The DVR user interface shall include a System Resource Meter independent of the Windows Resource Meter. The System Resource Meter shall provide a real-time indication of the utilization of DVR resources.
- C. The DVR shall also provide a simultaneous refreshing recording rate up to 480 images per second (NTSC) at CIF resolution with a DVD-RW as standard equipment.
- D. The DVR shall be capable of storage and playback of audio from 2 built-in audio inputs. The DVR shall have the ability to provide bidirectional audio to one remote client at a time, allowing the user to listen to audio as it is being recorded at a remote station.
- E. The DVR shall provide internal storage of up to 8 TB and support for optional external storage appliances using USB 2.0 JBOD (just a bunch of disks) of up to 8 TB. External RAID5 optional storage shall be available up to 24 TB.
- F. The server unit shall provide connection to a primary and secondary monitor and include dual display for as many as 72 local or remote cameras simultaneously. The secondary dual display output shall be switch-selectable to connect to a VGA (DB15) or analog (BNC) monitor, and it shall be capable of displaying up to 36 cameras simultaneously. The primary and secondary display shall provide live view of local or remote cameras.
- G. One standard composite monitor output shall be available. Camera views shall be configurable in multiple sequences with independently set dwell

times and shall have the ability to interleave alarm or motion events into the video sequences. In the case of two composite monitors, the display shall be mirrored between the two monitors.

- H. Optional MUX cards shall be available to provide live view of local cameras and send video to the VGA and composite monitor port at up to 480/400 (NTSC/PAL) ips for real-time viewing. Each display shall mirror live, local, and public cameras from the primary monitor.
- I. The unit shall support as many as 16 ATM/POS devices, synchronously record transaction data received from each ATM/POS device into a text database, and record the associated video of that transaction into the DVR's database. The user shall be able to search transaction video associated with transaction data by ATM/POS device name, data, transaction type, specific text within a transaction, or transaction exception. Connection to ATM/POS devices shall be accomplished through optional serial pass-through devices.
- J. The DVR server shall include a health check system that monitors certain server CPU components, including but not limited to the operating temperature of each internal hard drive. Health check administration shall allow the modification of some components' operational limits. If a component functions outside of the operating limit, the server shall display an alert on the server main monitor and connected remote client monitors. The error log shall contain details on the error condition.
- K. The DVR shall operate as part of a network of as many as five units with the ability of each to use the server for administrative functions as well as a control and video viewing station. An DVR operator shall have the ability to view and control up to 180 cameras from a server. With proper administrative rights the remote client shall have the ability to administer as many as 200 servers. A remote client with proper rights shall have the ability to simultaneously control and operate up to 36 cameras connected to any of 200 DVR/DVRs.
- L. The DVR shall utilize a Microsoft® Windows® XP Embedded operating system.
- M. Remote software shall be provided at no additional cost for operation using PC, Web, and Pocket PC handheld devices.
- N. An Emergency Agent application shall be included to provide alarm notification at any connected PC and shall not require the installation of the DVR's PC client software. There shall be no additional cost for the Emergency Agent application.
- O. The DVR shall meet or exceed the following design and performance specifications.
- P. General Specifications

1. Input Voltage: 100 to 240 VAC \pm 10%, 50/60Hz, autoranging
 2. Power Consumption: Maximum 350 W
 3. Signal System: NTSC/PAL
 4. Operating System: Windows 2000 (SP4) or Windows XP Pro
DirectX[®] 8.1 or later, 500 MB free disk space
 5. Frame Rate
 - a. NTSC: 480 ips, 240 ips, 120 ips
 - b. PAL: 400 ips, 200 ips, 100 ips
 6. Recording Resolutions
 - a. NTSC: 320 x 240, 640 x 240, 640 x 480, 352 x 240, 704 x 240, 704 x 480
 - b. PAL: 320 x 288, 640 x 288, 640 x 576, 352 x 288, 704 x 288, 704 x 576
 7. Recording Modes: Multi-event recording capability for continuous, motion detection, alarm activation, or scheduled recording, and ATM/POS with overlapping and differing frame rates and quality settings for each recording mode
 8. Motion Detection: Built-in motion detection for each camera to start recording or to increase the recording rate of the system
- Q. Maximum Cameras: 16 analog cameras
- R. External Storage: RAID 5 storage of up to 9 TB
- S. Video Inputs: 16 (looping with automatic termination)
- T. VGA Outputs: One (1) primary
- U. Password Protection: Four (4) user levels of protection for setup functions, operation, and system exiting; each level with user-assignable features per user level and offer multiple users per level
- V. Languages: English, Spanish, German, French, Italian, Portuguese, Russian, and Polish
- W. Alarm Input Terminals: 16 (user-selectable, N.O. or N.C.)
- X. Analog Video Outputs: One (1)
- Y. Relay Output Terminals: 16 (user-selectable, N.O./N.C.)
- Z. Relay Contact: 0.5 A at 120 VAC or 1 A at 24 VDC
- AA. Remote Administration: Full remote control through TCP/IP network

- BB. LAN/WAN Connection: Software and hardware is provided for viewing and controlling the DVR over the network, including an exclusive server-to-server connection feature
- CC. Video Quality: High-quality video recording of at least VHS grade compared to the original video; supports NTSC or PAL video
- DD. Backup: A scheduled backup management system is provided to back up data to external devices that are mapped to the server (CD, NAS, or other storage devices) without interrupting hard disk recording
- EE. Hard Disk Drives: 250 to 8000 GB on board storage capability
- FF. Programming: On-screen programming and operation through a keyboard or mouse (keyboard and mouse are supplied)
- GG. On-line Help system: Provides a built-in Help system containing the information needed for faster reference by the user at both the server and remote client
- HH. Search Modes: Thumbnail, Pixel (Smart Search), and ATM/POS
- II. View Favorites: Provides a mechanism to bookmark and name certain screen configurations and retrieve these by name
- JJ. Keyboard Support: Enables control of as many as 72 cameras connected to 5 servers from a single server-attached optional keyboard
- KK. Instant Playback Feature: Provides the option of a forced write to internal disk storage and allows users immediate playback of events
- LL. ATM/POS Support
 - 1. Single-Mode: Data interface for up to 4 ATM/POS devices per server
 - 2. Multimode: Data interface for up to 16 ATM/POS devices per server
- MM. System Health Check: Monitors and provides an error message if CPU components or hard disk drive operating parameters exceed their thresholds
- NN. API Integration: Published APIs are available for application integration to the DVR
- OO. Mechanical Specifications
 - 1. Connectors
 - a. BNC: Video inputs and outputs
 - b. 6-pin mini-DIN: PS/2 mouse and keyboard
 - c. DB9: COM 1
 - d. DB15: VGA Port

- e. RJ-45: 10/100/1000 Megabit Ethernet port and RS-485/RS-422 ports on PTZ control
- f. USB: 6 high-speed USB 2.0 ports (2 front, 4 back), connects the mouse, keyboard, and JBOD external storage

PP. Audio Specifications

- 1. Audio Connectors: Miniature male phone plug for line in, microphone in, and audio output
- 2. Audio Decoding: GSM610 Wave Format
- 3. Audio Bit Rate: 8 Kbps
- 4. Audio Levels
 - a. Input: Line-level input
 - b. Output: Line-level output
- 5. Audio Inputs: 16
- 6. Audio Outputs: 1

QQ. Physical Specifications

- 1. Dimensions, Standard
 - a. Rack Mount: 22.0" D x 19.0" W x 7.0" H (4 RUs) (55.88 x 48.26 x 17.78 cm)
- 2. Weight: A maximum of 45.4 lbs
- 3. Operating Temperature: 50° to 95°F (10° to 35°C)
- 4. Relative Humidity: Maximum 80%, noncondensing
- 5. Optical Drive: DVD-RW
- 6. Certifications
 - a. CE and FCC, Class A
 - b. CUL/cUL
 - c. C-Tick
- 7. Warranty: 36 months, parts and labor

RR. The Contractor shall connect the DVR to the Owner's network and install the DVR Remote Client Software on computers as directed by the Owner.

SS. Manufacturer

- 1. Basis of Design
 - a. Pelco DX8100 Series Hybrid Video Recorder
- 2. Acceptable Substitutions
 - a. Bosch

b. Vicon

2.6 UNINTERUPPTIBLE POWER SUPPLY (UPS)

- A. Shall be a rack mounted UPS designed for support of microprocessor based equipment.
- B. Technical:
1. Output Power Capacity: 980 Watts / 1440 VA
 2. Max Configurable Power: 980 Watts / 1440 VA
 3. Nominal Output Voltage: 120 VAC
 4. Efficient at Full Load: 95%
 5. Output Voltage Distortion: Less than 5% at full load
 6. Output Frequency (sync to mains): 57 – 63 Hz for 60 Hz nominal
 7. Crest Factor; up to 5:1
 8. Waveform Type: Sine Wave
 9. Output Connections: Six (6) NEMA 5-15R
 10. Nominal Input Voltage: 120 VAC
 11. Input Frequency: 60 Hz +/- 3 Hz (auto sensing)
 12. Input Connections NEMA 5-15P
 13. Input Voltage Range For Mains Operation: 82 – 144 V
 14. Input Voltage Adjustable Range For Mains Operation: 75 – 154V
 15. Battery Type: Maintenance-free sealed Lead-Acid battery with suspended electrolyte; leakproof
 16. Typical Recharge Time: 3 hours
 17. Interface Ports: DB-9 RS-232; Smart Slot, USB
 18. Control Panel: LED status display with load and battery bar-graphs and on line, on battery, replace battery, and overload indicators
 19. Audible Alarm: Alarm when on battery; distinctive low battery alarm, configurable delays
 20. Surge Energy Rating: 459 Joules
 21. Filtering: Full time multi-pole noise filtering; 0.3% IEEE surge let-through; zero clamping response time; meets UL 1449
- C. UPS shall be used as backup for the DVR's in the MDF only. Contractor shall calculate UPS size based on requirements of DVR's to be installed under this project and shall provide calculations with his submittals confirming UPS size. Contractor shall be prepared to upsize the UPS one size if necessary to meet the Owner's needs. UPS shall allow a minimum of 30 minutes of run time (full system operation including access to DVR hard drives as well as retrieval of video via DVD burner) plus fifty percent (50%) spare capacity.
- D. Manufacturer
1. Basis of Design
 - a. APC Smart-UPS Series or acceptable substitution

2.7 WIRE AND CABLE

- A. Contractor shall provide and install cable as required by the manufacturer, as specified elsewhere in these specifications, and to provide a complete, fully operational CCTV System.
- B. CCTV System cables installed in exterior and/or underground raceways shall comply with the applicable sections of N.E.C. Article 800.
- C. Plenum rating: Cable shall be plenum rated and marked CMP or Plenum (UL). Cable may be non-plenum rated where installed in non-plenum spaces/areas.
- D. Manufacturer
 - 1. Basis of Design
 - a. West Penn
 - 2. Acceptable Substitutions
 - a. Mohawk
 - b. Belden

2.8 SURGE SUPPRESSION

- A. Analog Cameras
 - 1. Shall be designed as a three-stage hybrid technology. The device shall address over-voltage transients with a primary Gas Discharge Tube (GDT) and secondary Silicon Avalanche Diode (SAD) components. Over-current protections (e.g. sneak and fault currents) shall be mitigated with solid-state resettable fuses – PTC's. The devices shall be designed in accordance with NFPA 780 requirements with up to 20 kA of surge current capability.
 - 2. Technical
 - a. Operating Voltage: 5 VDC
 - b. Clamping Voltage: 6 VDC
 - c. Operating Current: 0.15A
 - d. Peak Surge Current: 20 kA (8 x 20 μ s)
 - e. Frequency Range: 0 to 100 MHz
 - f. Insertion Loss: < 0.1 dB at 20 MHz
 - g. SPD Technology: GDT, SAD, w/ series PTC
 - h. Connection Type: BNC, 50/75 Ohm
 - 3. Provide and install in accordance with the manufacturer's recommendations.
 - 4. Manufacturers

- a. Basis of Design: Emerson EDCO CX Series

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

- 1. Comply with the requirements of Section 27 0500.

3.2 SYSTEM TESTING

A. General

- 1. Comply with the requirements of Section 27 0500.

B. UPS

- 1. The Contractor shall, in the presence of the system designer, perform a full load test of the UPS system for twenty (20) minutes. This test shall simulate the loss of normal 120 VAC power. At the end of the test the Contractor shall reapply power and show immediate operation of the control system and the A/V matrix mixer.
- 2. Failure of the UPS during the twenty (20) minutes test period or the inability of the control system and the A/V matrix mixer to function fully immediately upon reactivation of the normal 120 VAC power source shall require recalculation, by the Contractor, of the UPS sizing calculations described elsewhere in this specification and re-testing after the system deficiency has been alleviated.

3.3 PROTECTION AND CLEANING

- A. Comply with the requirements of Section 16701.

3.4 FIELD QUALITY CONTROL

- A. Comply with the requirements of Section 16701.

3.5 DEMONSTRATION

- A. Comply with the requirements of Section 16701.

END OF SECTION 16795

Geotechnical Engineering Report

**Holden Heights Community Center
Orange County Contract Y11-903A
Orlando, Florida**

July 12, 2012
Project No. AK125004

Prepared for:
Orange County Capital Projects Division
Orlando, Florida

Prepared by:
Nodarse & Associates
A Terracon Company
Winter Park, Florida

July 12, 2012

Orange County Capital Projects Division
400 East South Street, Suite 500
Orlando, Florida 32801

Attn: Ms. Kim Lanham
P: [407] 836 0042
E: kim.lanham@ocfl.net

Re: Geotechnical Engineering Report
Holden Heights Community Center
Orange County Contract Y11-903A
Orlando, Florida
Nodarse/Page One Project Number: AK125004

Dear Mr. Lanham:

Nodarse/Page One, Joint Venture (Nodarse/Page One) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PH1120484 dated June 5, 2012. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, pavements, and stormwater management for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Nodarse/Page One Joint Venture

Kevin C. Martin, E.I.
Project Engineer

Enclosures
cc: 1 – Client (PDF)

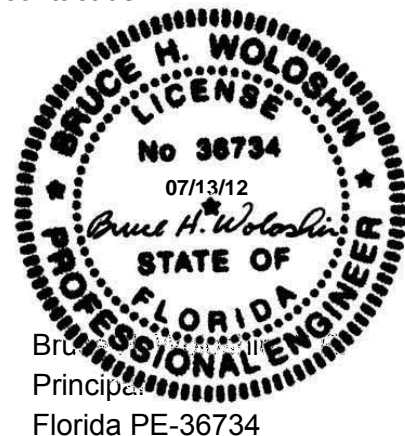


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EXECUTIVE SUMMARY

Geotechnical exploration has been performed for the proposed Holden Heights Community Center planned to be constructed on the northeast corner of South Orange Blossom Trail and 20th Street in Orlando, Orange County, Florida. Twelve (12) borings have been performed to depths of between 15 and 30 feet below the existing ground surface in the proposed building, pavement, and stormwater management areas.

Based on the information obtained from our geotechnical exploration, it appears that the site can be developed for the proposed project. The following geotechnical considerations were identified:

- The site appears to gently slope towards Lake June to the East. Therefore Nodarse/Page One anticipates 3 to 5 feet of fine grading fill may be necessary.
- The contractor should verify the groundwater conditions/depth immediately prior to construction. If signs of shallow groundwater are encountered, any dewatering necessary should commence prior to earthwork.
- The proposed structure may be supported on shallow footings bearing on the existing site soil or on newly placed engineered fill only if the proposed site preparations are followed according to the earthwork section of this report.
- With a bearing capacity of 2,000 psf, total allowable and differential settlement should be within normal limitations. If our assumed foundation loads change before construction, please let us know so that we may make any necessary modifications to our recommendations.
- The in-place sands appear suitable for re-use as general engineered fill. However, if compaction efforts become difficult because of excess moisture, the affected soil should be reconditioned and recompacted.
- The provided plan information does indicate inclusion of on-site stormwater management in the proposed site areas. Details of the proposed stormwater management system are not known at this time.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT HOLDEN HEIGHTS COMMUNITY CENTER ORLANDO, FLORIDA

Nodarse/Page One Project No. AK125004

July 12, 2012

1.0 INTRODUCTION

This geotechnical engineering report has been prepared for the proposed Holden Heights Community Center which will be located on the northeast corner of South Orange Blossom Trail and 20th Street in Orlando, Orange County, Florida, as shown on the Topographic Vicinity Map included as Exhibit A-1 in Appendix A. Twelve (12) soil borings were performed to depths of between 15 and 30 feet below the existing ground surface within the areas of the proposed building, pavement, and stormwater areas. Logs of the borings along with a Boring Location Diagram (Exhibit A-3) are included in Appendix A of this report. Laboratory testing procedures are included in Exhibit B-1 in Appendix B.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- floor slab design and construction
- pavement design and construction
- foundation design and construction
- stormwater design parameters

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-3: Boring Location Plan
Structure	The project will include an assumed one-story community center building with associated stormwater and parking areas.
Building Construction	Assumed Masonry Block Load Bearing Wall or Concrete Tilt Panels Structural Steel, Joists and Decking
Finished floor elevation	Above existing grade (assumed)
Maximum loads	Columns: 100 kips (assumed) Walls: 4 kips per linear foot (assumed) Slabs: 150 psf (assumed)

Item	Description
Maximum allowable settlement	Total: 1-inch (assumed) Differential: ½ inch (assumed)
Grading	Fill – fine grading, estimated at up to approximately 3 to 5 feet. Cuts– assumed to be no steeper than 3H:1V (Horizontal to Vertical)
Design traffic	Standard duty: 30,000 E ₁₈ SALs (given ¹) Heavy duty: 50,000 E ₁₈ SALs (given ¹)
Stormwater Management	A proposed stormwater management system is planned but details of this system are not known at this time.

1. Pavement design to be based on the indicated total number of 18-kip equivalent single axle load repetitions (E₁₈SALs) over a 20-year design life.

2.2 Site Location and Description

Item	Description
Location	This project will be located on the northeast corner of South Orange Blossom Trail and 20th Street in Orlando, Orange County, Florida.
Existing improvements	No existing structures on site.
Current ground cover	The site has been cleared.
Existing topography	Site currently appears nearly level. The USGS topographic quadrangle map Orlando West depicts the developed topography as nearly flat, with native ground surface elevations ranging from about elevation 100 feet to 104 feet referencing the National Geodetic Vertical Datum of 1929 (NGVD29).
Surface Water	The USGS topographic quadrangle map Orlando West depicts Lake June directly to the east of the proposed site, respectively with water level elevations of 99 feet NGVD29.

3.0 SUBSURFACE CONDITIONS

3.1 Regional Geology

The Soil Survey of Orange County, Florida, cites T. M. Scott of the Florida Geological Survey who wrote that Orange County is located in the north-central part of peninsular Florida, east and southeast of the crest of the Ocala Uplift, or the Ocala High. The area is underlain by extensive deposits of Eocene age carbonates covered by younger dolomite, limestone, sand, clay, and shell beds. The dissolution of limestone and the marine processes are the dominant forces responsible for the development of the surface features observed in the county.

Two major, generalized physiographic divisions occur in Orange County. They are the Central Highlands and the Coastal Lowlands. The Central Highlands form the western one-third of the county, and the Coastal Lowlands form the eastern two thirds. The highland area includes such physiographic features as the Marion Upland; the Mount Dora Ridge, the Lake Wales Ridge, and the Orlando Ridge; and the Central Valley. The Coastal Lowlands include the Eastern Valley, the Wekiva Plain, and the Osceola Plain.

Orange County is underlain Upper Eocene limestone units of the Ocala Group. These sedimentary deposits are very fine or fine grained, are chalky and porous, and have a cream color. The surface of the limestone generally dips eastward from the outcrop area west of Orange County under an increasing thickness of younger materials. The surface is irregular because of the dissolution of the limestone.

3.2 USDA – SCS Soil Survey

The Soil Survey of Orange County, Florida, (print, CD/floppy disk, and web versions) as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (SCS; later renamed the Natural Resource Conservation Service - NRCS), originally published in 1975, identifies the soil type at the subject site as Lochloosa Fine Sand and Wabasso Urban Land Complex. It should be noted that the Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be encountered. Boundaries between adjacent soil types on the Soil Survey maps are approximate. Descriptions of the mapped soil units are included in Appendix A as Exhibit A-14.

3.3 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	0 to 13.5	Fine sand to fine sand with silt ¹ (SP/SP-SM)	Very loose to medium dense
2	13.5 to 30	Fine sand with silt to silty fine sand ² (SP-SM/SM)	Loose to medium dense

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
	1. Fine sand with clay (SP-SC) was encountered in borings TB-5 and TB-6 from depths of 2 to 4 feet below existing grade. 2. Clayey fine sand (SC) was encountered in boring B-3 from depths of 23.5 to 28.5 feet below existing grade.		

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report. Descriptions of our field exploration are included as Exhibit A-4 in Appendix A. Descriptions of our laboratory testing procedures are included in Appendix B.

3.4 Groundwater

The boreholes were observed during drilling for the presence and level of groundwater. Groundwater was observed in all of the borings, between depths of 4½ and 7 feet below existing grade. Longer term monitoring in cased holes or piezometers, possibly installed to greater depths than explored under this project scope, would be required to better define groundwater conditions at the site.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the boring was performed. In addition, perched water can develop within higher permeability soils overlying less permeable soils. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the boring logs.

We estimate that during the June through October wet season, with rainfall and recharge at a maximum, groundwater levels will be about 1 to 2 feet below the existing grade. Our estimates of the seasonal groundwater conditions are based on the USDA Soil Survey, the Topographic Vicinity Map, the encountered soil types, and the encountered water levels. The estimated seasonal high water tables are included on the boring logs.

Estimates of the seasonal high water table presented in this report are based on and limited by the data collected during our geotechnical exploration, and the referenced published documents. Estimates of the seasonal high assume normal precipitation volumes and distribution. The seasonal high water table in any particular year will vary depending upon whether that year is a “wet” year, a “dry” year, or a “normal” year. These seasonal water table estimates do not represent the temporary rise in water table that occurs immediately following a

storm event, including adjacent to other stormwater management facilities. This is different from static groundwater levels in wet ponds and/or drainage canals which can affect the design water levels of new, nearby ponds. The seasonal high water table will be affected by any extreme weather changes, localized or regional flooding, karst activity, future grading, drainage improvements, or other construction that may occur on or around the site following the date of this report.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

It is our opinion that the proposed Holden Heights Community Center could be supported on shallow spread footings if the recommended site preparation procedures are implemented at the site. The site also appears suitable for support of concrete and asphalt pavements. Stabilizing material or borrow fill will likely be necessary for the construction of pavement subgrades.

The near surficial clean sands appear suitable for reuse as engineered fill. Our recommendations regarding design and construction of foundations, floor slabs, pavements, and stormwater management are provided in the following sections.

4.2 Earthwork

4.2.1 Site Preparation

Based on our estimated seasonal high water levels and grading assumptions, we recommend that the contractor verify the groundwater conditions/depth immediately prior to construction. If signs of shallow groundwater are encountered, any dewatering necessary should commence prior to earthwork. The design of a dewatering system falls under the contractor's choice of "means and methods", and should be designed by a qualified contractor. Dewatering should maintain a separation of at least 2 feet between the groundwater and all compaction surfaces.

We anticipate construction will be initiated by clearing any surface or subgrade debris that may have accumulated on the site and stripping the topsoil. Stripping depths between our boring locations and across the site could vary and we recommend actual stripping depths be evaluated by a representative of Nodarse/Page One during construction.

Once stripping is complete, the exposed subgrade should be observed, tested and proofrolled with a minimum of 10 overlapping passes of a medium or heavy weight roller (minimum 10,000 pounds static weight) operating in static mode due to the proximity to existing structures. Proofrolling aids in providing a firm base for compaction of new fill and delineating soft or disturbed areas that may exist at or near the exposed subgrade level as well overall

densification of the upper loose sands. Proofrolling should be performed in the presence of a Nodarse/Page One representative in order to aid in evaluating unstable subgrade areas. Unstable areas observed at this time should be improved as recommended by the engineer based on field conditions and typically includes scarification and recompaction or by undercutting and replacement with suitable compacted fill.

4.2.2 Material Requirements

Compacted structural fill should meet the following material property requirements:

Fill Type ¹	USCS Classification	Acceptable Location for Placement
General ¹	SP to SP-SM (fines content < 10 percent)	All locations and elevations

1. The in-place sands appear to meet this criterion.

4.2.3 Compaction Requirements

Item	Description
Fill Lift Thickness	12 inches or less in loose thickness when heavy compaction equipment is used in vibratory mode. Lift thickness should be decreased if static compaction is being used, typically to no more than 8 inches, and the required compaction must still be achieved. 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
Compaction Requirements ¹	95% of the material's maximum modified Proctor dry density (ASTM D 1557)
Moisture Content	Within ±2 percent of optimum moisture content as determined by the Modified Proctor test, at the time of placement and compaction.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

4.2.4 Grading and Drainage

Final surrounding grades should be sloped away from the structure on all sides to prevent ponding of water. Roof drainage should discharge to the stormwater system or a minimum of 10 feet beyond the footprint of the proposed structures.

4.2.5 Earthwork Construction Considerations

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. The use of static

compaction and/or light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. Should unstable subgrade conditions develop, stabilization measures will need to be employed.

Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

Trees or other vegetation whose root systems have the ability to remove excessive moisture from the subgrade or heave and crack pavement should not be planted adjacent to the pavement. Trees and shrubbery should be kept away from pavement edges a distance at least equal to 1.5 times their expected mature height or canopy diameter. Installation of landscape drains should be considered around the back sides of curbs to collect and control landscape irrigation and other water entering through landscaping from entering the sides of the pavement sections, reducing the potential for water-related damage. Landscape drains should be routed to the stormwater collection or other positive outfall, away from the pavement.

As a minimum, all temporary excavations should be sloped or braced as required to comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom.

The Geotechnical Engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of building floor slabs.

4.3 Foundations

In our opinion, the proposed Holden Heights Community Center building can be supported by a shallow spread footing foundation system bearing on native soil, approved existing fill, or newly placed fill extending to native soil. Design recommendations for shallow foundations for the proposed building are presented in the following sections.

4.3.1 Foundation Design Recommendations

Description	Column	Wall
Net allowable bearing pressure ¹		
■ Compacted structural fill or native soils	2,000 psf	2,000 psf
Minimum footing width	30 inches	24 inches
Minimum embedment below finished grade ²	24 inches	24 inches
Approximate total settlement from foundation loads ³	<1 inch	< 1 inch
Estimated differential settlement from foundation loads ³	<0.5 inch between columns	<3/4 inch over 40 feet
Minimum Compaction Requirements	95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557)	95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557)
Minimum Testing Frequency	One field density test per footing	One field density test per 100 linear feet

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable existing fill or soft soils, if encountered, will be undercut and replaced with compacted structural fill. Based upon a minimum Factor of Safety of 2.5.
2. Relative to lowest adjacent finished grade, typically exterior grade.
3. The above settlement estimates from foundation loads previously stated have assumed that the maximum footing size is 7.5 feet for column footings and 2 feet for continuous footings.

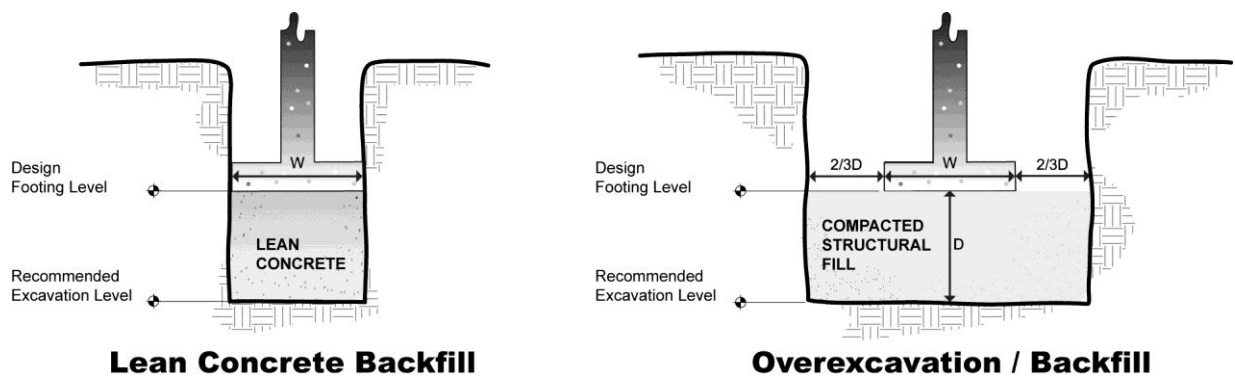
4.3.2 Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, the affected soil should be reconditioned and recompacted or removed prior to placing concrete. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

Nodarse/Page One anticipates all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, the affected soil should be removed prior to placing concrete. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

Nodarse/Page One anticipates hand-operated compaction equipment will be utilized, as necessary, in footing cuts, following any mass grading. If unsuitable bearing soils are

encountered in footing excavations, the excavation should be extended deeper to suitable soils and the footing could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. As an alternative, the footings could also bear on properly compacted backfill extending down to the suitable soils. Overexcavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation per the preceding general earthwork specifications, using hand operated compaction equipment in footing cuts. The overexcavation and backfill procedure is described in the following figure.



Lean Concrete Backfill

Overexcavation / Backfill

NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

4.4 Floor Slabs

4.4.1 Floor Slab Design Recommendations

Item	Description
Floor slab support	Free draining granular material meeting the general fill specification ¹
Modulus of subgrade reaction	150 pounds per square inch per inch (psi/in) for point loading conditions
Compaction Requirements	95 percent of the materials maximum Modified Proctor dry density (ASTM D 1557)
Item	Description
Minimum Testing Frequency	One field density test per 2,500 square feet or a minimum of 5 field density tests.

1. The in-place sandy soil appears to meet this criterion.

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or any cracks that develop should be sealed with a water-proof, non-extruding

compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

4.4.2 Floor Slab Construction Considerations

The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302, ACI 360, and Florida Building Code (FBC) Section 1807 and Appendix E – Chapter 9 B-67 regarding radon for procedures and cautions regarding the use and placement of a vapor retarder. We note that FBC Section 1807 requires a minimum of 6-mil polyethylene, which is typically used in Florida. However, local requirements that might affect what moisture barrier may use should also be consulted.

4.5 Pavements

Nodarse/Page One anticipates that recommendations for both Portland cement concrete (PCC) pavements and asphalt concrete sections will be required. Following are recommendations for both PCC pavement and asphalt concrete pavement sections for a 20-year pavement design period. The design period is considered to be the interval over which, with proper maintenance, the pavement will not require major repairs. A continuing regular maintenance program should be implemented to maintain satisfactory serviceability over the design life. The maintenance program should include sealing cracks and repairing minor deficiencies before they become major problems. The following sections present our recommendations for both rigid (concrete) pavement sections and flexible (asphalt) pavement sections.

4.5.1 Subgrade Preparation

We recommend the subgrades supporting pavements be prepared in accordance with the recommendations in the **Earthwork** section of this report. Pavements sections should conform to the latest edition of the Florida Building Code and/or any other local municipal requirements.

4.5.2 Design Considerations

Detailed traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. We anticipate that traffic loads will be produced primarily by automobile traffic and occasional delivery and trash removal trucks. The thickness of pavements subjected to heavy truck traffic should be determined using expected traffic volumes, vehicle types, and vehicle loads and should be in accordance with local, city, or county ordinances.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%;
- The subgrade and pavement surface should have a minimum 2% slope to promote proper surface drainage;
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting;
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils;
- Place compacted, low permeability backfill against the exterior side of curb and gutter; and,
- Place curb, gutter and/or sidewalk directly on stabilized subgrade soils rather than on unbound granular base course materials.

Estimates of minimum thicknesses for new pavement sections for this project have been based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). The following minimum thicknesses were estimated based upon our estimated traffic loading, limited soils information, variation across the project area, and experience with similar projects and soil conditions.

4.5.3 Asphaltic Cement Concrete Thickness Design Recommendations

Minimum Recommended ACC Pavement Section Thickness (inches)				
Traffic Area	Asphalt Surface	Base Course	Stabilized Subgrade ¹	Total Thickness
Light Duty (Automobile Parking)	1.5	6.0	12.0	19.5
Minimum Recommended ACC Pavement Section Thickness (inches)				
Traffic Area	Asphalt Surface	Base Course	Stabilized Subgrade ¹	Total Thickness
Heavy Duty (Drive Lanes/ Entrances/Exits)	2.5	8.0	12.0	22.5

1. Also known as Stabilized Subbase.

- The upper 1 foot of pavement subgrade soils (also identified as stabilized subbase) should be stabilized to a minimum Limerock Bearing Ratio (LBR; Florida Method of Test

Designation FM 5-515) value of 40 if they do not already meet this criterion, or replaced with new compacted fill that meets the minimum LBR value. This LBR criterion measures the “quality” of the soils. Although LBR testing has not been performed, our experience with similar soils indicates that the near surficial sands encountered in the soil borings are unlikely to meet this requirement.

- The stabilized subgrade course should be compacted to at least 98 percent of the Modified Proctor maximum dry density (AASHTO T-180 or ASTM D-1557). Any underlying, newly-placed subgrade fill need only be compacted to a minimum of 95 percent of the Modified Proctor maximum dry density.
- The subgrade and the pavement surface have a minimum ¼ inch per foot slope to promote effective surface drainage.
- Adequate separation is provided between the bottom of the base course and the seasonal high water table. Nodarse/Page One recommends a minimum separation of 12 inches for this purpose. Based on the encountered conditions and anticipated development, we anticipate this requirement will be met.
- The base course may be either limerock, soil cement, or washed crushed concrete. It should be noted that soil cement base courses typically experience shrinkage cracking due to hydration curing of the cement. This shrinkage cracking typically propagates through the overlying asphalt course and reflects in the pavement surface. This reflective cracking is not necessarily indicative of a pavement structural failure, though it is sometimes considered to be aesthetically undesirable. Regular pavement maintenance should be employed such that this sort of cracking does not exacerbate into greater pavement degradation.
- Limerock base courses should be mined from a Florida Department of Transportation (FDOT) approved source, should have a minimum LBR value of 100, and be compacted to a minimum of 98 percent of the maximum dry density as determined by the Modified Proctor test. Limerock should be placed in uniform lifts not to exceed 6 inches loose thickness.
- The asphalt surface course should be Marshall mix unless restricted by Orange County or other local jurisdiction.
- For light duty sections, surface courses should have a minimum stability of 1,000 pounds while for heavy duty sections, surface courses should have a minimum stability of 1,500 pounds. Asphalt should be compacted to a minimum of 95 percent of the Marshall design density. Asphalt surface courses should be Type S-III or other suitable mix design according to FDOT.

- To verify thicknesses, after placement and compaction of the pavement courses, core the wearing surface to evaluate material thickness and composition at a minimum frequency of 3,000 square feet or two locations per day's production.
- All curbing should be full depth. Use of extruded curb sections which lie on top of asphalt surface courses can allow migration of water between the surface and base courses, leading to rippling and pavement deterioration.
- Underdrains should be considered around all landscape islands and all other irrigated areas to control groundwater intrusion into the pavement base.

4.5.4 Portland Cement Concrete Thickness Design Recommendations

Minimum Recommended PCC Pavement Section Thickness (inches)			
Traffic Area	Portland Cement Concrete	Aggregate Base ¹	Total Thickness
Light Duty (Automobile Parking)	5.0	12.0	17.0
Heavy Duty (Drive Lanes/ Entrances/Exits)	6.0	12.0	18.0
Dumpster Pad ²	7.0	12.0	19.0

1. At least one foot of free-draining material should be included directly beneath rigid concrete pavement. Fill meeting the requirements presented in Section 4.2 (Earthwork) of this report may be considered free-draining for this purpose. Limerock should not be considered free draining for this purpose.
2. The trash container pad should be large enough to support the container and the tipping axle of the collection truck.

The following items are applicable to rigid concrete pavement sections.

- The upper 1 foot of rigid pavement subgrade soils should be compacted to at least 95 percent of the Modified Proctor maximum dry density (AASHTO T-180 or ASTM D-1557).
- The subgrade and the pavement surface have a minimum ¼ inch per foot slope to promote proper surface drainage.
- Rigid PCC pavements will perform better than ACC in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting

and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

- Adequate separation should be provided between the bottom of the concrete and the seasonal high water table. Nodarse/Page One recommends that in no case should less than 1 foot of separation be provided. Based on the encountered conditions and anticipated development, we anticipate this requirement will be met.
- Concrete pavement sections should include adequate details for joint spacing, joint reinforcement, and joint sealing be prepared in accordance with American Concrete Institute (ACI 330R-01 and ACI 325R.9-91). Portland cement concrete pavements should be provided with mechanically reinforced joints (doweled or keyed) in accordance with ACI 330R-01.
- Sawcut patterns should generally be square or rectangular but nearly square, and extend to a depth equal to a quarter of the slab thickness. If the bottom of the concrete pavement is separated from the seasonal high water table by at least 1 foot, filter fabric will not be necessary beneath the expansion joints.
- All curbing should be to the full depth of the pavement.

Rigid Portland cement concrete (PCC) pavement component thicknesses were derived based on general characterization of the subgrade and the assumption that concrete with a compressive strength of at least 4,000 psi will be utilized for all concrete pavements at the project. Further, we assume the concrete has a modulus of rupture of at least 580 psi. The following table does not include the thickness of the compacted subgrade because the compacted subgrade is assumed to be in-place soils rather than a pavement structural layer. Pavements should also meet the requirements of the Land Development Code of Orange County and any other applicable local jurisdictional requirements.

4.5.5 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage. Underdrains should be considered around all landscape islands and all other irrigated areas to control groundwater intrusion into the pavement base.

4.5.6 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

4.6 Stormwater Management

Laboratory permeability testing was performed on undisturbed samples of the anticipated stormwater management subgrade soils at boring locations TB-1 through TB-6, from between depths of 2 and 3 feet below existing grade. The table below shows the measured permeability rates for each of the boring locations tested. This value is indicative of the vertical permeability because an undisturbed sample was taken as opposed to a bulk sample. The vertical permeability is on the order of 2/3 times the horizontal permeability rate for the observed soil types.

The SPT borings at the permeability testing locations encountered fine sand to fine sand with silt to 13 feet and silty fine sand to the termination depth of 15 feet. Silty fine sand and fine sand with clay was observed in some of the boring locations at various depths across the site. . The table below summarizes our recommended stormwater management system design parameters.

Parameter	Boring Location TB-1 ²	Boring Location TB-2 ²	Boring Location TB-3 ²	Boring Location TB-4 ²	Boring Location TB-5 ²	Boring Location TB-6 ²
Boring Elevation	+104	+103	+103	+102	+100	+100
Estimated Confining Layer Elevation, B ¹	+91	+90	+90	+94	+98	+98
Estimated Seasonal High Water Table Elevation, WT	+102	+101	+101	+100	+99	+99

Parameter	Boring Location TB-1 ²	Boring Location TB-2 ²	Boring Location TB-3 ²	Boring Location TB-4 ²	Boring Location TB-5 ²	Boring Location TB-6 ²
Measured Saturated Vertical Infiltration Rate (ft/day), k_v	10	2	2	16	14	6
Recommended Horizontal Saturated Hydraulic Conductivity (ft/day), k_H	15	3	3	20	20	9
Recommended Saturated Vertical Infiltration Rate (ft/day), k_v	10	2	2	15	15	6
Fillable Porosity, η (%)	25	25	25	25	25	25

1. The depth to the confining layer should be re-evaluated when the geometry and location of the stormwater management system is determined.
2. All boring elevations are approximate. Once site specific topographic information is available, the seasonal high groundwater level used in stormwater system design should be re-evaluated.

5.0 GENERAL COMMENTS

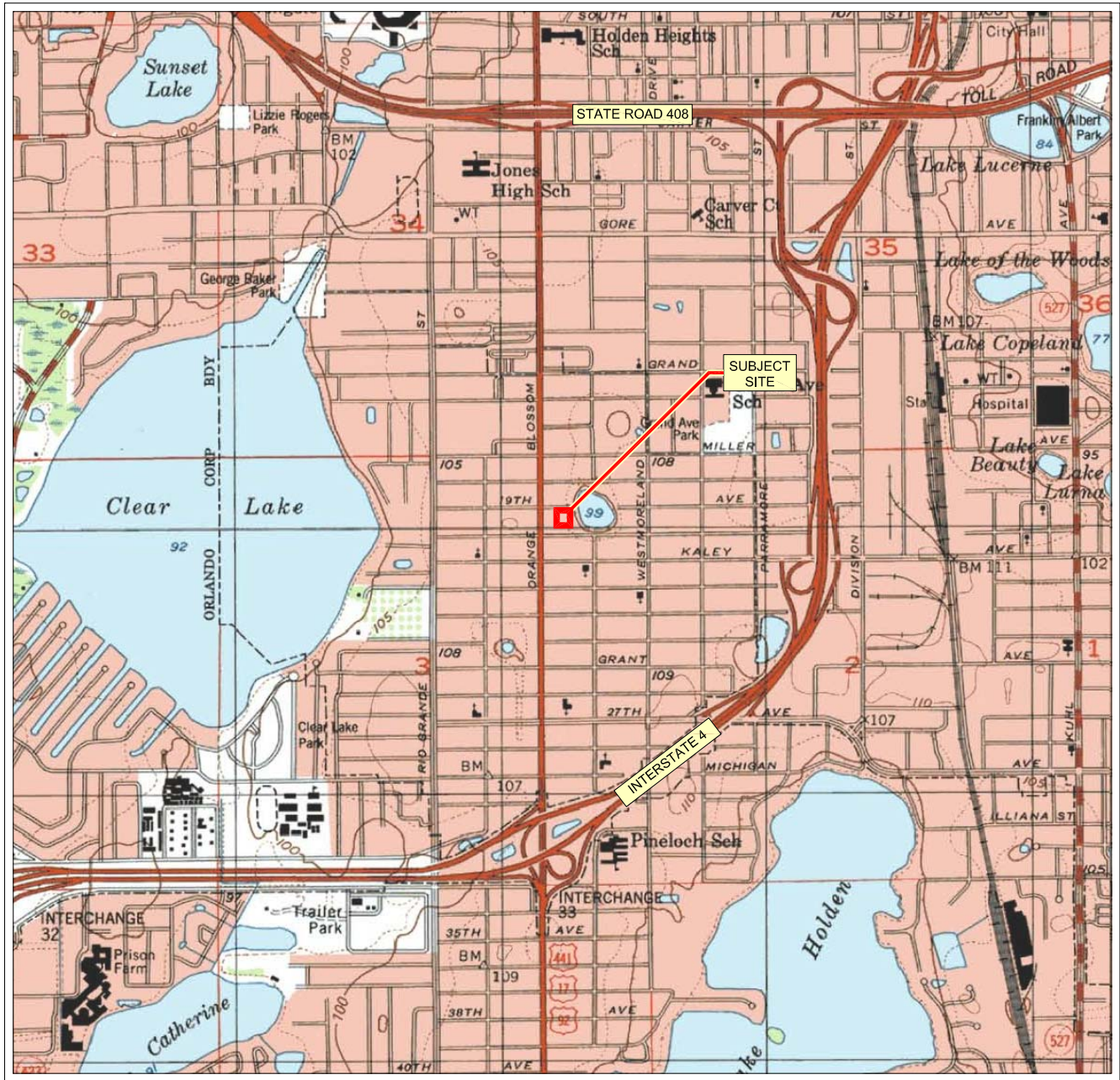
Nodarse/Page One should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Nodarse/Page One also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

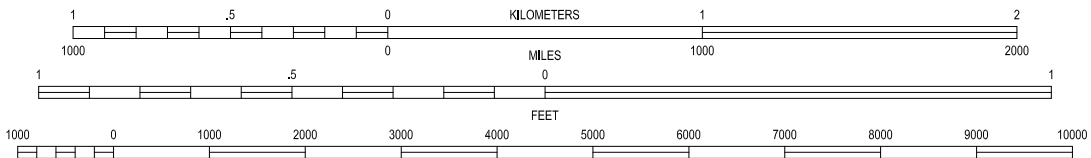
The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Nodarse/Page One reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



SCALE 1:24 000



CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

SECTION: 19
TOWNSHIP: 23 SOUTH
RANGE: 29 EAST

ORLANDO WEST, FLORIDA
1995
7.5 MINUTE SERIES (QUADRANGLE)



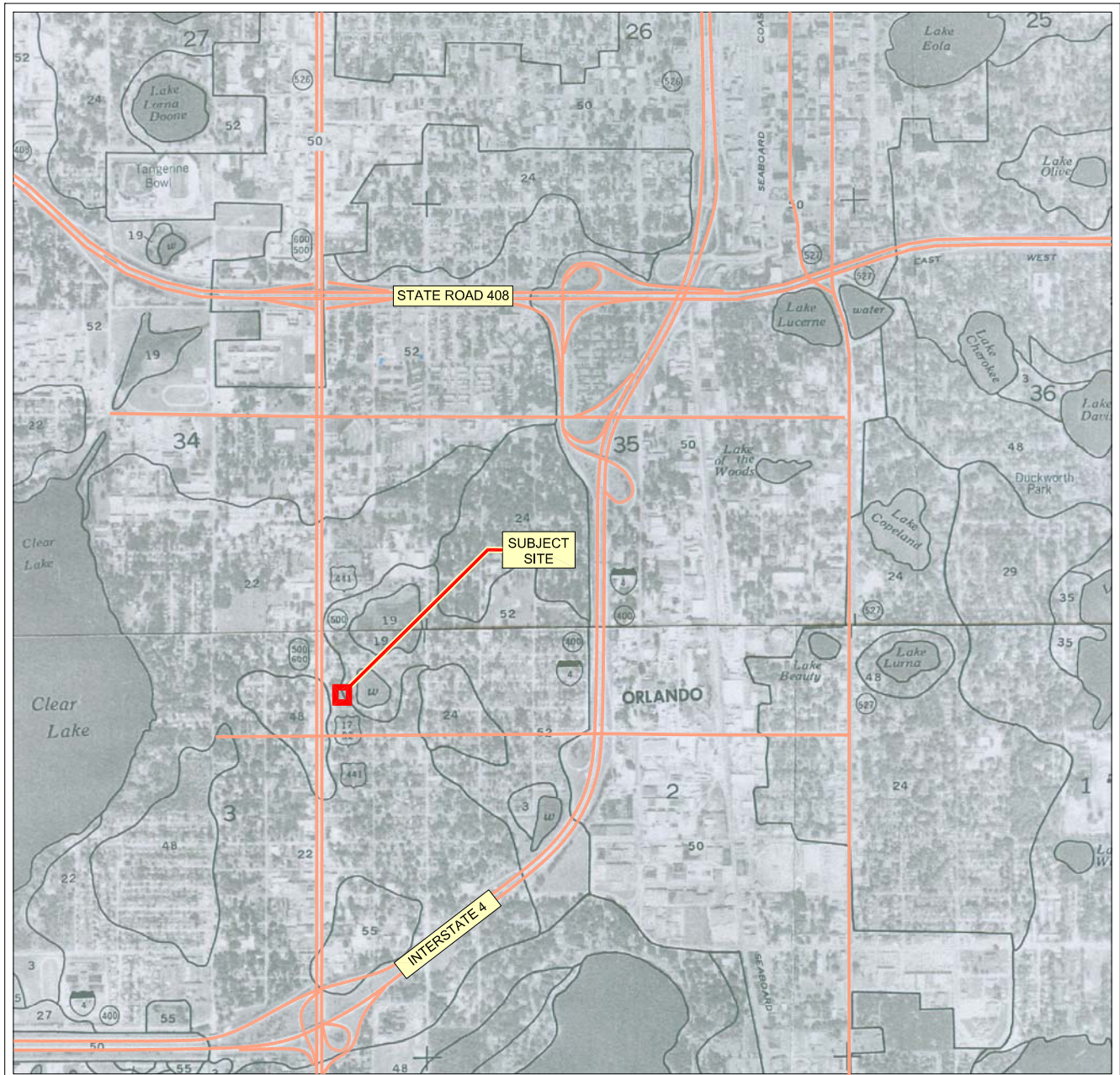
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Project Mngr:	KM	Project No.	AK125004
Drawn By:	MG	Scale:	AS SHOWN
Checked By:	KM	File No.	AK125004
Approved By:	BHW	Date:	7-6-12

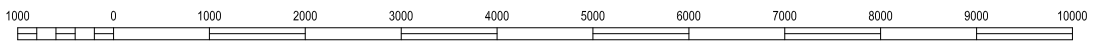
Terracon
Consulting Engineers and Scientists
1675 LEE ROAD WINTER PARK, FLORIDA 32789
PH. (407) 740-6110 FAX. (407) 740-6112

TOPOGRAPHIC VICINITY MAP
GEOTECHNICAL ENGINEERING REPORT
PINECASTLE BOULEVARD
6433 PINECASTLE BOULEVARD
ORLANDO, ORANGE COUNTY, FLORIDA

EXHIBIT
A-1



SCALE 1" = 2000'



U.S.D.A. SOIL SURVEY FOR ORANGE COUNTY, FLORIDA
 ISSUE: AUGUST 1989

SECTION: 19
 TOWNSHIP: 23 SOUTH
 RANGE: 29 EAST

SOIL LEGEND	
22	LOCHLOOSA FINE SAND
52	WABASSO-URBAN LAND COMPLEX



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Project Mngr:	KM	Project No.	AK125004
Drawn By:	MG	Scale:	AS SHOWN
Checked By:	KM	File No.	AK125004
Approved By:	BHW	Date:	7-6-12

Terracon
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SOILS MAP
 GEOTECHNICAL ENGINEERING REPORT
 PINECASTLE BOULEVARD
 6433 PINECASTLE BOULEVARD
 ORLANDO, ORANGE COUNTY, FLORIDA

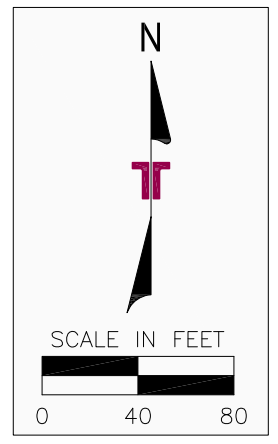
EXHIBIT
 A-2



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LEGEND

 APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING



Project Mngr:	KM	Project No.	AK125004
Drawn By:	MG	Scale:	AS SHOWN
Checked By:	KM	File No.	AK125004
Approved By:	BHW	Date:	7-6-12

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BORING LOCATION PLAN
GEOTECHNICAL ENGINEERING REPORT
PINECASTLE BOULEVARD
 6433 PINECASTLE BOULEVARD
 ORLANDO, ORANGE COUNTY, FLORIDA

EXHIBIT

A-3

Field Exploration Description

The boring locations were laid out at the project site by Nodarse/Page One personnel. The locations indicated on the attached diagram are approximate and were measured by pacing distances and estimating right angles, across vegetated/wooded terrain. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The SPT soil borings were drilled with a truck-mounted CME automatic SPT hammer to advance the split-barrel sampler in the borings performed on this site. The boreholes were advanced with a cutting head and stabilized with the use of bentonite (drillers' mud). A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs.

Portions of the samples from the borings were sealed in glass jars to reduce moisture loss, and then the jars were taken to our laboratory for further observation and classification. Upon completion, the boreholes were backfilled with the site soil.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation of the samples.

BORING LOG NO. B-01

PROJECT: Holden Heights Community Center	CLIENT: Oragne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.


GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
	FINE SAND WITH SILT (SP-SM) , gray	4.0	▽	X	2-4-5-4 N=9			
	FINE SAND (SP) , reddish brown	6.0		X	2-3-3-3 N=6		19	6
	FINE SAND WITH SILT (SP-SM) , reddish brown	13.5	▽	X	3-2-3-3 N=5			
	FINE SAND (SP) , grayish-brown	18.5		X	2-1-3-2 N=4			
	FINE SAND WITH SILT (SP-SM) , grayish-brown	28.5		X	2-1-2-5 N=3			
	FINE SAND (SP) , grayish-brown	30.0		X	6-9-10 N=19			
	Boring Terminated at 30 Feet				4-5-5 N=10			
					6-5-4 N=9			
					6-7-12 N=19			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head
Abandonment Method: Borings backfilled with soil cuttings upon completion.
WATER LEVEL
▽ <i>Estimated Seasonal High Water Table</i>
▽ <i>Depth of Water Table While Drilling</i>

See Exhibit A-4 for description of field procedures
See Appendix B for description of laboratory procedures and additional data, (if any).
See Appendix C for explanation of symbols and abbreviations.



NODARSE
A TERRACON COMPANY
1675 Lee Road
Winter Park, Florida

Notes:	
Boring Started: 6/30/2012	Boring Completed: 6/30/2012
Drill Rig: D-50	Driller: Travis
Project No.: AK125004	Exhibit A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12

BORING LOG NO. B-02

PROJECT: Holden Heights Community Center	CLIENT: Oragne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.

GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
2.0	FINE SAND WITH SILT (SP-SM) , dark gray	2.0	▽	X	2-2-2-2 N=4			
18.5	FINE SAND (SP) , light gray to brown	5		X	2-2-2-2 N=4			
18.5		10	▽	X	2-3-4-4 N=7			
18.5		15		X	3-2-3-3 N=5			
18.5		20		X	2-3-3-4 N=6			
18.5		25		X	5-6-8 N=14			
18.5	SILTY FINE SAND (SM) , grayish-brown	30.0		X	10-12-12 N=24			
30.0	Boring Terminated at 30 Feet	30		X	3-9-10 N=19			
30.0		30		X	6-7-9 N=16			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head	See Exhibit A-4 for description of field procedures See Appendix B for description of laboratory procedures and additional data, (if any).
Abandonment Method: Borings backfilled with soil cuttings upon completion.	See Appendix C for explanation of symbols and abbreviations.

Notes:	
Boring Started: 6/30/2012	Boring Completed: 6/30/2012
Drill Rig: DR009	Driller: Travis
Project No.: AK125004	Exhibit A-6

WATER LEVEL
▽ <i>Estimated Seasonal High Water Table</i>
▽ <i>Depth of Water Table While Drilling</i>



THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12

BORING LOG NO. B-03

PROJECT: Holden Heights Community Center	CLIENT: Oragne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.


GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
	FINE SAND WITH SILT (SP-SM) , dark gray	4.0	▽		2-1-3-3 N=4			
	FINE SAND (SP) , reddish brown	5	▼		2-1-2-3 N=3			
		10			3-4-3-4 N=7			
		13.5			2-1-2-3 N=3			
	SILTY FINE SAND (SM) , grayish-brown	15			4-4-6-7 N=10		19	24
		20			4-5-7 N=12			
		23.5			7-11-12 N=23			
	CLAYEY FINE SAND (SC) , grayish-brown	25			3-8-9 N=17			
		28.5			6-5-5 N=10			
	FINE SAND (SP) , grayish-brown	30.0						
Boring Terminated at 30 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head
Abandonment Method: Borings backfilled with soil cuttings upon completion.
WATER LEVEL
▽ <i>Estimated Seasonal High Water Table</i>
▼ <i>Depth of Water Table While Drilling</i>

See Exhibit A-4 for description of field procedures
See Appendix B for description of laboratory procedures and additional data, (if any).
See Appendix C for explanation of symbols and abbreviations.



NODARSE
A TERRACON COMPANY
1675 Lee Road
Winter Park, Florida

Notes:	
Boring Started: 6/30/2012	Boring Completed: 6/30/2012
Drill Rig: D-50	Driller: Travis
Project No.: AK125004	Exhibit A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12

BORING LOG NO. B-04

PROJECT: Holden Heights Community Center	CLIENT: Oagne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.


GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
2.0	FINE SAND WITH SILT (SP-SM) , dark gray	2.0	▽	X	1-2-3-4 N=5			
13.5	FINE SAND (SP) , brown	5		X	3-2-3-2 N=5			
13.5		5		X	2-2-3-3 N=5			
13.5		8	▽	X	2-3-3-4 N=6			
13.5		10		X	3-3-3-3 N=6			
13.5	SILTY FINE SAND (SM) , grayish-brown	15		X	5-6-6 N=12			
23.5		20		X	4-5-5 N=10			
23.5	FINE SAND WITH SILT (SP-SM) , grayish-brown	25		X	6-10-10 N=20			
30.0		30		X	6-6-6 N=12			
	Boring Terminated at 30 Feet	30						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head
Abandonment Method: Borings backfilled with soil cuttings upon completion.
WATER LEVEL
▽ <i>Estimated Seasonal High Water Table</i>
▽ <i>Depth of Water Table While Drilling</i>

See Exhibit A-4 for description of field procedures
See Appendix B for description of laboratory procedures and additional data, (if any).
See Appendix C for explanation of symbols and abbreviations.



NODARSE
A TERRACON COMPANY
1675 Lee Road
Winter Park, Florida

Notes:	
Boring Started: 6/28/2012	Boring Completed: 6/28/2012
Drill Rig: D-50	Driller: Travis
Project No.: AK125004	Exhibit A-8

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BORING LOG NO. B-05


PROJECT: Holden Heights Community Center	CLIENT: Oragne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.

GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
	FINE SAND WITH SILT (SP-SM) , dark gray	2.0	▽		2-2-3-2 N=5			
	FINE SAND (SP) , reddish brown to brown		▽		3-2-3-2 N=5			
		5			2-3-2-2 N=5			
					2-3-4-6 N=7			
		10			6-6-5-6 N=11			
	SILTY FINE SAND (SM) , grayish-brown	13.5			6-9-9 N=18			
	FINE SAND (SP) , grayish-brown	18.5			6-8-9 N=17			
	SILTY FINE SAND (SM) , grayish-brown	23.5			7-8-7 N=15		19	20
	FINE SAND (SP) , grayish-brown	28.5			6-5-5 N=10			
	Boring Terminated at 30 Feet	30.0						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head	See Exhibit A-4 for description of field procedures See Appendix B for description of laboratory procedures and additional data, (if any). See Appendix C for explanation of symbols and abbreviations.
Abandonment Method: Borings backfilled with soil cuttings upon completion.	
WATER LEVEL	
▽ <i>Estimated Seasonal High Water Table</i>	
▽ <i>Depth of Water Table While Drilling</i>	


NODARSE
A TERRACON COMPANY
 1675 Lee Road
 Winter Park, Florida

Notes:	
Boring Started: 6/28/2012	Boring Completed: 6/28/2012
Drill Rig: D-50	Driller: Travis
Project No.: AK125004	Exhibit A-9

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BORING LOG NO. B-06

PROJECT: Holden Heights Community Center	CLIENT: Oragne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.


GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
	FINE SAND WITH SILT (SP-SM) , dark gray to light brown	5	▽	X	2-2-5-4 N=7			
		10		X	2-3-3-3 N=6		13	9
		13.5	▼	X	3-4-3-3 N=7			
		15		X	2-2-2-2 N=4			
	SILTY FINE SAND (SM) , light gray	20		X	2-3-3-2 N=6			
		25		X	5-6-6 N=12			
		28.5		X	3-3-2 N=5			
	FINE SAND (SP) , light brown	30		X	5-5-6 N=11			
	Boring Terminated at 30 Feet			X	6-6-6 N=12			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head
Abandonment Method: Borings backfilled with soil cuttings upon completion.
WATER LEVEL
▽ <i>Estimated Seasonal High Water Table</i>
▼ <i>Depth of Water Table While Drilling</i>

See Exhibit A-4 for description of field procedures
See Appendix B for description of laboratory procedures and additional data, (if any).
See Appendix C for explanation of symbols and abbreviations.



NODARSE
A TERRACON COMPANY
1675 Lee Road
Winter Park, Florida

Notes:	
Boring Started: 6/28/2012	Boring Completed: 6/28/2012
Drill Rig: D-50	Driller: Travis
Project No.: AK125004	Exhibit A-10

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12


BORING LOG NO. TB-01

PROJECT: Holden Heights Community Center	CLIENT: Oagne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.

GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
8.0	FINE SAND (SP) , light gray to grayish-brown	5	▽	2-3-3-3 N=6				
		5		2-2-2-2 N=4		10	10	7
		5		2-2-2-2 N=4				
		8.0	▽	2-1-2-2 N=3				
15.0	FINE SAND WITH SILT (SP-SM) , grayish-brown	10		1-1-1-1 N=2			23	8
		15		4-6-9 N=15				
	Boring Terminated at 15 Feet	15						
		20						
		25						
		30						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head	See Exhibit A-4 for description of field procedures See Appendix B for description of laboratory procedures and additional data, (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Borings backfilled with soil cuttings upon completion.		
WATER LEVEL	 NODARSE A TERRACON COMPANY 1675 Lee Road Winter Park, Florida	Boring Started: 6/30/2012 Boring Completed: 6/30/2012
▽ <i>Estimated Seasonal High Water Table</i>		Drill Rig: D-50 Driller: Travis
▽ <i>Depth of Water Table While Drilling</i>		Project No.: AK125004 Exhibit A-11

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BORING LOG NO. TB-02

PROJECT: Holden Heights Community Center	CLIENT: Oagne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.


GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
	FINE SAND WITH SILT (SP-SM) , dark gray	2.0	▽	X	1-2-3-2 N=5			
	FINE SAND WITH SILT (SP-SM) , reddish brown	5.0		X	2-2-2-2 N=4	2	13	8
		7.5		X	2-1-2-2 N=3			
		10.0	▽	X	2-1-1-1 N=2		24	11
		12.5		X	3-4-5-5 N=9			
	SILTY FINE SAND (SM) , grayish-brown	13.5		X	5-5-5 N=10			
	Boring Terminated at 15 Feet	15.0		X				
		20.0						
		25.0						
		30.0						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head
Abandonment Method: Borings backfilled with soil cuttings upon completion.
WATER LEVEL
▽ <i>Estimated Seasonal High Water Table</i>
▽ <i>Depth of Water Table While Drilling</i>

See Exhibit A-4 for description of field procedures
See Appendix B for description of laboratory procedures and additional data, (if any).
See Appendix C for explanation of symbols and abbreviations.



NODARSE
A TERRACON COMPANY
1675 Lee Road
Winter Park, Florida

Notes:	
Boring Started: 6/30/2012	Boring Completed: 6/30/2012
Drill Rig: D-50	Driller: Travis
Project No.: AK125004	Exhibit A-12

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12


BORING LOG NO. TB-03

PROJECT: Holden Heights Community Center	CLIENT: Oagne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.

GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
2.0	FINE SAND WITH SILT (SP-SM) , reddish brown	2.0	▽	X	2-2-2-2 N=4			
4.0	FINE SAND (SP) , brown	4.0		X	2-2-2-2 N=4	2	15	9
13.5	FINE SAND WITH SILT (SP-SM) , brown	5	▽	X	2-2-2-2 N=4		23	10
15.0	SILTY FINE SAND (SM) , grayish-brown	10		X	1-1-2-5 N=3			
		15		X	3-3-4-3 N=7			
	Boring Terminated at 15 Feet	15		X	3-4-5 N=9			
		20						
		25						
		30						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head	See Exhibit A-4 for description of field procedures See Appendix B for description of laboratory procedures and additional data, (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Borings backfilled with soil cuttings upon completion.		
WATER LEVEL		Boring Started: 6/30/2012 Boring Completed: 6/30/2012
▽ <i>Estimated Seasonal High Water Table</i>	1675 Lee Road Winter Park, Florida	Drill Rig: D-50 Driller: Travis
▽ <i>Depth of Water Table While Drilling</i>		Project No.: AK125004 Exhibit A-13

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12

BORING LOG NO. TB-04


PROJECT: Holden Heights Community Center	CLIENT: Oagne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.

GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
	FINE SAND WITH SILT (SP-SM) , dark gray to reddish brown	4.0	▽		1-2-3-3 N=5			
	FINE SAND (SP) , brown	5.0	▽		2-2-2-2 N=4	16	16	10
	SILTY FINE SAND (SM) , light brown	8.0	▽		1-1-1-1 N=2			
		10.0			1-2-3-3 N=5			
		15.0			3-3-4-3 N=7		21	20
	Boring Terminated at 15 Feet	15.0			4-5-6 N=11			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head	See Exhibit A-4 for description of field procedures See Appendix B for description of laboratory procedures and additional data, (if any). See Appendix C for explanation of symbols and abbreviations.
Abandonment Method: Borings backfilled with soil cuttings upon completion.	
WATER LEVEL	
▽ <i>Estimated Seasonal High Water Table</i>	
▽ <i>Depth of Water Table While Drilling</i>	


NODARSE
A TERRACON COMPANY
 1675 Lee Road
 Winter Park, Florida

Notes:	
Boring Started: 6/28/2012	Boring Completed: 6/28/2012
Drill Rig: D-50	Driller: Travis
Project No.: AK125004	Exhibit A-14

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12


BORING LOG NO. TB-05

PROJECT: Holden Heights Community Center	CLIENT: Oagne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.

GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
	FINE SAND WITH SILT (SP-SM) , brown	2.0	▽		2-3-3-4 N=6			
	FINE SAND WITH CLAY (SP-SC) , light brown	4.0			4-4-3-3 N=7	14	15	14
	FINE SAND WITH SILT (SP-SM) , brown	5.0			3-4-5-3 N=9			
		10.0	▽		1-1-1-2 N=2		22	11
		10.0			2-2-3-3 N=5			
	SILTY FINE SAND (SM) , gray	13.5						
		15.0			5-7-9 N=16			
	Boring Terminated at 15 Feet							
		15.0						
		20.0						
		25.0						
		30.0						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head	See Exhibit A-4 for description of field procedures See Appendix B for description of laboratory procedures and additional data, (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Borings backfilled with soil cuttings upon completion.		
WATER LEVEL	 NODARSE A TERRACON COMPANY 1675 Lee Road Winter Park, Florida	Boring Started: 6/28/2012 Boring Completed: 6/28/2012
▽ <i>Estimated Seasonal High Water Table</i>		Drill Rig: D-50 Driller: Travis
▽ <i>Depth of Water Table While Drilling</i>		Project No.: AK125004 Exhibit A-15

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12


BORING LOG NO. TB-06

PROJECT: Holden Heights Community Center	CLIENT: Oagne County Capital Projects Orlando, Florida
SITE: S. Orange Blossom Trail and 20th Street Orlando, Orange County, Florida	Project Engineer: Kevin C. Martin, E.I.

GRAPHIC LOG	LOCATION See Exhibit A-3	DEPTH (ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Permeability (ft/day)	WATER CONTENT (%)	Percent Fines
	DEPTH							
2.0	FINE SAND (SP) , brown	2.0	▽		2-1-7-5 N=8			
4.0	FINE SAND WITH CLAY (SP-SC) , light brown	4.0			5-4-4-3 N=8	6	12	10
5.0	SILTY FINE SAND (SM) , gray to brown	5.0			4-3-4-3 N=7		32	12
		7.0	▽		4-3-2-2 N=5			
		10.0			2-3-4-6 N=7			
		15.0			5-6-10 N=16			
	Boring Terminated at 15 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Rotary drilling cutting head	See Exhibit A-4 for description of field procedures See Appendix B for description of laboratory procedures and additional data, (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Borings backfilled with soil cuttings upon completion.		
WATER LEVEL ▽ <i>Estimated Seasonal High Water Table</i>	 NODARSE A TERRACON COMPANY 1675 Lee Road Winter Park, Florida	Boring Started: 6/28/2012 Boring Completed: 6/28/2012
▽ <i>Depth of Water Table While Drilling</i>		Drill Rig: D-50 Driller: Travis
		Project No.: AK125004 Exhibit A-16

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LOG-DEPTH TO BOTTOM OF PAGE AK125004.GPJ TERRACON2012.GDT 7/12/12

Soil Survey Descriptions

22 – *Lochloosa fine sand.* This soil type is nearly level and somewhat poorly drained. It is typically found in the slightly high positions on the flatwoods. During years of normal precipitation, this soil type has a seasonal high water table between depths of 30 and 60 inches (2.5 and 5.0 feet) of the natural ground surface for 1 to 4 months. During rainy seasons, groundwater rises to a depth of 15 inches (1.3 feet) for 1 to 3 weeks. During prolonged dry periods, the groundwater table recedes to a depth of more than 60 inches (5.0 feet). This soil type is predominantly sandy to a typical depth of 29 inches (2.4 feet). Thereafter, to the maximum defined depth of 80 inches (6.7 feet), this soil type exists as silty clayey sand to clayey sand (USCS Classification symbol SC-SM to SC).

52 – *Wabasso-Urban land complex.* This complex consists of areas of Wabasso soil that is nearly level and poorly drained and areas of Urban land. It is typically found on broad flatwoods. Some areas of this complex have been modified by grading and shaping. The soil that is excavated from drainage ditches or imported fill is often used to fill the low areas. Drainage systems have been established in most areas. In undrained areas, this soil map complex has a seasonal high groundwater table at a depth of 10 to 40 inches (0.8 to 3.3 feet) for more than 6 months, and at a depth of less than 10 inches (0.8 feet) for 1 to 2 months. It recedes to a depth of more than 40 inches (3.3 feet) during prolonged dry periods. Wabasso soil is predominantly sandy to a typical depth of 16 inches (1.3 feet). Thereafter, to a typical depth of 25 inches (2.1 feet), Wabasso soil exists as sand with silt to silty sand (USCS Classification symbol SP-SM to SM). Thereafter, to a typical depth of 42 inches (3.5 feet), Wabasso soil exists as silty clayey sand to clayey sand (USCS Classification symbol SC-SM to SC). Thereafter, to the maximum defined depth of 80 inches (6.7 feet), Wabasso soil exists as sand with silt to silty sand (USCS Classification symbol SP-SM to SM). The areas of Urban land have been covered or altered such that the natural soil profile is no longer observable.

APPENDIX B
SUPPORTING INFORMATION

Laboratory Testing

During the field exploration, a portion of each recovered sample was sealed in a glass jar and transported to our laboratory for further visual observation and laboratory testing. Selected samples retrieved from the borings were tested for moisture (water) content, fines content (soil passing a US standard #200 sieve). Those results are included in this report and on the respective boring logs. The visual-manual classifications were modified as appropriate based upon the laboratory testing results.

The soil samples were classified in general accordance with the appended General Notes and the Unified Soil Classification System based on the material's texture and plasticity. The estimated group symbol for the Unified Soil Classification System is shown on the boring logs and a brief description of the Unified Soil Classification System is included in Appendix B. The results of our laboratory testing are presented on the corresponding borings logs.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1- ³ / ₈ " I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling	ESH:	Estimated Seasonal High Groundwater
DCI:	Dry Cave in	BCR:	Before Casing Removal	ESL:	Estimated Seasonal Low Groundwater
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

<u>Unconfined Compressive Strength, Qu, psf</u>	<u>Standard Penetration or N-value (SS) Blows/Ft*</u>	<u>Consistency</u>
< 500	0 – 1	Very Soft
500 – 1,000	2 – 3	Soft
1,000 – 2,000	4 – 6	Medium Stiff
2,000 – 4,000	7 – 12	Stiff
4,000 – 8,000	13 – 26	Very Stiff
8,000+	> 26	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

<u>Standard Penetration or N-value (SS) Blows/Ft.</u>	<u>Relative Density</u>
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30



Rev. 4/10

Exhibit C-1

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	$Cu < 4$ and/or $1 > Cc > 3$ ^E	GP	Poorly graded gravel ^F	
		Clean Sands: Less than 5% fines ^D	Fines classify as ML or MH	GM	Silty gravel ^{F,G,H}	
		Sands with Fines: More than 12% fines ^D	Fines classify as CL or CH	GC	Clayey gravel ^{F,G,H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
		Sands with Fines: More than 12% fines ^D	$Cu < 6$ and/or $1 > Cc > 3$ ^E	SP	Poorly graded sand ^I	
		Clean Sands: Less than 5% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G,H,I}	
		Sands with Fines: More than 12% fines ^D	Fines classify as CL or CH	SC	Clayey sand ^{G,H,I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line ^J	CL	Lean clay ^{K,L,M}	
		Inorganic:	$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K,L,M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K,L,M,N}
		Organic:	Liquid limit - not dried			Organic silt ^{K,L,M,O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K,L,M}	
		Inorganic:	PI plots below "A" line	MH	Elastic Silt ^{K,L,M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K,L,M,P}
		Organic:	Liquid limit - not dried			Organic silt ^{K,L,M,Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve
^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay
^E $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.
^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.
^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.
^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.
^N $PI \geq 4$ and plots on or above "A" line.
^O $PI < 4$ or plots below "A" line.
^P PI plots on or above "A" line.
^Q PI plots below "A" line.

