ORANGE COUNTY
WILLOW STREET COMMUNITY CENTER
HVAC REPLACEMENT
BID DOCUMENTS

FOR
ORANGE COUNTY
CAPITAL PROJECTS DEPARTMENT
IOC II, 400 EAST SOUTH STREET, SUITE 500
ORLANDO, FLORIDA 32801

BY
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ORANGE COUNTY
WILLOW STREET COMMUNITY CENTER
HVAC REPLACEMENT
JANUARY 30, 2015
BID DOCUMENTS

Division 8	**Doors and Windows**
08311	Access Doors and Frames

Division 9	**Finishes**
09250	Gypsum Assemblies
09511	Acoustic Panel Ceilings
09900	Painting

Division 10	**Specialties**
10200	Louvers and Vents

Division 11 thru 14
NOT USED

Division 15	**Mechanical**
15010	Mechanical General Provisions
15030	Electrical Provisions of Mechanical Work
15050	Basic Materials and Methods
15055	Piping Materials and Methods
15060	Pipes and Pipe Fittings
15097	Pipe, Escutcheons and Guards
15100	Valves
15125	Expansion Compensation
15135	Meters and Gages
15140	Supports and Anchors
15190	Mechanical Identification
15220	Water Treatment
15250	Mechanical Insulation
15682	Air Cooled Water Chillers
15855	Air Handling Units
15870	Exhaust Fans
15885	Air Cleaning Devices
15891	Metal Ductwork
15900	Building Automation Systems
15910	Ductwork Accessories
15932	Air Outlets and Inlets
15990	Testing, Adjusting and Balancing

Division 16	**Electrical**
16010	Electrical General Provisions
16060	Minor Electrical Demolition for Remodeling
16110	Raceways
16120	Wires and Cables
16135	Electrical Boxes
16142	Electrical Connections for Equipment
16143	Wiring Devices
16170	Circuit and Motor Disconnects
16180	Overcurrent Protective Devices
16190	Supporting Devices
16195	Electrical Identification
16450	Grounding
16470	Panelboards

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.

B. When the titles such as Engineer, Project Engineer, or Owner are used throughout this specification, this implies Orange County as property owner and/or an officially appointed County Representative.

1.02 PROJECT DESCRIPTION

A. Performance of all tasks specified in the contract documents shall be the responsibility of the contractor unless specified otherwise.

1.03 SCOPE OF WORK

A. The scope of work for this project includes but is not limited to all labor and materials necessary for the following:

1. Architectural scope generally includes demolition, protection, excavation, fill, concrete, masonry, miscelleneous carpentry, sealents, sheet metal flashing, gypsum work, ceilings, painting, as well as exterior louver work**.**
2. Contractor shall replace the existing DX split systems in the south portion of the building with new HVAC chilled water system. There are a total of two (2) DX split system air conditioning systems in the facility (both at 7.5 tons). These units will be replaced with two (2) new chilled water air handling units with 3-way valves – see floor plans and schedules for more information. Two existing exhaust fans serving the restrooms in the building shall be removed and replaced with new fans. The existing kitchen hood and associated exhaust and supply fans shall remain.
3. All new HVAC systems shall be a package air cooled water chiller with dual pumps, chilled water storage tank and associated insulated chilled water piping system.
4. Contractor shall replace all existing supply air, return air, outside air ductwork in the existing mechanical room. New ductwork shall connect to existing ductwork serving the building.
5. Contractor shall replace all existing VVT zone dampers with new variable air volume boxes and shall install additional VAV boxes and associated ductwork.
6. Contractor shall furnish and install new electrical provisions as required for all new and replaced HVAC equipment. Provide new 240 volt, three phase service to the building and to serve the new chiller.
7. Contractor shall remove and replace all hard ceilings in the building as necessary to accomplish the HVAC work.
8. The existing lay-in ceiling tiles and grid shall be removed and replaced as necessary to accomplish the HVAC work.
9. Contractor shall disconnect, remove, store and reinstall all electrical equipment mounted in the ceiling or on walls for areas to be renovated as necessary to accomplish the work. This includes lighting fixtures, speakers, smoke detectors, etc. Temporarily terminate wires and support all conduit from structure that may be resting on the ceiling.
10. Contractor shall protect or temporarily relocate all fixtures, equipment and furniture in the building throughout construction as necessary to accommodate the work.
11. Contractor shall test and balance all of the new HVAC systems and air distribution

systems. This work also includes the test and balance of the new exhaust systems. Test and Balance HVAC systems after each phase is completed and performs a final test and balance on the entire building including HVAC and exhaust systems after last phase is completed.

12. The facility shall remain fully occupied and functional throughout the project construction. Contractor shall work during occupied, non- occupied hours, evenings, weekends and holidays to perform the work.
13. Contractor shall repair/replace sections of the existing drywall/plaster ceiling or wall as necessary to accomplish the work. This is directed to the ceilings and walls surrounding exhaust fans to be replaced.
14. Contractor shall replace the existing Trane Controls system and all thermostats and temperature sensors with a new DDC Controls system.
15. Contractor shall provide temporary cooling and heating at the same or better comfort level during the construction period.

1.04 CONTRACTOR RESPONSIBILITIES

A. General:

1. The contractor shall have all submittals approved by the Engineer and accepted by the Owner prior to the start of active construction.
2. The contractor shall have all equipment and material onsite prior to the start of active construction.
3. The contractor shall submit to the Owner prior to the project pre-construction meeting the following:

   - Schedule of Values
   - Construction Schedule
   - Submittal Schedule
   - Emergency Telephone List including subcontractors and suppliers

4. The contractor shall field verify existing conditions of construction prior to start of active construction.
5. The contractor shall coordinate with the Owner on the operation of the existing fire alarm system prior to the start of active construction. There shall be an action plan for the operation of the fire alarm system during construction submitted by the contractor to the Owner for acceptance. This action plan shall be in place prior to the start of active construction. Any false fire alarms that occur during construction and deemed by the Owner to be the fault of the contractor, the contractor shall pay all costs incurred from the local fire department for responding to a false alarm.
6. The contractor is responsible for moving furniture and or equipment if necessary to perform the work included in the contract. The contractor is responsible for placing the furniture and or equipment back in its original location. The contractor is responsible for any damages to furniture, equipment, etc., which occur during construction. The contractor shall provide protection for floors, walls, furniture, equipment and any other items that may be subject to damage during the construction periods.
7. The contractor shall take digital pictures or video of pre-existing conditions of the interior and exterior of the building prior to the start of active construction. Failure to provide digital photographs or video prior to start of construction, places the responsibility on the Contractor to complete the necessary replacement, repairs, and or cleaning as determined by the Owner at no additional cost to the Owner. One CD copy of digital pictures or video of the existing site conditions shall be submitted to the Owner.
8. The contractor shall at all times maintain daily cleanup of construction areas. Work areas that are not cleaned by the contractor, and cleaned by the Owner, those costs

shall be charged back to the contractor via change order.

9. The contractor shall provide a construction schedule to the Owner's Project Manager prior to the pre-construction meeting. The contractor shall update the construction schedule weekly and submit it to the Owner's Project Manager for review.

1.05 WORK UNDER OTHER CONTRACTS

A. Separate contracts may be issued to perform certain construction operations at the site. The contractor of this project will allow reasonable access and coordination to the other contractor/s.

1.06 WORK SEQUENCE

A. The facility shall remain fully occupied and operational for the duration of the project. All indoor and outdoor work shall be performed during normal business hours during the week. Normal business hours are defined as 7:00 am to 5:00 pm, Monday to Friday. Material and equipment deliveries will be during normal business hours.

1.07 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 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 only use portion(s) of the site for storage or work areas only with prior approval from Orange County Project Manager.

1. Confine operations to areas within Contract limits indicated on the Drawings. 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 Owner's 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.

4. Where appropriate, maintain the existing building in a watertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

5. Confine construction operations to the areas permitted by the contract documents and other Owner directives.

6. Provide protection and safekeeping of material and equipment stored on premises.

7. Contractor will move any stored material and equipment, which interfere with operations of the Owner or other contractors at no additional cost to the Owner..

8. Comply with Owner's requirements for ingress and egress procedures, prohibitions against firearms, procedures for transportation of workers, safety and fire prevention requirements and all applicable pollution control requirements. Refer to the following reference requirements:

a) Orange County Safety and Health Manual
http://www.orangecountyfl.net/VendorServices/OrangeCountySafetyandHealthManual.aspx

b) Orange County Policy Manual page 96 regarding Firearms http://www.orangecountyfl.net/portals/0/resource%20library/employment%20-%20volunteerism/Policy%20Manual.pdf

9. Contractor to require all employees and subcontractors to wear non-objectionable clothing; prohibit revealing clothing and articles of clothing with offensive writings displayed. The contractor shall require offending personnel to leave the premises until such clothing is changed.

10. Contractor employees and subcontractors will not fraternize with County employees or the general public during the entire construction period.

11. Use of sound equipment (such as boom boxes, stereos, radios, etc.) is not allowed.

12. Contractor and their personnel shall abide to Orange County Tobacco free policy while on any Orange County Convention Center property. This policy shall apply to building, parking lots, parks, break areas and worksites. Tobacco is defined as tobacco products, including but not limited to: Cigars, cigarettes, pipes, chewing tobacco and snuff. Failure to abide by the policy may result in civil penalties levied under Chapter 386, Florida Statutes and/or Contract enforcement remedies. Refer to the following documents:

a) Orange County Smoking Policy: http://www.orangecountyfl.net/Portals/0/resource%20library/employment%20-%20volunteerism/Employee%20Handbook.pdf

13. Conduct that is disrespectful, abusive or otherwise objectionable to the Owners' employees or general public will not be allowed at any time during the construction period. Repetitive complaints and violations of the requirements listed above will be cause for dismissal and or permanent removal of offending personnel from the project.

14. Contractor to coordinate with the Owner the site location for storage of equipment, machinery, materials, tools and a construction waste dumpster.

15. Contractor shall at all times keep the premises free of all waste or surplus materials, rubbish and debris, which is caused by contractor employees or subcontractors resulting from their work. Contractor shall maintain a safe work environment to all building occupants during the construction period.

1.08 SECURITY AND IDENTIFICATION

A. The building shall be secured from unwarranted entry at the end of each workday.

B. All costs for background investigations will be Contractor's responsibility. The County shall have the right to request any additional investigative background information including, but limited to, the employment record, Right-To-Know records, E-Verify system records (if the Contractor uses this service as a means to determine employment eligibility, available through www.uscis.gov), training records, payroll records, position for which hired including site location of any personnel assigned to perform the services. The Contractor shall furnish, in writing, such information to the extent allowed by law, prior to commencement of services. The County reserves the right to conduct its own investigation of any employee of the Contractor.

C. Background Checks for the contractor's staff must be approved by Orange County's Security team prior to working in any County facility. Contractors are responsible for obtaining the necessary forms for background checks for work at Orange County. All contractor's staff background checks will be sent to the Orange County Project Manager for approval.

D. For security purposes and to maintain privacy, please submit a FDLE Background Checks via e-mail the subject line of the email must contain the following ***EXEMPT***

E. Orange County will inform the contractor of their Background Check results. Upon

Background Check approval, the contractor's staff shall arrange an appointment with the Orange County staff to obtain a Orange County photo ID badge. An affidavit of Identity form (issued by the contractor) and a State of Florida ID or Drivers License will be required.

F. Contractor's employees will not be allowed in Orange County facilities without completed and approved background investigations.

G. Work hours will be scheduled around business activity. Business activity is considered to be Orange County office/administrative staff located in or adjacent to construction/renovation site or Orange County Clients renting convention space located in or adjacent to construction/renovation site.

1.09 OWNER OCCUPANCY

A. Owner Occupancy: The Owner will be occupying the building during construction. Normal occupancy hours are 7:00 a.m. to 6:00 p.m. Monday through Friday. The contractor is to coordinate with the Owner's representative for areas in the building that work can be performed on during normal business hours. Work performed after normal business hours can be done provided the area where work is done is fully operational and back in original condition prior to beginning of the next business day. Such placing of equipment and partial occupancy shall not constitute acceptance of the total work.

1. A Certificate of Substantial Completion will be executed for each specific portion of the Work to be occupied prior to Owner occupancy.

2. Obtain a Certificate of Occupancy from local building officials prior to Owner occupancy.

3. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy, the Owner will provide operation and maintenance of mechanical and electrical systems in occupied portions of the building.

1.10 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.

1.11 CONTRACT DOCUMENT FILE

A. Copies of the Contract Documents, Plans, Specifications, Addenda, Change Orders, Engineers Supplemental Instructions, approved Shop Drawings, Substitution Acceptances, etc. shall be placed and maintained at the project site by the Contractor throughout the entire contract period. These said documents shall be filed in a manner that allows for ease of retrieval. Documents shall be made available to the Engineer and the County's representatives throughout this same period.

PART 2 - PRODUCTS

2.1 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 Engineer. 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.

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 Engineer
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 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. 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. HVAC: Typically shown per specification section, labor and material, per floor.
g. Electrical: same as HVAC.
h. Logical grouping of specification subsections are 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 Contractor's 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's 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 Contractor Construction Schedule. Use updated schedules if revisions have been made. ☐S

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 by means ensuring receipt within 24 hours; 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. Waivers of Mechanics Lien: With each Application for Payment submit waivers of mechanics liens from subcontractors of sub-subcontractors and suppliers for the construction period covered by the previous application.

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 Owner reserves the right to designate which entities involved in the work must submit waivers.
4. List all Subcontractor's start and finish dates to substantiate any Notice to Owner received by the Project Manager.

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 principal subcontractors
2. List of principal suppliers and fabricators
3. Schedule of Values
4. Approved Contractor's Construction Schedule (preliminary if not final)
5. Schedule of principal products
6. Schedule of unit prices (if applicable)
7. Submittal schedule (preliminary if not final)
8. List of Contractor's staff assignments
9. List of Contractor's principal consultants
10. Copies of building permits for trades requiring separate permits
11. Copies of authorizations and licenses from governing authorities for performance of the Work
12. Initial progress report
13. Report of Pre-construction Meeting
14. Initial settlement survey and damage report, (if required)
15. Listing of all long lead procurement items monthly applications for payment will be accompanied with updated schedule and review of as-built drawings

H. Interim Application for Payment: Payment will be processed once a month. No applications will be processed without receipt of previous months waiver of lien described in subsection F above. 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 interim applications.

I. 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.

J. Administrative actions and submittals that shall proceed or coincide with Substantial Completion Payment. Substantial Completion as defined per General Conditions Section "F" application include:

1. Occupancy permits and similar approvals
2. Warranties (guarantees) and maintenance agreements
3. Test/adjust/balance records
4. Maintenance instructions
5. Start-up performance reports
6. Change-over information related to Owner's occupancy, use, operation and maintenance
7. Final cleaning
8. Application for reduction of retainage, and consent of surety
9. List of incomplete Work, recognized as exceptions to Project Manager's Certificate of Substantial Completion

K. 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
3. Assurance that unsettled claims will be settled
4. Assurance that all work has been completed and accepted
5. Proof that taxes, fees and similar obligations have been paid
6. Removal of temporary facilities and services
7. Removal of surplus materials, rubbish and similar elements
8. Change of door locks to Owner's access
9. Submission of all close-out documents. Refer to Section 01700.

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.

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

1. Division 1 Section 01300 Submittals for requirements for the Contractor's Construction Schedule.
2. Division 1 Section 01027 Application for Payment for administrative procedures governing applications for payment.
3. Division 1 Section 01631 Product Substitutions for administrative procedures for handling requests for substitutions made after award of the Contract.

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 Engineer.

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. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. 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.

5. Contractor and subcontractors will provide a complete detailed labor and material breakdown to justify change order request amounts.

C. Proposal Request Form: Project Manager will transfer the information to the appropriate forms for approval. Use AIA Document G 709 for Change Order Proposal Requests.

D. Proposal Request Form: Use forms provided by the Owner for Change Order Proposals.

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.

1.06 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.

PART 2 PRODUCTS (Not Applicable)
PART 3 EXECUTION (Not Applicable)

END OF SECTION 01035

SECTION 01040
COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:

1. General project coordination procedures.

2. Conservation.

3. Coordination Drawings.

4. Administrative and supervisory personnel.

5. Cleaning and protection.

1.3 COORDINATION

A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

3. Make 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. 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 assure 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 closeout activities.

D. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the relationship of components shown on separate Shop Drawings.

2. Indicate required installation sequences.

3. Comply with the Article “Submittals” contained in each section.

B. Staff Names: Within fifteen (15) days of commencement of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers. 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

3.1 GENERAL COORDINATION 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. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

C. Provide labor and material required for a synchronized coordination of work with the G-010 project.

3.2 CLEANING AND PROTECTION

A. General: Refer to the General Conditions of the Contract for Construction.

B. Cleaning: Cleaning shall be performed by the Contractor on a daily basis. The entire Work area shall be left in a broom clean, or equivalent condition.

1. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration until Substantial Completion is accepted.

2. Clean and provide maintenance on completed construction necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

C. Protection - Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

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/Engineer to proceed with cutting and patching does not waive the Architect/Engineer'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

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

C. Visual and Weather Tightness Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect/Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching, or compromise weather tightness of the envelope and openings. 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
    j. Flashing and caulking.

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/Engineer/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 during cutting and patching operations. Provide protective covering over existing material during construction.

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, 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 – 01070 ABBREVIATIONS

PART 1 - GENERAL

A. GENERAL

A	Area Square Feet; Ampere
AAMA	Architectural Minimum Manufacturer's Association
ABS	Acrylonitrile Butadiene Styrene
A.C.	Alternating Current; Air conditioning; Plywood Grade A & C
A.B.	Anchor Belt
A.C.I.	American Concrete Institute
Acous.	Acoustical
AD	Plywood, Grade A & D
A.D.	Area Drain
Adh.	Adhesive
Addit	Additional
Adj.	Adjustable
af	Audio-frequency
Aff	Above Finished Floor
Afg	Above Finished Grade
A.G.A.	American Gas Association
Agg.	Aggregate
A.H.	Ampere Hours
A hr.	Ampere-hour
A.H.U.	Air Handing Unit
A.I.A.	American Institute of Architects
A.I.C.	Alternating Interrupting Capacity
AIC	Ampere Interrupting Capacity
AISC	American Institute of Steel Construction
Allow.	Allowance
ALT.	Alternate
Alt.	Altitude
Alum.	Aluminum
a.m.	Ante Meridiem
Amp.	Ampere
Anc.	Anchor
Anod.	Anodized
ANSCI	American National Standards Institute
A.P.	Access Panel
Appd.	Approved
Approx.	Approximately
Apt.	Apartment
Arch.	Architectural
Asb.	Asbestos
A.S.B.C.	American Standard Building Code
A.S.H.R.A.E.	American Society of Heating, Refrig. & AC Engineers
A.S.M.E.	American Society of Mechanical Engineers
A.S.T.M.	American Society for Testing and Materials
Attchmt.	Attachment
Auto.	Automatic

Avg.	Average
A.W.G.	American Wire Gauge
AWI	American Wood Institute
AWS	American Welding Society
Bbl.	Barrel
B.C.	Bare Copper
B.& B.	Grade B. and Better; Balled and Burlapped
B.& S.	Bell and Spigot
B.& W.	Black and White
b.c.c.	Body-centered Cubic
Bd	Board
BE	Bevel End
B.F.	Board Feet
BF.	Bottom Face
Bg. Cem	Bag of Cement
BHP	Boiler Horsepower, Brake Horsepower
B.I.	Black Iron
Bit. ;Bitum	Bituminous
Bk.	Backed
Bkrs.	Breakers
Bldg.	Building
Blk.	Block
Blkg.	Blocking
Bm.	Beam
B.M.	Benchmark
B.O.C.	Bottom of Curb
BOT.	Bottom
Boil.	Boilermaker
B.P.M.	Blows Per Minute
BR	Bedroom
Brg.	Bearing
Brhe.	Bricklayer Helper
Bric.	Bricklayer
Brk.	Brick
Brkt.	Bracket
Brng.	Bearing
Brs.	Brass
Brz.	Bronze
Bsmt.	Basement
Bsn.	Basin
Btr.	Better
BTU	British Thermal Unit
BTUH	BTU per hour
Btwn.	Between
B.U.R.	Built up Roofing
BX	Interlocked Armored Cable
c	Conductivity
C	Hundred; Centigrade
C.	Course
C/C	Center to Center
Cab.	Cabinet
Cair.	Air Tool Laborer
Calc.	Calculated

Cap.	Capacity
Carp.	Carpenter
C.B.	Circuit Breaker
C.BD.	Chalk Board
C.C.A.	Chromate Copper Arsenate
C.C.F.	Hundred Cubic Feet
cd	Candela
cd/sf	Candela per Square Feet
CD	Grade of Plywood Face & Back
CDX	Plywood, grade C & D, exterior glue
Cefi.	Cement Finisher
Cem.	Cement
Cer.	Ceramic
CF	Hundred Feet
C.F.	Cubic Feet
CFM	Cubic Feet per Minute
c.g.	Center of Gravity
CG	Corner Guard
CHW	Chilled Water
C.I.	Cast Iron
C.I.P.	Cast in Place
Circ.	Circuit
C.J.	Control Unit
C.L.	Carload Lot
Clab.	Common Laborer
Clec.	Clock Equipment Cabinet
C.L.F.	Hundred Linear Feet
CLF	Current Limiting Fuse
Clg.	Ceiling
Clkg.	Caulking
Clo.	Closed
CLP	Cross Linked Polyethylene
Clr.	Clear
cm	Centimeter
CMP	Corr. Metal Pipe
C.M.U.	Concrete Masonry Unit
Cntr.	Counter
C.O.	Cleanout
Col.	Column
Conn.	Connection
Cont.	Continuous
Cont.	Contractor
C.Opng.	Cased Opening
CO2	Carbon Dioxide
Comb.	Combination
Compr.	Compressor
Conc.	Continuous; Continued
Cond.	Conductor
Corr.	Corrugated
Cos	Cosine
Cot	Cotangent
Cov.	Cover
CPA	Control Point Adjustment

Cplg.	Coupling
C.P.M.	Critical Path Method
CPVC	Chlorinated Polyvinyl Chloride
C.Pr.	Hundred Pair
CRC	Cold Rolled Channel
Creos.	Creosote
Crpt.	Carpet & Linoleum Layer
CRT	Cathode Ray Tube
CS	Carbon Steel
Csc	Cosecant
C.S.F.	Hundred Square Feet
CSI	Construction Specifications Institute
C.T.	Current Transformer
CTS	Copper Tube Size
Cu	Cubic
Cu. Ft.	Cubic Foot
cw	Continuous Wave
C.W.	Cool White; Cold Water
C. Wall	Curtain Wall
Cwt.	100 Pounds
C.W.X.	Cool White Deluxe
C.Y.	Cubic Yard (27 cubic feet)
C.Y./Hr.	Cubic Yard per Hour
Cyl.	Cylinder
d	Penny (nail size)
D	Deep; Depth; Discharge
Dis; Disch	Discharge
Db.	Decibel
Dbl.	Double
DC	Direct Current
Demob.	Demobilization
d.f.u.	Drainage Fixture Units
D.H.	Double Hang
DHU	Domestic Hot Water
Diag.	Diagonal
Diam.	Diameter
Distrib.	Distribution
Dk.	Deck
D.L.	Deck Load
Do.	Ditto
Dp.	Depth
D.P.S.T.	Double Pole, Single Throw
Dr.	Driver
Drink.	Drinking
D.S.	Double Strength
D.S.A.	Double Strength A Grade
D.S.B.	Double Strength B Grade
Dty.	Duty
DWV	Drain Waste Vent
DX	Deluxe White, Direct Expansion
dyn	Dynbe
e	Eccentricity
E	Equipment only; East

Ea	Each
E.B.	Encased Burial
Econ.	Economy
EDP	Electronic Data Processing
E.D.R.	Equiv. Direct Radiation
Eq.	Equation
Elec.	Electrician; Electrical
Elev.	Elevator; Elevating
EMT	Electrical Metallic Conduit; Thin Wall Conduit
Eng.	Engine
EPDM	Ethylene Propylene Diene Monomer
Eqhv.	Equip. Oper., heavy
Eqlt.	Equip. Oper., light
Eqmd.	Equip. Oper., medium
Eqmm.	Equip. Oper., Master Mechanic
Equol.	Equip. Oper., Oilers
ERW	Electric Resistance Welded
Est.	Estimated
esu	Electrostatic Units
E.W.	Each Way
EWT	Entering Water Temperature
Excav.	Excavation
Exp.	Expansion, Exposure
Ext.	Exterior
Extru.	Extrusion
f.	Fiber Stress
F	Fahrenheit; Female; Fill
Fab.	Fabricated
F.B.C.	Florida Building Code
FBGS	Fiberglass
F.C.	Foot candles
f.c.c.	Face Centered Cubic
f'c	Compressive Stress in Concrete; Extreme Compressive Stress
F.E.	Front End
FRP	Fluorinated Ethylene Propylene (Teflon)
F.G.	Flat Grain
F.H.A.	Federal Housing Administration
Fig.	Figure
Fin	Finished
Fixt.	Fixture
Fl. Oz.	Fluid Ounces
Flr.	Floor
F.M.	Frequency Modulation; Factory Mutual
Fmg.	Framing
Fndtn.	Foundation
Fori.	Foreman; Inside
Fount.	Fountain
FPM	Feet Per Minute
Fr.	Frame
F.R.	Fire Rating
FRK	Foil Reinforced Kraft
FRP	Fiberglass Reinforced Plastic
FS	Forged Steel

FSC	Cast Body; Cast Switch Box
Ft.	Foot; Feet
Ftng.	Fitting
Ftg.	Footing
Ft.Lb.	Foot Pound
Furn.	Furniture
FVNR	Full Voltage Non-Reversing
FXM	Female by Male
Fy.	Minimum Yield Stress of Steel
g	Gram
G	Gauss
Ga.	Gauge
Gal.	Gallon
Gal./Min.	Gallon per Minute
Galv.	Galvanized
Gen.	General
G.F.I.	Ground Fault Interrupter
Glaz.	Glazier
GPD	Gallons per Day
GPH	Gallons per Hour
GPM	Gallons per Minute
GR	Grade
Gran.	Granular
Grnd.	Ground
H	High; High Strength Bar Joist; Henry
H.C.	High Capacity
H.D.	Heavy Duty; High Density
H.D.O.	High Density Overlaid
Hdr.	Header
Hdwe.	Hardware
Help.	Helper Average
HEPA	High Efficiency Particular Air Filter
Hg.	Mercury
HIC	High Interrupting Capacity
H.O.	High Output
Horiz.	Horizontal
H.P.	Horsepower; High Pressure
H.P.F.	High Power Factor
Hr.	Hour
Hrs./Day	Hours per Day
HSC	High Short Circuit
Ht.	Height
Htg.	Heating
Htrs.	Heaters
HVAC	Heating, Ventilating & Air Conditioning
Hvy.	Heavy
HW	Hot Water
Hyd.;Hydr.	Hydraulic
Hz.	Hertz (cycles)
I.	Moment of Inertia
I.C.	Interrupting Capacity
ID	Inside Diameter
I.D.	Inside Dimension; Identification

I.F.	Inside Frosted
I.M.C.	Intermediate Metal Conduit
In.	Inch
Incan.	Incandescent
Incl.	Included; Including
Int.	Interior
Inst.	Installation
Insul.	Insulation
I.P.	Iron Pipe
I.P.S.	Iron Pipe Size
I.P.T.	Iron Pipe Threaded
I.W.	Indirect Waste
J	Joule
J.I.C.	Joint Industrial Council
K	Thousand; Thousand Pounds; Heavy Wall Copper Tubing
K.A.H.	Thousand Amp. Hours
KCMIL	Thousand Circular Mils
KD	Knock Down
K.D.A.T.	Kiln Dried After Treatment
Kg	Kilogram
kG	Kilogauss
kgf	Kilogram force
kHz	Kilohertz
Kip	1000 Pounds
KJ	Kiljoule
K.L.	Effective Length Factor
Km	Kilometer
K.L.F.	Kips per Linear Foot
K.S.F.	Kips per Square Feet
K.S.I.	Kips per Square Inch
K.V.	Kilovolt
K.V.A	Kilovolt Ampere
K.V.A.R.	Kilovolt (Reactance)
KW	Kilowatt
KWh	Kilowatt-hour
L	Labor only; Length; Long; Medium Wall Copper Tubing
La.	Labor
lat	Latitude
Lath.	Lather
Lav.	Lavatory
lb,;#	Pound
L.B.	Load Bearing; L Conduit Body
L. & E.	Labor & Equipment
lb./hr.	Pounds per Hour
lb./L.F.	Pounds Per Linear Foot
L.C.L.	Less than Carload Lot
Ld.	Load
LE	Lead Equivalent
L.F.	Linear Foot
Lg.	Long; Length; Large
L. & H.	Light and Heat
L.H.	Long Span high Strength Bar Joist
L.J.	Long Span Standard Strength Bar Joist

L.L.	Live Load
L.L.D.	Lamp Lumen Depreciation
lm	Lumen
lm/sf	Lumen per Square Feet
lm/W	Lumen per Wall
L.O.A.	Length Over All
log	Logarithm
L.P.	Liquified Petroleum; Low Pressure
L.P.F.	Low Power Factor
L.R.	Long Radius
L.S.	Lump Sum
Lt.	Light
Lt.Ga	Light Gauge
L.T.L.	Less than Truckload Lot
Lt. Wt.	Lightweight
L.V.	Low Voltage
M	Thousand; Material; Male; Light Wall Copper Tubing
m/hr; M.H.	Man Hour
mA	Milliampere
Mach	Machine
Mag. Str.	Magnetic Starter
Maint.	Maintenance
Marb.	Marble Setter
Mat. Mat'l	Material
Max	Maximum
MBF	Thousand Board Feet
MBH	Thousand BTU's per hr.
MC	Metal Clad Cable
M.C.F.	Thousand Cubic Feet
M.C.F.M.	Thousand Cubic Feet per Minute
M.C.M.	Thousand Circular Mils
M.C.P.	Motor Circuit Protector
MD	Medium Duty
M.D.O.	Medium Density Overlaid
Med.	Medium
MF	Thousand Feet
M.F.B.M.	Thousand Feet Board Measure
Mfg.	Manufacturing
Mfrs.	Manufacturers
mg	Milligram
MGD	Million Gallons per Day
MGPH	Thousand Gallons per Hour
MH:M.H.	Manhole; Metal Halide; Man-Hour
MHz	Megahertz
Mi.	Mile
Ml	Malleable Iron; Mineral Insulated
mm	Millimeter
Mill.	Millwright
Min.;min.	Minimum; minute
Misc.	Miscellaneous
mi	Millimeter
M.L.F.	Thousand Linear Feet
Mo.	Month

Mobil.	Mobilization
Mog.	Mogul Base
MPH	Miles per Hour
MPT	Male Pipe Thread
MRT	Mile Round Trip
ms	Millisecond
M.S.F.	Thousand Square Feet
Mstz.	Mosaic & Terrazzo Worker
M.S.Y.	Thousand Square Yards
Mtd.	Mounted
Mthe.	Mosaic & Terrazzo Helper
Mult.	Multi; Multiply
M.V.A.	Million Volt Amperes
M.V.A.R.	Million Volt Amperes Reactance
MV	Megavolt
MW	Megawatt
MXM	Male by Male
MYD	Thousand Yards
N	Natural; North
nA	Nanoampere
NA	Not Available; Not applicable
N.B.C.	National Building Code
NC	Normally Closed
N.F.M.A.	National Electrical Manufacturers Association
NEHB	Bolted Circuit Breaker to 600V
N.L.B.	Non-Load-Bearing
NM	Non-Metallic Cable
nm	Nanometer
No.	Number
N.O.C.	Not Otherwise Classified
Nose.	Nosing
N.P.T.	National Pipe Thread
NQOB	Bolted Circuit Breaker to 240V
N.R.C.	Noise Reduction Coefficient
N.R.S.	Non Rising Stem
ns	Nanosecond
nW	Nanowatt
OB	Opposing Blade
OC	On-Center
OD	Outside Diameter
O.D.	Outside Dimension
ODS	Overhead Distribution System
O & P	Overhead and Profits
Oper.	Operator
Opng.	Opening
Orna.	Ornamental
O.S. & Y.	Outside Screw and Yoke
Ovhd.	Overhead
OWG	Oil, Water or Gas
Oz.	Ounce
P.	Pole; Applied Load; Projection
p.	Page
Pape.	Paperhanger

P.A.P.R.	Powered Air Purifying Respirator
PAR	Weatherproof Reflector
Pc.	Piece
P.C.	Portland Cement; Power Connector
P.C.M.	Phase Contract Microscopy
P.C.F.	Pounds per Cubic Feet
P.E.	Professional Engineer; Porcelain Enamel; Polyethylene; Plain End
Perf.	Perforated
Ph.	Phase
P.I.	Pressure Injected
Pile.	Pile Driver
pkg.	Package
Pl.	Plate
Plah.	Plaster Helper
Plas.	Plasterer
Pluh.	Plumbers Helper
Plum.	Plumber
Ply.	Plywood
p.m.	Post Meridiem
Pord.	Painter Ordinary
pp	Pages
PP;PPL	Polypropylene
P.P.M.	Parts per Million
Pr.	Pair
Prefab.	Prefabricated
Prefin.	Prefinished
Prop.	Propelled
PSF;psf	Pounds per Square Foot
PSI;psi	Pounds per Square Inch
PSIG	Pounds per Square Inch Gauge
PSP	Plastic Sever Pipe
Pspr.	Painter, Spray
Psst.	Painter, Structural Steel
P.T.	Potential Transformer
P. & T.	Pressure & Temperature
Ptd.	Painted
Ptns.	Partitions
Pu	Ultimate Load
PVC	Polyvinyl Chloride
Pvmt.	Pavement
Pwr.	Power
Q	Quantity Heat Flow
Quan.; Qty	Quantity
Q.C.	Quick Coupling
r	Radius of Gyration
R	Resistance
R.C.P.	Reinforced Concrete Pipe
Rect.	Rectangle
Reinf.	Reinforced
Req'd	Required
Res.	Resistant
Resi	Residential

Rgh.	Rough
R.H.W.	Rubber, Heat & Water Resistant; Residential Hot Water
rms	Root Mean Square
Rnd.	Round
Rodm.	Rodman
Rofc.	Roofer, Composition
Rofp.	Roofer, Prcast
Rohe.	Roofer Helpers (Composition)
Rots.	Roofer, Tile & Sale
R.O.W.	Right of Way
RPM	Revolutions per Minute
R.R.	Direct Burial Feeder Conduit
R.S.	Rapid Start
R.T.	Round Trip
S.	Suction; Single Entrance; South
Scaf.	Scaffold
Sch.;Sched.	Schedule
S.C.R.	Modular Brick
S.D.	Sound Deadening
S.D.R.	Standard Dimension Ratio
S.E.	Surfaced Edge
Sel.	Select
S.E.R.;S.E.U.	Service Entrance Cable
SF.	Square Foot
S.F.C.A.	Square Foot Contact Area
S.F.F.C.M.U.	Split Face Fluted Concrete Masonry Unit.
S.F.G.	Square Foot of Ground
S.F. Hor.	Square Foot Horizontal
S.R.F.	Square Foot of Radiation
S.F.Shlf.	Square Foot of Shelf
S4S	Surface 4 Sides
Shee.	Sheet Metal Worker
Sin.	Sine
Skwk.	Skilled Worker
S.L.	Saran Lined
S.L.	Slimline
Sldr.	Solder
S.N.	Solid Neutral
S.P.	Static Pressure; Single Pole; Self Propelled
Spri.	Sprinkler Installer
Sq.	Square; 100 Square Feet
S.P.D.T.	Single Pole, Double Throw
S.P.S.T.	Single Pole, Single Throw
SPT	Standard Pipe Thread
Sq.Hd.	Square Head
Sq.In.	Square Inch
S.S.	Single Strength; Stainless Steel
S.S.B.	Single Strength B Grade
Sswk.	Structural Steel Worker
Sswl.	Structural Steel Welder
St.;Stl.	Steel
S.T.C.	Sound Transmission Coefficient
Std.	Standard

STP	Standard Temperature & Pressure
Stpi.	Steamfitter, Pipefitter
Str.	Strength; Starter; Straight
Strd.	Stranded
Struct.	Structural
Sty.	Story
Subj.	Subject
Subs.	Subcontractors
Surf.	Surface
Sw.	Switch
Swbd.	Switchboard
S.Y.	Square Yard
Syn.	Synthetic
Sys.	System
t.	Thickness
T	Temperature; Ton
Tan	Tangent
T.C.	Terra Cotta
T & C	Threaded and Coupled
T.D.	Temperature Difference
T.E.M.	Transmission Electron Microscopy
TFE	Tetrafluoroethylene (teflon)
T.& G.	Tongue & Groove; Tar & Gravel
Th.;Thk.	Thick
Thn.	Thin
Thrded.	Threaded
Tilf.	Tile Layer Floor
Tilh.	Tile Layer Helper
THW	Insulated Strand Wire
THWN;THHN	Nylon Jacketed Wire
T.L.	Truckload
Tot.	Total
T.S.	Trigger Start
Tr.	Trade
Transf.	Transformer
Trhv.	Truck Driver, Heavy
Trir.	Trailer
Trit.	Truck Driver, Light
TV	Television
T.W.	Thermoplastic Water Resistant Wire
UCI	Uniform Construction Index
UF	Underground Feeder
U.H.F.	Ultra High Frequency
U.L.	Underwriters Laboratory
Unfin.	Unfinished
URD	Underground Residential Distribution
V	Volt
V.A.	Volt Amperes
V.C.T.	Vinyl Composition Tile
VAV	Variable Air Volume
VC	Veneer Core
Vent.	Ventilating
Vert.	Vertical

V.F.	Vinyl Faced
V.G.	Vertical Grain
V.H.F.	Very High Frequency
VHO	Very High Output
Vib.	Vibrating
V.L.F.	Vertical Linear Foot
Vol.	Volume
W	Wire; Watt; Wide; West
w/	With
W.C.	Water Column; Water Closet
W.F.	Wide Flange
W.G.	Water Gauge
Wldg.	Welding
W. Mile	Wire Mile
W.R.	Water Resistant
Wrck.	Wrecker
W.S.P.	Water Steam, Petroleum
WT, Wt.	Weight
WWF	Welded Wire Fabric
XRMR	Transformer
XHD	Extra Heavy Duty
XHHW;XLPE	Cross Linked Polyethylene Wire Insulation
Y	Wye
yd	Yard
yr	Year
Δ	Delta
%	Percent
Φ	Phase
@	At
<	Less Than
>	Greater Than

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01070

SECTION 01096
REFERENCE STANDARDS AND DEFINITIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic contract definitions are included in the Conditions of the Contract.

B. "Approved": The term "approved," when used in conjunction with the Designer(s) action on the Contractor's submittals, applications, and requests, is limited to the
Designer(s) duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Owner, requested by the Owner, and similar phrases.

D. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

E. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted", "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.

F. "Install": The term "install" describes operations at the Project site including the actual unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

G. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, who performs a particular activity including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

H. “Manufacturer”: The manufacturer is the individual entity with responsibility for and control of the assembly of the major components.

I. "Project site" is the space available to the Contractor for performing installation activities, either exclusively or in conjunction with others performing work as part of the Project. The extent of the Project site is shown on the Drawings.

J. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

K. "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 industry that control performance of the Work.

The term "experienced," when used with the term "installer," means having successfully completed a minimum of 5 previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

L. "Testing Agencies": A testing agency is an independent entity engaged by the Owner, to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 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 "MasterFormat" system.

B. Specification Content: These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.

    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: Where compliance with 2 or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different but apparently equal to the A/E for a decision before proceeding.

D. Minimum Quantity or Quality Levels: The quantity or 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. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate,

for the context of the requirements. Refer uncertainties to the A/E for a decision before proceeding.

E. Copies of Standards: Each entity engaged in installation on the Project must be familiar with industry standards applicable to its installation activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed to perform a required installation activity, the Contractor shall obtain copies directly from the publication source and make them available on request.

F. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research Inc.'s "Encyclopedia of Associations," which is available in most libraries.

1.5 GOVERNING REGULATIONS AND AUTHORITIES

A. Copies of Regulations: Obtain copies of the following regulations and retain at the Project site to be available for reference by parties who have a reasonable need.

1.6 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, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01096

SECTION 01200 – PROJECT MEETINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:

1. Job coordination meetings (JCM's).
2. Preconstruction/preinstallation conferences.

1.3 PROGRESS MEETINGS

A. General: Conduct Job Coordination Meetings (JCM's) at the Project Site, or at an alternate location designated by the Owner, on a bi-weekly basis.

The Owner may request additional Job Coordination Meetings or may require the Contractor to increase the frequency of JCM's, to once-a-week, depending upon project progress. Additional meetings or changes in meeting frequency, as directed by the Owner, shall not affect the cost of the original Contract.

B. Attendees: In addition to the A/E, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: The A/E will record meeting minutes and update the agenda.

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 or ahead or behind schedule. Discuss whether schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time.
2. Contractors Look Ahead: Contractor shall present and distribute a two-week look ahead schedule during the "Schedule" portion of the meeting.
3. 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. Submittals.
i. Requests for information.
j. Non-compliance notices.
k. Temporary facilities and services.
l. Hours of work.

m. Resource allocation.
n. Hazards and risks.
o. Housekeeping.
p. Quality and work standards.
q. Safety issues.
r. Change orders.
s. Documentation of information for payment requests.

D. Reporting: Transcript copies of each meeting will be distributed to each attendee and to those parties who were scheduled but unable to attend.

E. Schedule Updating: Refer to Section 01315, Scheduling.

F. As-Built Documents: Review progress of as-built documents for all disciplines of work.

1.3 PRECONSTRUCTION / PREINSTALLATION CONFERENCES

A. General: Where required by the Owner or by individual specification sections, conduct preconstruction conferences at the Project Site before each construction activity that requires coordination with other construction.

B. Attendees: 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 the A/E of scheduled meeting dates.

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each preconstruction conference, including, but not limited to, the following:

a. Contract Documents.
b. Options.
c. Shop Drawings, Product Data, and quality-control samples.
d. Coordination requirements.
e. Time schedules.
f. Weather limitations.
g. Manufacturer's recommendations.
h. Warranty requirements.
i. Governing regulations.
j. Inspecting and testing requirements.
k. Recording requirements.
l. Protection.
m. Related change notices.
n. Purchases.
o. Deliveries.
p. Possible conflicts.
q. Compatibility problems.
r. Acceptability of substrates.
s. Temporary facilities.
t. Space and access limitations.
u. Safety.
v. Required performance results.

2. Record significant discussions of each conference, and the approved schedule. Promptly distribute a typewritten copy of the record of the meeting to all attendees.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01200

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".

1.03 ELECTRONIC SUBMITTAL PROCEDURES

A. General: Submittals shall be submitted electronically directly to the Engineer from the General/Mechanical/Electrical Contractor.

1. **All shop drawings and other submittals as specified herein, shall be submitted in electronic format.** All electronic CAD generated drawings shall be in Acrobat PDF format and all product data or other information shall be submitted in Acrobat PDF format. Coordinate with Engineer prior to submitting. All electronic submittals shall be posted to the Engineer's FTP site. Information regarding the username and password shall be distributed to all parties prior to the pre-construction meeting.

B. Electronic copies of CAD drawings made from the Construction/Contract Documents will not be provided by Engineer without a written indemnification. Indemnification form will be provided by the Engineer at Pre-Construction Meeting to the General/Mechanical/Electrical Contractor upon written request.

C. 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 Engineer sufficiently in advance of the Work to permit processing.

D. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
3. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name and address of Architect/Engineer.
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
        2) Where multiple products are shown, highlight/circle or identify product intended to be used

    i. Number and title of appropriate Specification Section.
    j. Drawing number and detail references, as appropriate.
    k. Location(s) where product is to be installed, as appropriate.
    l. Other necessary identification.

E. 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.

F. 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 electronic submittals are approved or approved as noted, they will be transmitted 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.

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 Engineer'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 precalculated 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 Engineer, 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 organized using the CSI format. 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 for the Engineer'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 revisions 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. Number of Copies: Submit one (1) electronic copy of each submittal to the County's Representative, unless copies are required for operation and maintenance manuals. Submit one (1) electronic copy where copies are required for operation and maintenance manuals. Engineer will retain 1 electronic copy. Mark up and retain one returned electronic copy as a Project Record Drawing.
8. Submit one (1) hard copy once approved for legal seal stamping if needed at jobsite. Coordinate with Engineer and County's Representative.
9. 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. Manufacturers 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 Engineer'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 Engineer’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 ENGINEER’S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Engineer/Project Manager will review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Engineer/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, or elsewhere where work is in progress.

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.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01300

SECTION 01315
SCHEDULING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section is to provide for the comprehensive depiction, measurement, assessment and reporting of project progress and status pursuant to the sub-articles entitled "Contractor's Construction Schedules" of the General Conditions. The Contractor's responsibility shall include scheduling of all work within its contractual scope of work, creation of a Preliminary Schedule, a Baseline Schedule, production of reports, narratives, execution of the plan described by the current accepted schedule, participation in meetings with the Owner and Owner's designees, and submission of Progress Schedules and revision data, as set forth herein. Conventional Critical Path Method (CPM) techniques must be utilized to satisfy the requirements of this section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE REQUIREMENTS:

A. Scheduling System: The scheduling system shall utilize computerized CPM scheduling techniques and be capable of identifying the critical path for the entire project, as well as the critical path to completion of Contract Milestone dates.

B. Narratives: The Baseline Schedule submittals will include a narrative that explains the Contractor’s project approach, the basis for determination of activity durations, sequence and logic. The narrative shall include an explanation of the Contractor’s work phasing plan and include diagrams as required. The Contractor’s Progress Schedule submittals shall include a narrative that describes the overall progress of the work and any significant problems encountered along with proposed corrective action. The narrative should describe the Contract changes incorporated in the Progress Schedule and list all activity and relationship changes made since the previous submittal.

C. Schedule Activities: In addition to construction activities, the Baseline Schedule shall include activities for submittals, shop drawings, testing, turnover and training, review and approval cycles, meetings and operations by other agencies and all other activities that will affect the Contractor's schedule. Material selections, procurement, delivery, receiving and issuing restrictions shall be accounted for by additional activities. Contractual milestones, such as "Notice of Award," "Notice to Proceed," “Substantial Completion” and "Final Completion," etc., shall be included along with other Contract Milestones and the Contractor's own milestones. The Owner may identify additional interfaces during the course of the Work and the Contractor will incorporate these in the Progress Schedule as required. Activities shall be identified with

unique alpha-numeric strings not to exceed eight characters in length. Activity descriptions shall be as specific as possible, not exceeding forty-eight (48) characters in length, and use generally recognized abbreviations. Activities will be gap-numbered to facilitate the addition of activities. Activity durations must not exceed twenty (20) days.

D. Relationships: The relationships defined between activities shall be restricted to the following:

1. FS - Predecessor must finish before successor starts.
2. SS - Predecessor must start before successor starts.
3. FF - Predecessor must finish before successor finishes.

Relationships shall also include, where necessary, definition of lag times between predecessors and successors. The use of lags is not encouraged; it is preferable to use an activity to represent the reason for the waiting period between activities. Negative lags will not be allowed.

E. Calendars: Calendar information will include the number of working days per week and the Contractor's holiday schedule, including any other non-work periods. Each calendar must identify the planned working hours per workday. Multiple calendars may be used; in which case, documentation supporting each calendar shall be submitted.

F. Activity Codes: As a minimum, all activities shall carry the following separate codes.

1. Phase or Area Code: Phase or Area Codes will divide the project into component areas. The Contractor shall include for each activity within the schedule a code for identifying the activity locations or phase within the project. Additional phases or areas may be defined by the Owner and will be incorporated into the Contractor's schedule as required.
2. Trade Code: Trade Codes will be assigned to each activity corresponding to the trade responsible for performing the work described by the activity. Additional Trade coverage may be added by the Contractor or required by the Owner and incorporated into the Contractor's schedule as required. These additional codes shall follow the general CSI Divisions for all vertical construction and/or the Contract bid items for horizontal construction.
3. Responsibility Code: Responsibility Codes will be assigned to each activity corresponding to the organization responsible for completing the work described by the activity description. As a minimum, a separate responsibility code shall be used for Owner, Designer, Contractor, each Subcontractor and other third parties.

G. The schedule shall be cost-loaded with the total Contract value. The cost loading in the schedule must correspond to the accepted Schedule of Values for the Contract. Cost loading will be at the detailed activity level and accurately represent the value of the Work contained in each activity.

H. Activity Listings: Activity listings shall be provided, sorted by Activity ID and shall include the following fields:

1. Activity ID
2. Activity Description
3. Early Start and Early Finish
4. Late Start and Late Finish
5. Calendar #
6. Original Duration
7. Activity Codes
8. Total Float
9. Percent Completion

10. Remaining Duration
11. Activity Constraints
12. Actual Start and Actual Finish

I. Predecessor and Successor Report: A Predecessor and Successor Report sorted by Activity ID shall be provided. The report shall list all activities and include the following information:

1. Activity ID
2. Activity Description
3. Early Start and Early Finish
4. Late Start and Late Finish
5. All Predecessor data for each activity
6. All Successor data for each activity

J. Schedule Submission and Acceptance:

1. Preliminary Meeting: The Contractor shall participate in a preliminary meeting to discuss the proposed schedule and the requirements of this specification prior to submission of the Baseline Schedule.
2. Preliminary Schedule: A Preliminary Schedule shall be submitted for review as required in the General Conditions within ten (10) days from “Notice of Intent to Award.”
3. Baseline Schedule: The Baseline Schedule showing all activities shall be submitted as required in the General Conditions within twenty (20) days of the issuance of the Notice to Proceed.

    a. Baseline Schedule Review and Evaluation: The Contractor shall participate in a review and evaluation of the proposed Baseline Schedule by the Owner in accordance with the schedule of events. Any revisions necessary as a result of this review shall be resubmitted for review within ten (10) days after the schedule review conference. This review cycle will continue until the Contractor submits a Baseline Schedule that is accepted by the Owner. The accepted Baseline Schedule shall be the schedule used by the Contractor for planning, organizing, directing the Work and reporting progress. Baseline Schedule submittals shall be in accordance with the “Schedule Submittal Format” as outlined in subsection L.

4. Progress Schedules: Progress Schedule reporting frequency shall be monthly as specified in the General Conditions. Progress Schedule submittals shall be in accordance with the “Schedule Submittal Format” as outlined in Subsection L.
5. Job Coordination Meeting (JCM) Look-Ahead Schedule: This schedule shall be in the form of a time-scaled bar chart schedule including all Contractor activities in the window of time one (1) week prior to the meeting and two (2) or four (4) weeks after the meeting. The Look-Ahead Schedule is to be accurately updated as of the day before the JCM. The Look-Ahead Schedule should be printed on letter size (8.5”x11”) paper for incorporation into the JCM minutes. The Contractor is to provide copies of the Look-Ahead Schedule to all JCM attendees.
6. As-Built Schedule: After all Contract work items are complete, and prior to final payment, the Contractor shall submit the final Progress Schedule that will be called the “As-Built” Schedule, showing actual start and actual finish dates for all schedule activities and milestones.

K. Changes: The Contractor will incorporate Contract changes into the Progress Schedules for the period in which the change was issued. Contract changes that must be incorporated in

Progress Schedules include Change Orders, Construction Change Directives (CCD) and Field Change Orders (FCO).

L. Schedule Submittal Format:

1. Time-scaled bar charts and Precedence Diagrams shall be submitted on E-size plots (36”x48”), and be reproducible as blueprints without loss of legibility. Include two (2) copies of each. Each plot shall contain a title block with the following information:

   a. Contractor’s name
   b. Project name
   c. Plot date
   d. Data date
   e. Symbol definitions

2. Hard copies of activity listings, narratives, cash flow reports and predecessor/ successor reports shall be prepared on letter or legal size paper. Include two (2) copies of each report. Each report shall contain the following information:

   a. Contractor’s name
   b. Project name
   c. Data date
   d. Report date

3. All project schedule files shall be copied and submitted on CD or DVD compatible disks. A disk containing all project schedule files shall accompany all Contractor submissions. Schedule files must be p3, prx, mpp or mpx file format.

M. Resource Loading: The schedule shall be resource-loaded at the detailed activity level. Schedule submittals shall include resource graphs in histogram and cumulative curve formats for each resource item. Tabular reports shall be submitted that detail all resources assigned to each activity including all resource calendars that apply.

1. The schedule activities shall be resource-loaded with the direct labor manhours required to complete each activity, including each subcontractor’s manhours.
2. The schedule activities shall be resource-loaded with the equipment (cranes, lifts, trucks, loaders, excavators, etc.) required for each activity, including subcontractors’ equipment.

N. Computerized CPM Scheduling Software: The Contractor is required to utilize Primavera Project Planner (P3) scheduling software to accomplish the scheduling requirements of this Contract. (Primavera Project Planner and P3 are registered trademarks of Primavera Systems, Inc.)

END OF SECTION 01315

SECTION 01379 – PRE-CONSTRUCTION DIGITAL VIDEO

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes: construction digital video.

1.3 SUBMITTALS

A. Submit two (2) DVD disk of the entire construction site prior to the commencement of any work. The digital video shall be approved by the Architect/Engineer prior to the commencement of construction activity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

2.1 PRE-CONSTRUCTION DIGITAL VIDEO

A. Before starting construction, take digital video of the site and surrounding properties from different points of view as selected by the Owner and or Architect. Record pre-existing conditions of the site and abutting properties obtained from several perspectives. Provide narrative describing the vantage point and area being photographed.

1. Take digital video in sufficient number to show existing conditions adjacent to the property before starting work.

2. Take digital video of existing improvement adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.

END OF SECTION 01379

SECTION 01380
CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. General: This Section specifies administrative and procedural requirements for construction photographs.

1.03 SUBMITTALS

A. General: Refer to Division 1 Section “Submittals” for general requirements for submitting photographs.

B. Electronic: Submit electronic photos in .JPG format of each view directly to the Project Manager within 5 days of taking photographs. The Project Manager will distribute .JPG files as follows:

1. One .JPG to the Contractor shall be retained in the field office at the project site and available at all times for reference.
2. One .JPG to the Owner as the Owner’s permanent record.
3. One .JPG shall be retained in the Architect’s files.

C. Electronic Files: Retain the photographic electronic files 3 years after date of Substantial Completion. During this period, the photographer shall fill orders by the Architect for extra prints. Extra prints shall be priced at prevailing local commercial prices.

PART 2 PRODUCTS

2.01 PHOTOGRAPHIC COPIES

A. Provide .JPG file via electronic format, e-mail, DVD or memory stick.

B. Identification: Label each .JPG file with project name and date the photograph was taken.

C. Identify on Excel spreadsheet, description of vantage point, in terms of location, and direction (by compass point).

PART 3 EXECUTION

3.01 PHOTOGRAPHIC REQUIREMENTS

A. Take project electronic photographs at monthly intervals, coinciding with the cutoff date associated with each Application for Payment. The project manager shall select the vantage points for each shot each month to best show the status of construction and progress since the last photographs were taken.

B. Circumstances that could require additional photographs include, but are not limited to:

1. Substantial Completion of a major phase or component of Work.
2. Owner’s request for special publicity photographs.
3. Special events planned at project site.

C. Immediate follow-up when on-site events result in construction damage or losses. Photographs to be taken at fabrication locations away from project site. Record photographs at time of final acceptance.

END OF SECTION 01380

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 1-16 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS:

A. Required inspection and testing services are intended to assist in the determination of probable compliance of the work with requirements specified or indicated. These required services do not relieve the Subcontractor of responsibility for compliance with these requirements or for compliance with requirements of the Contract Documents.

B. Definitions: The requirements of this section relate primarily to customized fabrication and installation procedures, not to the production of standard products. Quality control services include inspections and tests and related actions, including reports, performed by independent agencies and governing authorities as well as directly by the Contractor. These services do not include Contract enforcement activities performed directly by the Owner.

1) Specific quality control requirements for individual units of work are specified in the section of these specifications that specify the individual element of the work. These requirements, including inspections and tests, cover both production of standard products and fabrication of customized work. These requirements also cover quality control of the installation procedures.

2) Inspections, tests and related actions specified in this section and elsewhere in the Contract Documents are not intended to limit the Subcontractor's own quality control procedures which facilitate overall compliance with requirements of the Contract Documents.

3) Requirements for the Contractor to provide quality control services as required by the A/E, the Owner, governing authorities or other authorized entities are not limited by the provisions of this section.

1.03 RESPONSIBILITIES:

A. Construction Manager and Subcontractor Responsibilities: Except where specifically indicated as being provided by another, identified entity, inspections, tests and similar quality control services are the Subcontractor's responsibility; these services also include those specified to be performed by an independent agency and not directly by the Subcontractor. Costs for these services shall be included in the Contract Sum., except quality control services listed as being provided by the Contractor. The Contractor shall employ and pay an independent agency, testing laboratory or other qualified firm to perform quality control services for the following ; soils compaction, soils moisture, sieve analysis, concrete, structural bolted and welded connections, mortar strength, masonry, and paving.

B. Retest Responsibility: Where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance of related work with the requirements of the Contract Documents, then retests are the responsibility of the Contractor regardless of whether the original test was the Contractor's responsibility. Retest the work revised or

replaced by the Subcontractor is the Contractor's responsibility, where required tests were performed on original work.

C. Responsibility for Associated Services: The Contractor is required to cooperate with the independent agencies performing required inspections, tests and similar services. Provide such auxiliary services as are reasonably requested. Notify the testing agency sufficiently in advance of operations to permit assignment of personnel. These auxiliary services include but are not necessarily limited to the following:

Providing access to the work.
Taking samples or assistance with taking samples.
Delivery of samples to test laboratories.
Security and protection of samples and test equipment at the project site.

D. Coordination: The Contractors and each independent agency engaged to perform inspections, tests and similar services for the project shall coordinate the sequence of their activities so as to accommodate required services with a minimum of delay in the progress of the work. In addition, the Subcontractor and each independent testing agency shall coordinate their work so as to avoid the necessity of removing and replacing work to accommodate inspections and tests. The Subcontractor is responsible for advising the Construction Manager at least 48 hours in advance of the required times for inspections, tests, taking of samples and similar activities.

1.04 QUALITY ASSURANCE:

A. Qualification for Service Agencies: Except as otherwise indicated, the engage inspection and test 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 are recognized in the industry as specialized in the types of inspections and tests to be performed.

1.05 SUBMITTALS:

A. Refer to Division 1 section on "Submittals" for the general requirements on submittals. Submit Four(4) copies of the certified written report of each inspection, test or similar service. Two (2) shall be submitted directly to the Construction Manager and two (2) directly to the A/E. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

1) Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to the following:

Name of testing agency or test laboratory.
Dates and locations of samples and tests or inspections.
Names of individuals making the inspection or test.
Designation of the work and test method.
Complete inspection or test data.
Test results.
Interpretations of test results.
Notation of significant ambient conditions at the time of taking sample and testing.
Comments or professional opinion as to whether inspected or tested work complies with requirements of the Contract Documents.
Recommendations on retesting, if applicable.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION:

A. Upon completion of inspection, testing, sample-taking and similar services performed on the work, repair damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed finishes. Comply with the Contract Document requirements for "Cutting and Patching". Protect work exposed by or for quality control service activities, and protect repaired work. Repair and protection is the Subcontractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 01400

SECTION 01500 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, maintenance of traffic, security and protection.

B. Temporary utilities which may be required include but are not limited to:

1. Temporary electric power and light.
2. Telephone service.
3. Temporary project identification sign - all other signs are prohibited.
4. Drinking water.
5. Sanitary facilities.

C. Temporary construction and support facilities which may be required include but are not limited to:

1. Storage sheds.
2. Temporary enclosures including fences, personnel and vehicle gates.
3. Waste disposal services.
4. Construction aids and miscellaneous services and facilities.
5. Fire Extinguishers.
6. Scaffles and lifts.
7. Temporary roofing protection.
8. Temporary protection of furniture and equipment.

D. Temporary construction and support facilities:

1. Field office/trailer. It shall be located at a temporary location as indicated by the owner.
2. Portable air filters.

E. Security and protection facilities which may be required include, but are not limited to:

1. Temporary fire protection.
2. Barricades, warning signs, lights.
3. Enclosure fence for the site used for storage and staging.
4. Environmental protection.
5. Temporary ventilation equipment.
6. Temporary weather protection of exterior openings.

1.3 SUBMITTALS

A. Temporary Utilities: Maintain reports of tests, inspections, meter readings and similar procedures performed on temporary utilities for review by the Owner and A/E.

B. Implementation and Termination Schedule: Submit a schedule indicating implementation and termination of each temporary utility within 15 days of the date established for commencement of the Work.

C. Maintenance of Traffic Plan: Submit a "Maintenance of Traffic Plan" within 15 days of the date established for commencement of work requiring maintenance of traffic and airport operations.

1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building Code and Life Safety Code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, Fire Department and Rescue Squad rules.
5. Environmental protection regulations.
6. OCCC Requirements
7. Orange County BCC Standards

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 Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 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 of 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, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

C. Temporary Roof protection: Provide temporary roofing protection while performing the work, transporting or placing of material on any existing roof surface.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Where visible to the public, provide new materials suitable for the use intended. Where not visible to the public, Contractor may provide undamaged previously used materials, suitable for the use intended.

B. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less.

C. Water: Provide potable water meeting the requirement of the local health authorities.

D. Fire Retardant Material: All material used for protection of existing surfaces or separations of public from work area shall be rated, label fire- retardant.

2.2 EQUIPMENT

A. General: Provide new equipment or previously used equipment in serviceable condition suitable for use intended.

B. 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 button and pilot light, for connection of power tools and equipment.

C. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Eliminate trip hazards.

D. 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.

E. 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.

F. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical type, properly vented and fully enclosed with a glass fiber reinforced polyester shell. Coordinate location with OCCC Project Manager.

G. First Aid Supplies: Comply with governing regulations.

H. 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 NFPA recommended classes for the exposures. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Relocate and modify facilities as required.

3.2 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 utility company and the Owner 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. Cost or use charges for temporary facilities are not chargeable to the Owner or the Designer(s), and will not be accepted as a basis of claims for a Change Order.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction. Provide a backflow prevention device.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period.

D. Temporary Lighting: Whenever overhead floor or roof deck has been installed, provide temporary lighting with local switching. 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 personnel engaged in construction activities, throughout the construction period.

3.3 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. General: Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities as indicated or as directed by OCCC Project Manager.

1. Maintain temporary construction and support facilities until near Final Acceptance. Remove prior to Final Acceptance. Personnel remaining after removal will be permitted to use permanent facilities, under conditions acceptable to the Owner.
2. Provide non-combustible construction for offices, shops and sheds located within the construction area, or within 30’ of building lines. Comply with requirements of NFPA 241.

B. 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.

C. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.

D. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.

E. Sanitary Facilities: Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with local health authorities for the administration of these facilities. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

F. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.

G. Wash Facilities: Install wash facilities supplied with potable 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.

H. Drinking Water Accommodations: Provide drinking water accommodations as necessary, including paper supply.

I. Temporary Enclosures - Demising Walls: Provide temporary enclosure for protection of construction in progress from foul weather.

J. Project Identification/Construction Company Identification Sign: Prepare project identification sign of the size indicated; install sign where indicated to inform the public and persons seeking entrance to the Project. Securely attach, as required, to demising wall. Install sign at commencement of construction and remove upon issuance of the Certificate of Occupancy.

1. Size: 2½'x5' with 4" radius corners.
2. Quality Assurance: Engage an experienced sign painter to apply graphics.
3. Location: Locate on demising wall.
4. Graphic Description: Information shall include the Contractor, Designer, and Designer(s) name, project name, and completion date.

a. Type Style: Frutiger 55 or Helvetica Medium.
b. Color: Jetport Brown background with white lettering.
c. Quantity: One sign per project.

K. Collection and Disposal of Waste: Collect waste from construction areas 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 rise above 80 degrees F (27 degrees C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

1. The Contractor shall not use the Owner's waste disposal systems.
2. The Owner will not provide waste disposal services.

L. 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.

M. Portable ventilation/filtration of air with heppa filters.

N. Daily vacuum of construction area to control dust.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. General: 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 Designer(s).

B. Temporary Fire Protection: Install and maintain temporary fire protection 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 241 "Standard for Safeguarding Construction, Alterations 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 to fire extinguishers, fire hydrants, temporary fire protection facilities, exitways and other access routes for fighting fires.
4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. 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.

D. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by the elements.

B. Termination and Removal: Unless the Designer(s) 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 Final Acceptance. 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.
2. Prior to Final Acceptance, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:

    a. Repair of any and all damages to existing materials or finishes. Repair shall be complete and made to the satisfaction of the OCCC Project Manager at no additional cost.
    b. Replace air filters and clean inside of ductwork and housings.
    c. Replace significantly work parts and parts that have been subject to unusual operating conditions.
    d. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION 01500

SECTION 01600
MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

1.3 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 terms "material," "equipment," "system," and terms of similar intent.

a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed 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 the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. "Materials" are products 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.

1.4 SUBMITTALS

A. SD-07; Product List: Prepare a list of specified products. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate product list with the Contractor's Construction Schedule and the Schedule of Submittals.

2. Form: Prepare product list with information on each item tabulated under the following column headings:

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.

3. Submit list following procedures and requirements as outlined in Division 1 Specifications Section 01300, Shop Drawings, Product Data, and Samples.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. To the fullest extent possible, provide products of the same kind from a single source.

2. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Designer to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: When the Contractor is given the option of selecting between 2 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.

1. Each prime contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate contractors.

2. If a dispute arises between prime contractors over concurrently selectable, but incompatible products, the Designer will determine which products shall be retained and which are incompatible and must be replaced.

C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:

1. No available domestic product complies with the Contract Documents.

2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.

3. The foreign product is produced or supplied by entities with significant ties, contacts, and assets in the United States, there are no statutes or regulations that bar such entities from doing business in the United States and the Owner has determined, in its sole

discretion, that inclusion of the foreign product would enhance competition and be in its best interest.

D. 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 that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are 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 that 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. UL Listing or other Owner approved listing agency.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, 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 assure 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 an undamaged condition 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 weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.

2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Refer to Section 01631, Product Substitutions.

1. Visual Matching: Where Specifications require matching an established Sample, the Designer(s) decision will be final on whether a proposed product matches satisfactorily.

2. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.

3. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Designer will select the color, pattern, and texture from the product line selected.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

B. 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: The Contract will be awarded based on the design, methods, materials and/or equipment as addressed in the Contract Drawings and/or described in the Contract Specifications, without any consideration for substitution or "or-equal" replacement. Addressing, describing or naming an item is intended to establish the type, function, characteristics and quality required in order to establish a base for bidding.

1. Within thirty (30) days after Contract award, the Contractor may submit for approval substitutes for any equipment and/or material. In addition to the product documents, a written certification shall accompany the documentation indicating that the proposed substitute will have the same characteristics, will perform in accordance with the design requirements and that complies with all the requirements set for in the Contract. Any additional information required by the Owner or County Representative shall be provided by the Contractor. Rejection of any proposed substitute will be considered final and the Contractor shall not get into any agreement with manufacturers or providers until the submittal has been finally approved.
2. The submission of this documentation shall follow the requirements set quality required in order to establish a base for bidding.

1.04 SUBMITTALS

A. Substitution Request Submittal: Request for substitution will be considered if received within thirty (30) days after contract award. 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. Engineer's Action: Within two weeks of receipt of the request for substitution, the Engineer 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, which ever is later, the Engineer 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 Engineer is considered final. Acceptance will be in the form of a Change Order.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; 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 Engineer 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 15 through 16.

C. Final Payment to be made when the County has reviewed and accepted 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 in 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 Engineer 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 Engineer 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 Engineer 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 Engineer.

1. Upon completion of reinspection, the Engineer 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 purposed; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer’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. **Submit one (1) hardcopy of the most current record set of drawings when the project is considered 50% substantially complete for review and comment by Owner.**

5. Organize record drawing sheets, and print. suitable titles, dates and other identification on the cover of each set.

6. Provide three (3) additional sets of black line drawing sets of As-Built Drawings.

7. Provide one (1) CD-ROM with all As-Built Drawings in AutoCAD and PDF format.

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 Engineer 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 Engineer 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 Engineer 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 four (4) suitable sets of manageable size and electronically as PDFs on one (1) CD-ROM compact disc. 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 USED)

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 competed 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 one (1) hardcopy.

B. Bind in commercial quality 8 ½" 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.

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-Builts: 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.

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. Removal of Protection: Remove temporary protection and facilities installed for protection of the work during construction.

D. 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 01710
FINAL CLEANING AND PROTECTIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes final cleaning at Substantial Completion.

B. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.

1. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the material to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 – EXECUTION

3.1 FINAL CLEANING

A. General: Provide final-cleaning operations. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

B. Cleaning Operations: Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.
1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.
2. Sweep paved areas broom clean. Broom clean concrete floors in unoccupied spaces.
3. Remove petrochemical spills, stains, and other foreign deposits.
4. Remove tools, construction equipment, machinery, and surplus material from the site.
5. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

7. Remove marks, stains, fingerprints, and other soils or other dirt from painted, decorated, and natural finished woodwork and other Work.
9. Clean cabinet work removing stains, paint, dirt and dust.
10. Remove spots, plaster, soil and paint from ceramic tile, marble, and other finished materials, and wash or wipe clean.
11. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
12. Clean flooring materials thoroughly, comply with materials manufacturer's instructions and recommendations.
13. Remove labels that are not permanent labels.
14. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
15. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
16. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
17. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
18. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
19. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
20. Clean ductwork, blowers, and coils of units that were operated during construction.
21. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
22. Remove all debris from roof surfaces.
23. Clean louvers and flashing surfaces.
24. Leave the Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.

D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.

E. Compliances: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.

1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Owner.
2. The Contractor shall not dispose of debris or waste materials on the Owner's property without the prior approval of the Owner.

F. Maintenance: Provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

3.2 PROTECTIONS

A. General: Supervise construction operations to assure 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 applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining, and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High-speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.

END OF SECTION 01710

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 this document.
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.

. 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 Engineer'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 Engineer/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 Engineer'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 Engineer 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 1/2“ 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

SECTION 02070
DEMOLITION AND ALTERATIONS

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 SCOPE OF SECTION

A. Cut, demolish and remove existing work associated with the renovation. Cut and remove existing work as indicated or necessary to fit new work to existing that is to remain. Where practical, salvage existing items that may be reused or are indicated for reuse or to be turned over to Owner.

1.3 REFERENCE STANDARDS

A. The latest edition of publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM E 84; Surface Burning Characteristics of Building Materials

C. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1. NFPA 241; Safeguarding Construction, Alteration and Demolition Operations

D. Unknown Conditions: Work shall not include Contractor's identification, detection, abatement, encapsulation or removal of asbestos or similar hazardous substance(s). In the course of performing this work, if such material/product is encountered, discontinue work and remove workers from the project until such material/product and hazards connected therewith are abated, encapsulated or removed, or it is determined that no hazard exists. An extension of time will be granted for delay resulting from such condition and correction.

E. Structural Members: Do not cut any building structure without written authorization of the Architect. Any structural members intentionally cut without proper authorization or accidentally cut shall be restored to their original integrity and condition.

1. Do not cut or drill existing wood truss, existing wood deck, concrete masonry and concrete structure.

1.4 PROTECTION

A. Safety: Before commencing any work, provide warning signs, lights, barricades, fences, rails and other safety devices. Exercise caution when working adjacent to spaces occupied by Owner's personnel.

B. Temporary Work: Do not commence demolition until temporary shoring, bracing, partitions, exits and other support and protective measures have been properly installed.

C. Temporary Partitions and Closures: Where new existing openings are created and where work is in occupied spaces or existing equipment, provide physical separation and protect from dust and moisture with partitions and closures. Maintain partitions in place until new work have been completed and provide protection from the weather and dust. Before and during removal, clean all surfaces with a vacuum cleaner (to avoid dispersion of dust).

D. Portable Coverings: For minor interior alterations, where acceptable to Architect, flame-proofed drop cloths may be used. Plastic sheet or film shall not be used for any purpose for interior work.

E. Air filters: During Demolition provide portable air filters as part of dust control. Use portable hepa filters and place temporary filters at all return air intakes.

F. Wet mop concrete floors slab to control dust.

G. Vacuum space every day at the completion of the work.

1.5 SECURITY

A. Establish procedures and execute operations to provide continuous security. Provide temporary protection for openings and at other locations as may be appropriate during construction. Deny entrance of unauthorized persons into work area.

1.6 HOUSEKEEPING

A. Collect debris, rubbish and trash resulting from operations at designated places. Sprinkle dusty debris with water. Handle in a controlled manner. Do not accumulate waste unnecessarily; remove promptly from premises; generally daily. Sweep and vacuum floors in work areas as frequently as necessary to maintain premises in acceptable condition for continuous, uninterrupted operation by Owner.

1.7 OCCUPIED FACILITY

A. Since the facility is in operation, coordination will be required with staff to coordinate time of demolition to minimize disturbance of occupants.

PART 2 - MATERIALS

2.1 LUMBER

A. Wood and plywood used in building temporary partitions shall be fire-retardant treated to provide flame spread rating, per ASTM E 84, or maximum of twenty-five (25).

2.2 TAPE

A. Kraft paper two (2) inches wide with pressure sensitive adhesive one side. Shear strength (peel adhesion); 60-oz. per inch width. Acceptable: FasTape.

2.3 TEMPORARY CLOSURES

A. In addition to the requirements of Division 0, flame-proofed drop cloths (not flammable plastic), UL labeled, flame spread maximum fifteen (15). Where daylight would be beneficial for workmanship and reduce need of artificial illumination, translucent polyvinyl chloride film reinforced in diamond pattern with 33 nylon threads per foot. Acceptable: "Griffolyn" T-55-FR, Reed Industries, Box 248, Houston, Texas 77233, phone 800/231-6074.

PART 3 - EXECUTION

3.1 RELOCATION AND REMOVAL

A. Temporarily remove or suitably relocate designated equipment, utilities or services to clear the work, or to properly function in the complete installation. Where services or utilities are removed, suitable cap or terminate according to applicable ordinances and requirements of governing authorities and/or per other sections of specifications and drawings. Where such items interfere with the work and specific instructions are not included on the drawings, they shall be adequately protected and further instructions requested from the Architect. Existing construction that does not interfere with new work and will be concealed may remain in place unless indicated to be removed.

3.2 PORTABLE COVERINGS

A. For interior alterations, where acceptable to Architect, flame-proofed drop cloths may be used. Flammable plastic sheet or film shall not be used within the building.

B. Protect all furnishing and equipment with covers.

3.3 DEMOLITION

A. Plan of Operations: Establish procedures for safe removal of parts by methods that will not transmit excessive vibrations to or eccentric loads on building structure, create a nuisance, damage existing work that will remain, nor endanger either workmen, public, occupants nor adjacent work.

B. Supervision: Cut and demolish under supervision of a competent foreman, capable of identifying hazardous conditions and authorized to promptly take corrective action to eliminate them.

C. Precaution: Exercise care to avoid unnecessary damage to work that shall remain.

D. Hole Cutting: Neatly cut holes where necessary. Keep area and debris covered to minimize creation of dust. Use care and adjust hole locations as required to minimize necessary cutting.

E. Finishes and Exposed Work: Cut to true and straight lines to permit satisfactory refinishing or connection to new work. Remove items to nearest full piece that is to remain.

3.4 OWNERSHIP OF MATERIALS

A. Salvaged materials that are to be relocated or remain the property of the Owner shall be carefully removed and stored on the site for reuse or disposition specified. Other materials become the property of Contractor and shall be removed and disposed of off the site.

3.5 SALVAGE OPERATIONS

A. Salvage existing materials/products identified to be reused or turned over to Owner. Carefully remove, collect, protect, repair, clean or restore to first class condition, relocate and reinstall where and as indicated. After cleaning and repairing salvaged items to be furnished to Owner, place in location on premises designated by Owner's representative.

3.6 REMOVAL

A. Remove materials/products/equipment which are not to be reused in the work in an orderly and careful manner so as not to endanger or damage adjacent work which is to remain. When removing nails by claw hammer, place a small piece of wood under the hammer head to keep claws at right angle to the nail and prevent damage to the surface.

3.7 DISPOSAL

A. Haul rubbish, debris and unusable material away from the site promptly and dispose of legally. Burning on site is prohibited.

3.8 CLEANING

A. Clean surfaces as described in specifications.

3.9 CONCRETE

A. Exercise due caution in cutting and patching, chipping or general concreting so as not to deface that portion of the existing structure which is to remain. Should any such impairment occur, immediately clean or restore to original condition at no cost to Owner.

B. Do not cut or core existing columns, joist and beams.

C. Patch all existing slab penetrations caused by demolition of mechanical and plumbing.

3.10 UTILITIES AND RELATED EQUIPMENT, PLUMBING, AND ELECTRICAL WORK

A. Protect existing utilities, storm, waste, water, fire protection, conduit racks, refrigerant pipes and raceways as indicated and as uncovered by the work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Architect/Engineer. If electrical, communications, fire protection and systems lines are encountered and not shown on drawings, contact the Architect/Engineer prior to the start of the work.

B. Temporary support of all lighting, low voltage wiring other devices on, below, and in the ceiling system will be required will require temporary support until new ceiling system is installed.

3.11 Drywall

A. Within the limits of the work, should any portion of existing drywall surfaces be deemed broken, scratched or unfastened, spackle with drywall compound, refasten or refinishing as necessary to complete repairs. Where indicated on the drawings for drywall to be removed remove the covering, base, drywall board, vapor barrier, insulation, metal furring and all fasteners.

B. Within the limits of the work make repairs to drywall partitions. Match adjacent surfaces or as indicated on the drawing.

C. Within the limits of the work remove drywall ceiling and ceiling suspension system and supports, fasteners complete. Provide support for adjacent ceilings to remain.

3.12 PATCHING

A. Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish.

B. Where patching occurs on rated partition or fireproofed structure repair to match existing UL rated system to match code required hourly rating for assembly.

3.13 FIRESTOPPING AND DRAFT STOPPING

A. Fire stop existing holes at all rated masonry walls, floor slab & GWB Partitions.

B. Fire stop existing open ends of conduits:

C. Fire stop all existing plumbing penetrations at existing rated walls and floors.

D. Draft stop all penetrations into cavity of walls, ceilings, and attics. They include all penetrations created by new work or penetrations left by removal of existing proposed for replacement. Repair the top plate of all frame partitions to prevent air infiltration from the attic into the wall cavity.

3.14 ACOUSTICAL LAY-IN CEILING

A. Remove acoustical ceiling and suspension system as required by the work U.O.N. on the drawings.

END OF SECTION 02070

SECTION 02226
EXCAVATING AND BACKFILLING FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. Section includes all work required to complete, as indicated by the Contract Documents, and furnish all supplementary items necessary for the proper installation of the structure subgrade not specified elsewhere in these Specifications.

B. Section includes:

1. Excavating, backfilling and compacting for structures.
2. Restore and expand grades to required elevations.
3. Remove excess materials from site.
4. Bring in additional materials to site.
5. Pumping and dewatering.
6. Sheeting of excavations.

1.3 SUBMITTALS

A. Provide submittal per Section 01300 Submittals

1. Provide Compaction compliance test report for each 200 liner feet of foundation excavation and 50 linear feet of plumbing trench excavation.

1.4 QUALITY ASSURANCE

A. Tests and inspections:

1. Test methods:

a. Maximum density of backfill materials will be determined by ASTM D3017 (Nuclear method), or ASTM D1557 Method A (5-layer method), unless other applicable method is approved.
b. Field density tests will be determined by ASTM D2922 (Nuclear method), or ASTM D1556 (sand-cone method), unless other applicable method is approved.

2. Required tests:

a. Backfill material: Determine suitability of backfill and bedding material not previously evaluated.
b. Maximum density tests: Determine optimum moisture content and maximum density of backfill and bedding materials placed and compacted.
c. Compaction inspection: Determine degree of backfill compaction.

B. Reference specifications and standards:

1. ASTM D1557 Moisture-Density Relations of Soils, using 10 lb. Rammer and 18 inches Drop.

PART 2 - PRODUCTS

2.1 MATERIALS

A. On-site materials: Materials obtained by selective stockpiling of excavated soils. Stockpile materials acceptable to testing laboratory until used.

1. Materials, approved for use in fill and backfill.

B. Borrow materials: Non-expansive clean earth and granular materials, with not more than 10% passing No. 200 sieve, and free of roots or organic materials. Do not use rocks or lumps larger than 2 inches in any dimension.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect public and adjacent properties, on and off site, in accord with applicable laws and ordinances.

B. Protect from damage, all existing on-site features scheduled or indicated to remain, including flora scheduled to remain.

1. Do not allow earthmoving equipment within the branch spread perimeter (drip line) of existing trees.

C. Utilities:

1. Protect and support active utility lines in a manner to prevent damage. Methods subject to Owner's approval.
2. Remove abandoned lines encountered during excavation and dispose of off-site.

a. Report unidentified lines to Owner for determination as to "dry" or "abandoned" prior to removal.

D. Dust control:

1. Throughout the entire construction period effectively dust-palliate the working area, roadways, and involved portions of the site.
2. Palliation: Intermittent watering and sprinkling of such frequency as will satisfactorily allay the dust at all times. Chemical treatment of any type is not permitted.

E. Water control:

1. Do no allow rain, surface or subsurface water, or other fluid, to accumulate in excavations nor under or above the structures. Should such conditions develop or be encountered, constantly control and legally dispose of the water by well pointing, temporary pumps, piping, ditches, or other approve methods.
2. Dispose of water properly in such manner as not to cause injury to public or private property, nor to create a nuisance, nor to interfere with other contractors operations.
3. Method of dewatering and disposal of water is subject to Owner's approval.

F. Cribbing and shoring:

1. Provide temporary or permanent cribbing, sheeting and shoring as necessary to safely retain earth banks and protect excavations from caving or other damage.
2. Be responsible for design, installation and maintenance of cribbing, sheeting and shoring. Remove temporary cribbing and shoring after use.
3. Protect adjacent existing building foundations do not cut or undermine bottom of existing foundations or slabs to remain.

3.2 EXCAVATING

A. Excavate materials of every nature to dimensions and elevations indicated. Use equipment of suitable type for materials and conditions involved.

B. Extend excavation a sufficient distance from walls to allow for forming and shoring, application of waterproofing, installation of services and approvals. Do not excavate below indicated depths.

C. Correct unauthorized excavation made below depths indicated, as recommended by soils engineer at no additional cost to Owner.

D. Where additional excavation is required to remove unsatisfactory materials encountered, such additional work will be paid for by means consistent with terms of Contract.

3.3 FILL, BACKFILL AND COMPACTION

A. Fill and backfill:

1. Place fill and backfill in layers that will uniformly compact to the required densities, but not in loose layers more than 12 inches thick.
2. Place backfill only after walls are supported by completion of interior floor systems or are braced to resist the imposed loading.
3. Place backfill against walls below grade after waterproofing systems have been completed and approved.

4. Protect waterproofing systems during backfill operations.
5. If waterproofing is damaged, do not continue backfilling until damage is repaired as approved by Owner.
6. Fill slopes should not exceed 2 horizontal to 1 vertical.
7. Restore grades to indicated elevations.

B. Compaction:

1. Bring each layer to optimum moisture content before compaction. Add water by uniform sprinkling.
2. When moisture content and condition of each layer is satisfactory, compact to not less than 95% of the soils modified Proctor maximum dry density as determined by ASTM Specification D-1557. In place density tests shall be performed by an experienced geotechnical engineering technician under the direction of a registered geotechnical engineer. Tests shall be performed at a rate of one (1) test per lift per 2,500 square feet of fill area.
3. Compact areas not accessible to motor-driven equipment shall be compacted with mechanical or heavy hand tampers.
4. Rework compacted areas failing to meet specified maximum density, as determined by tests. Re-compact and re-test as required to achieve 95% maximum density.
5. All fill placed in utility line trenched and adjacent footings beneath slabs on grade shall be compacted with lightweight, hand guided compaction equipment and lift thicknesses shall be limited to a maximum of 4 inches loose thickness.

END OF SECTION 02226

SECTION 02361
TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. This Section includes the following for termite control:

1. Soil treatment.

1.3 DEFINITIONS

A. EPA: Environmental Protection Agency.

B. PCO: Pest control operator.

1.4 SUBMITTALS

A. Product Data: Treatments and application instructions, including EPA-Registered Label.

B. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.

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. 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.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A pest control operator who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located.

B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

C. Independent Testing: Independent testing laboratory shall certify that treatment meets the requirements.

1.6 PROJECT CONDITIONS

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

1.7 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.

1.8 WARRANTY

A. 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.

1. Warranty Period: Five years from date of Substantial Completion.

a. Provide optional renewal on the same terms.

B. Should damage occur during the guarantee period, the Contractor shall make repairs to structurally damaged surfaces to a dollar value based on the size of the building.

1.9 MAINTENANCE SERVICE

A. Continuing Service: Provide a proposal for continuing service, including monitoring, inspection, and re-treatment for occurrences of termite activity, from applicator to Owner, in the form of a standard continuing service agreement, starting on the date of Substantial Completion. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for

application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate.

1. 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.

1. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.

3.3 APPLICATION, GENERAL

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

3.4 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 chimney bases; 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 02361

SECTION 02821
CHAIN-LINK FENCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes chain-link fences and swing gates.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:

1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 12 feet (3.66 m) high, or as shown on drawings and post spacing not to exceed 10 feet (3 m) material Group IA, ASTM F 1043, Schedule 40 Steel pipe or as shown on the drawings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Product Certificates: For each type of chain-link fence and gate, from manufacturer.

D. Product Test Reports: For framing strength according to ASTM F 1043.

E. Operation and maintenance data.

F. Sample of special warranty.

G. Signed and Sealed foundation shop drawings prepared by a Florida Registered P.E.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer & Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire Fabric: Wire with a diameter of 0.192 inch (4.88 mm) .
   a. Zinc-Coated Fabric: ASTM A 392, Type II, Class 2, 2.0 oz./sq. ft. (610 g/sq. m)] with zinc coating applied before weaving.

2.2 FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1. Fence Height: 8'-0".

2. Heavy Industrial Strength: Material Group IA, round steel pipe, Schedule 40

   a. Line Post: 4.0 inches (102 mm) in diameter
   b. End, Corner and Pull Post: 4.0 inches (102 mm) in diameter.

3. Horizontal Framework Members: Intermediate, top and, bottom rails complying with ASTM F 1043.
4. Truss Rod Assemblies: Comply with ASTM F 1043.
5. Metallic Coating for Steel Framing:

   a. Type A zinc coating.
   b. Type B zinc with organic overcoat.
   c. External, Type B zinc with organic overcoat and internal, Type D zinc-pigmented coating.
   d. Type C, Zn-5-Al-MM alloy coating.
   e. Coatings: Any coating above.

2.3 FITTINGS

A. General: Comply with ASTM F 626.

B. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.

2.4 Gates

A. General: Provide gate of width and height to match fence.

1. Finish: Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.

2. Lockable hasp for pad lock.

PART 3 - EXECUTION

3.5 INSTALLATION

A. Examine areas and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Mark locations of fence lines, and terminal posts.

D. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated and according to drawings.

E. Post Setting:

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with anchorage devices.

F. Terminal Posts: Locate terminal end, corner, per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of as indicated on Drawings.

E. Line Posts: Space line posts uniformly as indicated on the drawings.

G. Chain-Link Fabric: Apply fabric to inside of enclosing framework. See drawings for distance from steel angle stop at floor.

H. Set all post in 3000 PSI concrete as shown on drawings if not shown on drawings as required by wind load and provide signed and sealed shop drawings prepared by a Florida Registered Professional Engineer..

END OF SECTION 02821

SECTION 03200
CONCRETE REINFORCING

PART 1 - GENERAL

A. Applicable provisions of “General Conditions”, “Special Conditions” and Division One, govern work under this Section.

1.01 DESCRIPTION

A. Work Included: Labor and materials to complete all concrete reinforcing steel, indicated on Drawings, as specified herein, or both, for all site-cast concrete.
B. Concrete Slabs for HVAC equipment.
C. Foundations
D. Filled cells, Lintels and Bond Beams
E. Floor slabs and misc repairs
F. Misc work and repairs associated with renovation work.

1.02 QUALITY ASSURANCE

A. The Code of Standard Practice for Reinforcing Materials and Service, as published by the Concrete Reinforcing Steel Institute shall become a part of this Specification.

B. Florida Building Code (latest adopted edition and revisions).

C. American Concrete Institute (ACI).

D. American Society for Testing and Materials (ASTM).

1.03 SUBMITTALS

A. Shop Drawings:

1. Shop Drawings shall be prepared immediately on award of this Contract. No steel shall be ordered until shop drawings have been approved.

2. Drawings shall indicate necessary information of fabrication and erection.

3. Contract documents shall not be duplicated for use as shop drawing submittals.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel Reinforcement: Shall conform to current standard specifications of ASTM.

B Bars: ASTM Specification A-615, Grade 60, for Billet-Steel Bars for concrete reinforcement.

1. Provide special size bars where called for on Drawings.

C. Accessories: Such as bolsters, spacers, ties, chairs, shall be hot-dipped galvanized furnished to permit proper placement of steel.

D. Fabric: Shall be manufactured to meet ASTM Specifications A-185-79. Fabric shall be manufactured of cold drawn wire of size specified on Drawings and welded at intersections.

2.02 FABRICATION

A. Shop drawings showing dimensions, bar schedules, bending details, stirrup spacing for all other details shall be submitted for approval before beginning of fabrication of reinforcing materials in accordance with requirements of General Conditions.

B. All bars shall be shop fabricated and cut to required length.

C. Bars with kinks, twists or bends, other than shown by approved shop drawings, not to be used.

2.03 CLEANING

A. All reinforcing shall be free from rust, scale, grease or other coating which might prevent proper bond.

B. Provide means at site for cleaning before placement.

C. Where is delay in depositing concrete, reinforcement shall be reinspected and when necessary cleaned and retied.

2.04 STORAGE

A. At site, in racks to keep steel at least 6” above ground.

B. Protect, as required, against excessive rusting or mechanical injury.

PART 3 - EXECUTION

3.01 PLACING

A. Placing of reinforcing shall be in strict accordance with Concrete Reinforcing Steel Institute, “Specifications for Placing of Reinforcements”.

B. Before placing reinforcing, all forms to be coated with form and release agents to avoid coating reinforcing steel.

C. All reinforcing shall be placed accurately and held in position to prevent its displacement during concrete operations by using at intersections annealed wire of not less that No. 18 gauge. It shall be supported by metal chairs or spacers.

D. All spacing shall be as shown on Drawings.

E. Footing, Columns, Beams, Wall and Slab Reinforcement:

1. Unless otherwise shown, cover reinforcing with concrete to following thickness:

Footing Bottoms	3”
Walls	2”
Slabs	1”
Columns	1 1/ 2”
Beams	1 1/ 2”

2. Support reinforcing at proper intervals and distances from forms by means of welded wire spacers or chairs.

3. Separate multiple layers with approved spacers.

4. All rods securely wired with No. 18 gauge annealed wire at all intersections with reinforcement and temperature rods, spacers or chairs.

5. Wire fabric where shown, to extend to within 2” of all edges of slab or sections. Do not extend fabric across expansion joints. Lap adjacent sheets at least 6”.

F. Shrinkage and Temperature Reinforcement:

1. Where not otherwise shown on Drawings, provide temperature steel or mesh equivalent to a ratio of .003 reinforcement area to concrete area.
(For foundation, slabs, aprons, etc.).

END OF SECTION 03200

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes the following:

1. Foundations and footings.
2. Slabs-on-grade, Equipment Pads.
3. Concrete Beams.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 03200 Concrete Reinforcing

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, and others if requested by Architect.

C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.

D. Shop drawings for formwork indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

1. Architect's review is for general architectural applications and features only. Designing formwork for structural stability and efficiency is Contractor's responsibility.

E. Samples of materials as requested by Architect, including names, sources, and descriptions, as follows:

1. Color finishes.

2. Normal weight aggregates.
3. Fiber reinforcement.
4. Reglets.
5. Waterstops.
6. Vapor retarder/barrier.
7. Form liners.

F. Laboratory test reports for concrete materials and mix design test.

G. Material certificates in lieu of material laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

H. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
2. ACI 318-08, "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

B. Concrete Testing Service: Engage a testing agency acceptable to Architect to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

D. Mockup: Cast mockup of size indicated or as required to demonstrate typical joints, form tie spacing, and proposed surface finish, texture, and color. Maintain sample panel exposed to view for duration of Project, after Architect's acceptance of visual qualities.

1. Demolish mockup and remove from site when directed by Architect.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings" and the following:

1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:

a. Contractor's superintendent.
b. Agency responsible for concrete design mixes.
c. Agency responsible for field quality control.
d. Ready-mix concrete producer.
e. Concrete subcontractor.

f. Primary admixture manufacturers.

F. No one, except for the concrete supplier's quality control representative is to be allowed to add water to the concrete after it leaves the plant. If water is added, the person authorizing it must legibly print his/her name and how much water was added and then sign the delivery ticket.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.
2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration to match Architect's control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Form Release WB; Lambert Corporation
b. Euco Super-Slip; Euclid
c. Cast-Off; Sonneborn

E. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches (38 mm) to the plane of the exposed concrete surface.

1. Provide ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in the concrete surface.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615 Grade 60 (ASTM A 615M Grade 400), deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

D. Deformed-Steel Welded Wire Fabric: ASTM A 497.

E. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs such as Besser Brick.
2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout Project unless otherwise acceptable to Architect.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

D. Water: Potable.

E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Air-Tite, Cormix Construction Chemicals.
b. Air-Mix or Perma-Air, Euclid Chemical Co.
c. Darex AEA or Daravair, W.R. Grace & Co.
d. MB-VR or Micro-Air, Master Builders, Inc.
e. Sealtight AEA, W.R. Meadows, Inc.
f. Sika AER, Sika Corp.

G. Water-Reducing Admixture: ASTM C 494, Type A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Chemtard, ChemMasters Corp.
b. PSI N, Cormix Construction Chemicals.
c. Eucon WR-75, Euclid Chemical Co.
d. WRDA, W.R. Grace & Co.
e. Pozzolith Normal or Polyheed, Master Builders, Inc.

f. Metco W.R., Metalcrete Industries.
g. Prokrete-N, Prokrete Industries.
h. Plastocrete 161, Sika Corp.

H. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Q-Set, Conspec Marketing & Manufacturing Co.
b. Lubricon NCA, Cormix Construction Chemicals.
c. Accelguard 80, Euclid Chemical Co.
d. Daraset, W.R. Grace & Co.
e. Pozzutec 20, Master Builders, Inc.
f. Accel-Set, Metalcrete Industries.

I. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

1. Products: Subject to compliance with requirements, provide one of the following:

a. PSI-R Plus, Cormix Construction Chemicals.
b. Eucon Retarder 75, Euclid Chemical Co.
c. Daratard-17, W.R. Grace & Co.
d. Pozzolith R, Master Builders, Inc.
e. Protard, Prokrete Industries.
f. Plastiment, Sika Corporation.

2.4 RELATED MATERIALS

A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217- inch- (0.46-mm-) thick galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch thick (0.76 mm) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.

C. Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.

D. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as indicated on the drawings.

E. Nonslip Aggregate Finish: Provide fused aluminum oxide granules or crushed emery as the abrasive aggregate for a nonslip finish, with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof, nonglazing, and unaffected by freezing, moisture, and cleaning materials.

1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

a. EMAG; Lambert Corporation
b. Euco Non-slip; Euclid
c. Frictex NS; Sonneborn

F. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m), complying with AASHTO M 182, Class 2.

G. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

H. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. m when applied at 200 sq. ft./gal (4.9 sq. m/L).
1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. A-H 3 Way Sealer, Anti-Hydro Co., Inc.
b. Spartan-Cote, The Burke Co.
c. Conspec #1, Conspec Marketing & Mfg. Co.
d. Sealco 309, Cormix Construction Chemicals.
e. Day-Chem Cure and Seal, Dayton Superior Corp.
f. Eucocure, Euclid Chemical Co.
g. Horn Clear Seal, A.C. Horn, Inc.
h. L&M Cure R, L&M Construction Chemicals, Inc.
i. Masterkure, Master Builders, Inc.
j. CS-309, W.R. Meadows, Inc.
k. Seal N Kure, Metalcrete Industries.
l. Kure-N-Seal, Sonneborn-Chemrex.
m. Stontop CS2, Stonhard, Inc.
n. Lambco 120, Lambert Corporation

I. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Aquafilm, Conspec Marketing and Mfg. Co.
b. Eucobar, Euclid Chemical Co.
c. E-Con, L&M Construction Chemicals, Inc.
d. Confilm, Master Builders, Inc.
e. Waterhold, Metalcrete Industries.
f. Lambco Skin, Lambert Corporation

J. Bonding Agent: Polyvinyl acetate or acrylic base; ASTM C-1059.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Polyvinyl Acetate (Interior Only):

1) Superior Concrete Bonder, Dayton Superior Corp.
2) Euco Weld, Euclid Chemical Co.
3) Weld-Crete, Larsen Products Corp.

4) Everweld, L&M Construction Chemicals, Inc.
5) Herculox, Metalcrete Industries.
6) Ready Bond, Symons Corp.
7) Hibond; Lambert Corporation

b. Acrylic:

1) Acrylic Bondcrete, The Burke Co.
2) Strongbond, Conspec Marketing and Mfg. Co.
3) Day-Chem Ad Bond, Dayton Superior Corp.
4) FlexCon, Euclid Chemical Co.
5) Daraweld C, W.R. Grace & Co.
6) Hornweld, A.C. Horn, Inc.
7) Everbond, L&M Construction Chemicals, Inc.
8) Acryl-Set, Master Builders Inc.
9) Intralok, W.R. Meadows, Inc.
10) Acrylpave, Metalcrete Industries.
11) Sonocrete, Sonneborn-Chemrex.
12) Stonlock LB2, Stonhard, Inc.
13) Strong Bond, Symons Corp.
14) Acrylbond, Lambert Corporation

K. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements. **No substitutions will be accepted.**

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hilti - HY 150 MAX, HIT-RE 500.
b. Powers – PE1000, AC100+ Gold.
c. Simpson Strong Tie – SET XP, SET, AT, AT XP, ET-HP
d. Euco Epoxy System #452, Euclid Chemical Co.
e. Red Head A7, C6 and G5 Epoxy

L. Joint Protector shall be furnished to protect saw cut joints at intersections of joints as follows:

1. While cutting a new joint across a previously cut fresh joint to prevent the corners from breaking down on the previous cut, insert the proper Soff-Cut Joint Protector. Place the Joint Protector into the previous cut, flush with the top surface. An additional Joint Protector may be used to prevent breakdown where the drive wheels of the saw crosses the initial cut. After proper installation, cut through the joint protector and do not remove untill the concrete has permently set.

M. Warehouse floors that will receive hard wheel industrial vechicular traffic shall be provided with a special metallic or mineral aggregate surface hardener and repeated hard steel-troweling.

2.5 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

1. Do not use the same testing agency for field quality control testing.

2. Limit use of fly ash to not exceed 20 percent of cementitious material by weight.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules shall be provided as shown below when strength data from field experience or trial mixtures are not available.

1. 4000 psi, 28-day compressive strength; water-cement ratio, 0.44 maximum (non-air-entrained), 0.35 maximum (air-entrained).
2. 3000 psi, 28-day compressive strength; water-cement ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained).

D. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:

1. Subjected to freezing and thawing: W/C 0.45.
2. Subjected to deicers/watertight: W/C 0.40.
3. Subjected to brackish water, salt spray, or deicers: W/C 0.40.

E. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps and sloping surfaces: Not more than 4 inches.
2. Reinforced foundation systems: Not more than 4 +/- 1 inches.
3. Slabs: Not more than 4 +/- 1 inches.
4. Other concrete: Not more than 5 inches.

F. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in Work.

2.6 ADMIXTURES

A. Use water-reducing admixture in concrete, as required, for placement and workability.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

C. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:

1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:

a. 4.5 percent (moderate exposure); 5.5 percent (severe exposure) for 1-1/2 inch (38 mm) maximum aggregate.
b. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) for 1 inch (25 mm) maximum aggregate.

c. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) for 3/4 inch (19 mm) maximum aggregate.
d. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) for 1/2 inch (13 mm) maximum aggregate.

2. Concrete slabs not exposed to freezing, thawing, or hydraulic pressure: 0 to 2 percent air.

3. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

D. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

A. Job-Site Mixing: Mix concrete materials in appropriate drum-type batch machine mixer. For mixers of 1 cu. yd. (0.76 cu. m) or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than 1 cu. yd. (0.76 cu. m), increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).

1. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (29 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

1. Provide Class A tolerances for concrete surfaces exposed to view.
2. Provide Class C tolerances for other concrete surfaces.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking,

screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for Other Trades: Coordinate openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER/BARRIER INSTALLATION

A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.

B. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended mastic or pressure-sensitive tape.

1. Cover vapor retarder/barrier with sand cushion and compact to depth indicated.

3.4 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, besser brick, and hangers, as approved by Architect.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and tie splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect. Construction joints shall be per FBC Sections 1907.4.1 and 1907.4.2 (cleaned, laitance removed, wetted, standing water removed).

B. Provide keyways at least 1-1/2 inches (38 mm) deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's printed instructions.

F. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

G. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8 inch (3 mm) wide by one-fourth of slab unless otherwise indicated.

1. Form contraction joints in exterior slabs by inserting ¼" wide premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. If joint pattern is not shown, provide joints not exceeding 15 ft. (4.5 m) in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
3. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

3.6 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Install dovetail anchor slots in concrete structures as indicated on drawings.

D. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified. Concrete shall be per FBC 1906.4.2 and shall be carried on at such a rate that the concrete is at all times plastic. Prohibit the following concrete per FBC 1906.4.3 and 1906.4.4, partially harded concrete , contaminated concrete, re-tampered concrete or concrete that has been re-mixed after it has taken its initial set.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures and as follows:

1. Minimum Concrete placement temperatures as a funtion of thickness:

<12 inches	12-26 inches	36-72 inches	>72 inches
55 degrees F	50 degrees F	45 degrees F	40 degrees F

Once the concrete has been placed, it must be maintained at a temperature above 50 degrees F for a period of 72 hours to allow for adequate curing.

G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients (if required) before mixing to maintain concrete temperature at time of placement to below 100 deg F (35 deg C). Mixing water may be chilled 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. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch (6 mm) in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Smooth-Rubbed Finish: Provide smooth-rubbed finish on scheduled concrete surfaces that have received smooth-formed finish treatment not later than 1 day after form removal.

1. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. 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 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

1. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155 (ASTM E 1155M). Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155 (ASTM E 1155M). Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155

(ASTM E 1155M). Grind smooth any surface defects that would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

F. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and where indicated.

1. After completing float finishing and before starting trowel finish, uniformly spread dampened nonslip aggregate at a rate of 25 lb per 100 sq. ft. (12 kg/10 sq. m) of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.
2. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, 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 shown or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items if required by Architectural drawings. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.12 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling. Suggest a wet cure time of 7 days minimum at 50 degrees minimum temperture per ACI 318-02 section 5.11.1 and FBC section 1906.5.1.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified. **It is highly recommended that one of the moist cure methods be used.**

D. Provide moisture curing by the following methods:

1. Keep concrete surface continuously wet by covering with water.
2. Use continuous water-fog spray.
3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4 inch (100 mm) lap over adjacent absorptive covers.

E. Provide moisture-retaining cover curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches (75 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

H. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.

1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.13 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.14 REUSING FORMS

A. 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-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.

3.15 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Architect.

B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh (1.2 mm) sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch (6 mm) in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch (25 mm). Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas 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.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces 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. Proprietary underlayment compounds may be used when acceptable to Architect.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch (25 mm) in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated random cracks and single holes 1 inch (25 mm) or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

F. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Architect.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: The Contractor (unless provided by Owner) will employ an independent testing agency to perform tests and to submit test reports.

B. Sampling and testing for quality control during concrete placement may include the following, as directed by Architect.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

    a. Slump: ASTM C 143; one test at point of placement (end of hose if pumped) for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
    b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
    c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
    d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
    e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. (4 cu. m) plus additional sets for each 50 cu. yd. (38 cu. m) more than the first 25 cu. yd. (19 cu. m) of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
3. When total quantity of a given class of concrete is less than 50 cu. yd. (38 cu. m), Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi (3.4 MPa).

C. Test results will be reported in writing to Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

E. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03300

SECTION 04200 - UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 RELATED SECTIONS:

A. Section 03200 – Concrete Reinforcement.

B. Section 03300 – Cast-in-Place Concrete.

C. Section 04230 – Reinforced Unit Masonry

1.03 CODES AND SPECIFICATIONS:

A. Codes and Specifications:

All concrete masonry construction shall conform to the requirements of the local building code and the following codes:

1. Building Code Requirements for Masonry Structures, ACI 530-08.
2. Building Code for Masonry Structures, The Masonry Society (TMS) Document No. 402-08.

1.04 DESCRIPTION OF WORK:

A. Extent of each type of masonry work is indicated on the architectural and structural drawings and in schedules. Provide all labor, materials, equipment, and services necessary for and incidental to the installation of all masonry construction as indicated on the drawings and specified herein.

Masonry construction includes non-reinforced concrete masonry including concrete filled masonry beams, columns, pilasters, lintels, and soffits. Accessories include, but are not necessarily limited to ties, horizontal and vertical reinforcement, anchors to the structure, and control joints.

B. The masonry contractor shall install all accessory items that are required in the work and supplied by others, including: bolts, nailing blocks, inserts, anchors, flashing, lintels, expansion joints, conduits, etc.

C. Types of masonry work required include:

1. Concrete unit masonry (CMU).

1.05 QUALITY ASSURANCE:

A. Single Source Responsibility for Masonry Units:

Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

B. Single Source Responsibility for Mortar Materials:

Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

C. Fire Performance Characteristics:

Where indicated or required, provided materials and construction which are Identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction.

1.06 SUBMITTALS:

A. Product Data and Samples:

1. Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Provide certification of pull-out strength of all masonry ties and anchors. Submit certification of compliance with required standards for all masonry units. Submit one sample each of all masonry accessories items.
2. Submit unit masonry samples for each type of exposed masonry required, including all special shapes. Include colors and textures to be expected in completed work.

B. Mix Designs:

Mix designs for mortar and grout specifying type, source, and brand of all materials shall be submitted for Engineer and Owner testing laboratory approval prior to start of the work. Mix designs shall be submitted only for structural load bearing walls and exterior walls subjected to wind load.

C. Certificates:

1. Prior to delivery, submit to Architect/Engineer certificates attesting compliance with the applicable specifications for grades, types or classes included in these specifications.

1.07 DELIVERY, STORAGE, AND HANDLING:

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.

C. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.

D. Store cementitious materials and masonry units off the ground, under cover and in dry location. All materials must be protected from wetting by capillary action, rain, or snow, and protected from mud, dust, or other materials and contaminants likely to cause staining or defects.

E. Store aggregates where grading and other required characteristics can be maintained.

F. Store masonry accessories including metal items to prevent deterioration by corrosion or accumulation of dirt.

G. Store mortar materials on dunnage, in a dry place. During freezing weather, protect masonry units with tarpaulins or other suitable material.

H. Protect reinforcement and accessories from elements.

1.08 PROJECT CONDITIONS:

A. Protection of Work:

The Contractor shall construct and maintain temporary protection as required to permit continuous progress of the work. During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.
3. Do not apply concentrated loads for at least 3 days after building masonry walls or columns.

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS:

A. Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

B. Provide special shapes where required for lintels, corners, jambs, sash, control joints, headers, bond beams, knock out panels, and other special conditions. All special shapes provided shall match approved samples.

C. Provide square-edged units for outside corners, except where indicated as bullnose.

D. Provide units complying with characteristics indicated below for Grade, Type, face size, exposed face and, under each form of block included, for weight classification.

1. Size:

a. Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thicknesses indicated unless shown otherwise on the

drawings. The Contractor shall furnish all required sizes and shapes as required to complete the work.

2. Type II, non-moisture-controlled units.

3. Hollow Loadbearing Block:

ASTM C 90 normal weight.

2.02 MORTAR AND GROUT MATERIALS:

A. Portland Cement:

ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.

B. Hydrated Lime:

ASTM C 207, Type S.

C. Quicklime:

ASTM C5.

D. Aggregate for Mortar:

ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.

E. Coarse Aggregate for Grout:

ASTM C404, maximum size 3/8”.

F. Water:

Clean and potable. Mixing water must be free of harmful amounts of acids, alkalis, organic materials, or other substances that would adversely affect the quality or appearance of the mortar or the masonry units.

G. Proprietary Mortar Mixes:

Proprietary mortar mixes may not be used.

2.03 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES:

A. General:

1. Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:

2. Manufacturers:

a. Subject to compliance with requirements, provide products of one of the following:

(i) AA Wire Products Co.
(ii) Dur-O-Wall, Inc.
(iii) Hohmann & Barnard, Inc.
(iv) National Wire Products Corp.

b. Other manufacturers shall be used only with Engineer approval. The Contractor shall submit technical literature for all reinforcing units.

B. Hot-Dip Galvanized Steel Wire:

ASTM A 82 for uncoated wire and with ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.

1. Application: Use for masonry exposed to exterior and in contact with earth.

C. Zinc-Coated (Galvanized) Steel Sheet:

Carbon steel with zinc coating complying with ASTM A 525, Coating Designation G90.

1. Application: Use for dovetail slots and where indicated.

D. Hot-Dip Galvanized Carbon Steel Sheet:

ASTM A 366, Class 2 or ASTM A 635; hot-dip galvanized after fabrication to comply with ASTM A 153, Class B.

1. Application: Use for anchors.

E. Joint Reinforcement:

Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods in straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:

1. Width: Fabricate joint reinforcement in units with widths a minimum of 2" less than nominal width of walls. Provide mortar coverage over joint reinforcement of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.

2. Wire Size for Side and Cross Rods:

a. 0.1483" diameter (9 ga.) for all masonry construction except as noted below.

b. 0.1875" diameter (6 ga.) for loadbearing or reinforced concrete masonry construction.

3. For single-wythe masonry provide type as follows with single pair of side rods:

a. Ladder design with perpendicular cross rods spaced not more than 16" o.c.

F. Bend-Wire Ties:

Provide individual prefabricated bent-wire units complying with requirements indicated below:

1. Wire Size: 0.1875" diameter.
2. Length: Provide units of length indicated but not less than that required for embedment into each wythe of 2" for solid units and for a minimum of 2" embedment of tie end into face shells of hollow units, with not less than 5/8" mortar cover on exterior face joints, 1/2" elswhere.
3. Tie Shape for Hollow Masonry Units Laid with Cells Vertical: Rectangular with ends welded closed and not less than 2" wide.
4. Tie Shape for Solid Masonry Unit Construction: Z-shaped ties with ends bent 90° to provide hooks not less than 2" long.
5. Type for Masonry Where Coursing Between Wythes Align: Unit ties bent from one piece of wire.
6. Type for Masonry Where Coursing Between Wythes Does Not Align: Adjustable ties composed of two parts, one with a pintle, the other with an eye.

G. Flexible Anchors:

Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.

1. For anchorage to concrete framework, provide manufacturer's standard anchors with dovetail anchor section formed from 0.1046" (12 gage) thick sheet metal and triangular-shaped wire tie section sized to extend within 1" of masonry face.
2. For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4" diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1" of masonry face.
3. Wire Size: 0.1875" diameter.

H. Rigid Anchors:

Provide straps of form and length indicated, fabricated from sheet metal strips of following width and thickness, unless otherwise indicated. Typical length to be 24" plus 2" long, 90° bends at ends.

1. Width: 1-1/4".
2. Thickness: 1/4".

I. Unit Type Masonry Inserts in Concrete:

Furnish cast iron or malleable iron inserts of type and size indicated.

J. Dovetail Slots:

Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336" (22 gage) sheet metal.

K. Anchor Bolts:

Provide steel bolts with hex nuts and flat washers complying with ASTM A 307, Grade A, hot-dip galvanized to comply with ASTM C 153, Class C, in sizes and configurations indicated.

2.04 MISCELLANEOUS MASONRY ACCESSORIES:

A. Reinforcing Bars:

Deformed steel, ASTM A 615, Grade 60.

B. Non-Metallic Expansion Joint Strips:

Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE 41E1, capable of compression up to 35%, of width and thickness indicated.

C. Premolded Control Joint Strips:

Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Premolded PVC Control Joint Strips. Strips shall be polyvinyl chloride complying with ASTM D 2287, Type PVC 654-4 with a durometer hardness of 90.

D. Bond Breaker Strips:

Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.05 MASONRY CLEANERS:

A. Job-Mixed Detergent Solution:

Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.

2.06 MORTAR AND GROUT MIXES:

A. General:

1. Do not add admixtures including coloring pigments, air-entraining agent, accelerators, retarders, water repellent agent, anti-freeze compounds or other admixtures.
2. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry:

Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated. Minimum twenty-eight day compressive strength shall be 1800 psi.

1. Limit cementitious materials in mortar to portland cement-lime.
2. Use Type S mortar for reinforced masonry unless noted otherwise.
3. Mortar mix design shall conform to Florida Building Code (FBC) requirements.

C. Grout for Unit Masonry:

1. Comply with ASTM C476 for grout for use in construction of reinforced and nonreinforced unit masonry. Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Minimum twenty-eight day compressive strength shall be 3000 psi.
2. Use fine grout in grout spaces less than 2" in horizontal direction, unless otherwise indicated. Fine grout shall be composed of one part portland cement, to which may be added not more than one-tenth part hydrated lime or lime putty, and two and one-fourth to three parts sand.
3. Use coarse grout in grout spaces 2" or more in least horizontal dimension, unless otherwise indicated. Coarse grout shall be composed of one part portland cement to which may be added not more than one-tenth part hydrated lime or lime putty, and two to three parts sand, and not more than two parts gravel.
4. Satisfy all local codes for maximum aggregate size with respect to minimum clear opening to be grouted.
5. Do not add admixtures to grout.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL:

A. Inspect surfaces that are to support masonry work to assure completion to proper lines and grades free of dirt and other deleterious material. Do not begin work until surfaces not properly prepared have been satisfactorily corrected.

B. Do not wet concrete masonry units.

C. Cutting masonry units:

1. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous patterns and to fit adjoining work. Use full-size units without cutting where possible.
2. Use dry cutting saws to cut concrete masonry units.

D. Match bonding, coursing height, jointing, color, and texture of new masonry work with existing masonry work.

3.02 CONSTRUCTION TOLERANCES:

A. Variation from Plumb:

For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10 feet, or 3/8" in a story height not to exceed 20 feet, nor 1/2" in 40 feet or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20 feet maximum, nor 1/2" in 40 feet or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10 feet, 1/2" maximum.

B. Variation from Level:

For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20 feet maximum, nor 1/2" in 40 feet or

more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10 feet or 1/16" within width of a single unit.

C. Variation of Linear Building Line:

For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20 feet maximum, nor 3/4" in 40 feet or more.

D. Variation in Cross-Sectional Dimensions:

For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".

E. Variation in Mortar Joint Thickness:

Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.03 LAYING MASONRY WALLS:

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

C. Pattern Bond:

Lay exposed masonry in the bond pattern shown or indicated. If not shown or indicated, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work:

Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces at set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

E. Built-in Work:

Install bolts, anchors, nailing blocks, inserts, frames, vent flashings, conduit, and other built-in items specified under this and other sections of these specifications as masonry work progresses. Avoid cutting and patching. Solidly grout spaces around built-in items. Provide joints around exterior framed openings 1/4" to 3/8" wide, raked and tooled smooth to a uniform depth of 3/4", ready for caulking by others. Build chases, do not cut. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Install chases minimum of one full masonry unit length from jambs.

1. Fill in space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core, unless detailed otherwise.
3. Fill cores in hollow concrete masonry units with grout to supporting beam or slab below under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.

F. Bondbreaker Strips at Corners:

Unless shown otherwise, provide bondbreaker strips between concrete foundation and first masonry course for a length of 3 feet each direction from all corners.

G. Bond pattern layout of Ramp Level exterior walls shall be stacked bond to match existing.

3.04 MORTAR BEDDING AND JOINTING:

A. Provide uniform nominal joint thickness as shown below, unless noted otherwise on the drawings:

1. Concrete Masonry Units 3/8"

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells of cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.

D. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners of jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

E. Provide weatherproof, concave, tooled joints in exposed surfaces when mortar is thumbprint hard, using round jointing tool. Strike joints flush in surfaces to be plastered, stuccoed, or covered with other material or surface-applied finish other than paint. Remove mortar protruding into cells or cavities to be grouted. Do not permit mortar droppings to fall into cavities of multi-wythe walls or to block weep holes. Do not fill horizontal joints between top of masonry partitions and underside of concrete or steel construction with mortar unless specifically shown on the drawings. If not shown otherwise, provide 1" clear joint to be filled with caulk. Keep movement joints clean of all mortar and debris. For tuckpointing, rake mortar joints to a depth of 1/2 to 3/4 in., saturate with clean water, fill solidly with pointing mortar, and tool to match existing joints.

3.05 HORIZONTAL JOINT REINFORCEMENT:

A. General:

1. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcing a minimum of 6" at splices.
2. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
3. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.
4. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
5. Space continuous horizontal reinforcement as follows:

    a. For single-wythe walls, laid in running bond space reinforcement at 16" o.c. vertically, unless otherwise indicated.
    b. For masonry walls laid in stacked bond, concrete masonry cantilever walls and fences, space reinforcement at 8" o.c. vertically, unless otherwise indicated.

6. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in two horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints. Horizontal joint reinforcement interrupted by the jamb of an opening shall have the cross rod or side rod bent and hooked at the jamb. Provide an additional rectangular adjustable tie at the jamb for each joint not containing the normal horizontal reinforcing unit.
7. Provide reinforcement at openings in addition to other specified wall reinforcement.

3.06 ANCHORING MASONRY WORK:

A. General:

1. Provide anchor devices of type indicated.

B. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following, unless noted otherwise on the drawings:

1. Provide an open space not less than 1" in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24" o.c. vertically and 24" o.c. horizontally.

C. Where wire ties are welded to structural members, paint welded area with Z.R.C. Cold Galvanizing Compound after welding.

D. Anchor single wythe masonry veneer to metal studs with masonry veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to metal studs with 2 metal fasteners of type indicated.
2. Embed tie section at least 2" into masonry joints. Provide not less than 1" air space between back of masonry veneer wythe and face of sheathing.

3. Locate anchor section relative to course in which tie section is embedded to allow maximum vertical differential movement of tie up and down.
4. Space anchors at not more than 16" o.c. vertically and 24" o.c. horizontally. Install additional anchors within 1'-0" of openings and at intervals around perimeter not exceeding 3'-0".

3.07 GROUTING

A. Fully grout vertical cells of concrete masonry containing steel reinforcement. Wherever possible, grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.

3.08 CONTROL AND EXPANSION JOINTS:

A. General:

1. Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.

B. Where control joints are not indicated on the drawings the Contractor shall submit a proposed control joint layout for Architect and Engineer approval. General guidelines for control joint locations are as follows:

1. At major changes in wall height
2. At changes in wall thickness
3. At corresponding control joints in foundations, floor, or roof construction
4. At one or both sides of wall openings (masonry veneer only)
5. Near wall intersections
6. At column centerlines.

C. Maximum Spacing:

Maximum control joint spacing shall be as follows:

1. Non-Reinforced Masonry. Ratio of wall length to height shall not exceed 3 with maximum spacing of fifty feet.

3.09 LINTELS

A. Provide masonry lintels where shown or required, and wherever openings of more than 2'-0" are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels until grout is properly cured.

1. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars filled with coarse grout.

B. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.

3.10 FLASHING OF MASONRY WORK

A. Provide concealed flashing in masonry work at, or above, shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar. Extend flashings through exterior face of masonry and turn down to form drip.

B. Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall is exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills turn up ends not less than 2" to form a pan.

3.11 REPAIR, POINTING, AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing:

1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Pointup all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants. If the repairs must be made after the mortar has hardened, the joint must be raked or chiseled out to a depth of about 1/2" thoroughly wetted, and repointed with fresh mortar.
2. To prehydrate mortars, thoroughly mix all ingredients except water in proportions used for original mortar mix; then mix again, adding only enough water to produce a damp unworkable mix which will retain its form when pressed into a ball. After 1 to 2 hours, add sufficient water to bring it to the proper consistence; that is conventional masonry mortars.

C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
2. Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.

D. Protection and Cleanup

1. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensure unit masonry work being without damage and deterioration at time of substantial completion.
2. Leave work area and surrounding surfaces clean and free of mortar spots, droppings, and broken masonry.

END OF SECTION 04200

SECTION 04230
REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Requirements of Section 04200 – Unit Masonry apply to work of this Section.

1.02 SCOPE OF WORK:

A. Extent of reinforced unit masonry work is indicated on drawings. Provide all labor, materials, equipment, and services necessary for and incidental to the installation of all reinforced unit masonry construction as indicated on the drawings and specified herein. Reinforced unit masonry construction includes reinforced concrete masonry walls, including grout filled masonry columns, pilasters, beams, and lintels. Accessories include, but are not necessarily limited to ties, horizontal and vertical reinforcement, anchors to the structure, and control joints.

1.03 SUBMITTALS:

A. Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcement steel required for project.

B. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcement bars and for steel templates for layout of dowels for columns and pilasters. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of all reinforcement for reinforced unit masonry work.

C. Formwork Design Calculations: Prepared and sealed by a Professional Engineer licensed in the State of Florida.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. General: Refer to Section 04200 – Unit Masonry for masonry materials and accessories not included in this Section.

B. Reinforcement Bars: Provide deformed bars of following grades complying with ASTM A615, except as otherwise indicated.

1. Provide Grade 60 for bars No. 3 to No. 11, except as otherwise indicated.

2. Where No. 2 bars are shown, provide plain, round, carbon steel bars, ASTM A675, Grade 80.

3. Shop fabricate reinforcement bars which are shown to be bent or hooked.

PART 3 - EXECUTION

3.01 GENERAL:

A. Refer to Section 04200 – Unit Masonry for general installation requirements of unit masonry.

3.02 PLACING REINFORCEMENT:

A. General: Clean reinforcement of loose rust, mill scale, earth, or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 8’-0”.

C. For columns, piers, and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2”, whichever is greater. Provide lateral ties sa indicated.

D. All dowels shall be grouted into a cell with vertical reinforcement. Unless detailed otherwise on the drawings, dowels shall be the same size and number as the vertical steel. Unless noted otherwise provide a lap length of dowels to vertical reinforcement equal to 50 times the nominal dowel diameter. Dowels for columns and pilasters shall be set using 1/8” thick steel plate templates. Templates shall be detailed and submitted with reinforcing steel shop drawings.

E. All horizontal reinforcing steel shall be placed in continuous bond beam or lintel block units and shall be solidly grouted in place. Maintain a minimum of one bar diameter or 1” (whichever is greater) clearance between adjacent bars. Horizontal reinforcement may be placed as the masonry work progresses.

F. Splice reinforcement bars as indicated. Do not splice at other points unless acceptable to Architect/Engineer. Where splices occur, adjacent splices shall be staggered so that no more than 25% of the total number of bars are spliced at any one point, with a minimum stagger between splices in adjacent bars of at least the lap length. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact, and tie with wire. Minimum lap splice length shall be 50 bar diameters unless indicated otherwise.

G. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.

3.03 FORMWORK:

A. Temporary Formwork: Provide formwork and shoring as required for temporary support of reinforced unit masonry elements.
B. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.

C. Formwork shall be designed and shop drawings prepared by a Professional Engineer licensed in the State of Florida.

D. Formwork shall not be removed until the reinforced masonry element has cured sufficiently to carry its own weight and any other loads that may be placed on it during construction. Allow not less than the following minimum time to elapse after completion of the element before removing shores or forms provided adequate curing conditions have been maintained during the full curing period:

1. Lintels and beams: 10 days.

2. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads. Allow an additional 48 hours before applying concentrated loads such as girders, beams, or trusses.

3.04 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY:

A. General:

1. Do not wet concrete masonry units (CMU).

2. Lay CMU with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to but not less than the thickness of longitudinal face shells. Solidly bed all cross-webs in mortar. Maintain head and bed joint widths indicated, or if not indicated, provide 3/8” joints.
   a. Where solid CMU are shown, lay with full mortar head and bed joints.

B. Walls:

1. Pattern Bond: Lay CMU wall units in ½ stack bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams, and other special conditions.

2. Maintain vertical continuity of core or cell cavities which are to be reinforced and grouted to provide minimum clear dimensions indicated or required, and to provide maximum grout coverage for vertical reinforcing bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

3. Where horizontal reinforced beams (bond beams) are indicated or required, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joist under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

C. Columns, Piers, and Pilasters:

1. Use CMU of the size, shape and number of vertical core spaces indicated. If not indicated, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars indicated.

2. Provide pattern bond indicated, or if not indicated, alternate head joints in vertical alignment.

3. Where bonded pilaster construction is indicated, lay wall and pilaster inits together to maximum pour height specified.

D. Grouting:

1. General:
   a. Use “Fine Grout” per ASTM C476 for filling spaces less than 4” in one or both horizontal directions.
   b. Use “Coarse Grout” per ASTM C476 for filling spaces 4” or larger in both horizontal directions.
   c. Use 3000 psi normal weight concrete for filling spaces 10” and larger in both directions.
   d. Grouting Technique: At the Contractor’s option, use either low-lift or high-lift grouting techniques subject to requirements which follow.

2. Low-Lift Grouting:
   a. Provide minimum clear dimension of 2” and clear area of 8 square inches in vertical cores to be grouted.
   b. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diametes nor 8’-0”.
   c. Lay CMU to maximum pour height. Do not exceed 5 feet height, or if a bond beam occurs below 5 feet height stop pour at course below bond beam.
   d. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2” below top of course of pour.
   e. Bond Beams: Stop grout in vertical cells 1-1/2” below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections. Place grout in bond beam course before filling vertical cores above bond beam.

3. High-Lift Grouting:
   a. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 3” and 10 square inches, respectively.
   b. Provide clean-out holes in the first course of masonry, and over all bond beams, door headers, or other openings. Use a high pressure water jet to remove excess mortar and drippings from grout core and from reinforcement.
   c. Do not plug clean-out holes until condition of area to be grouted has been accepted.
   d. Construct masonry to full height of maximum grout pour specified, prior to placing grout.
   e. Limit grout lifts to a maximum height of 5 feet and grout pour to a maximum height of 20 feet, for single wythe hollow concrete masonry walls, unless otherwise indicated.
   f. Place horizontal beam reinforcement as the masonry units are laid.
   g. Embed lateral tie reinforcement in mortar joints where indicated. Place as masonry units are laid, at vertical spacing indicated.

4. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Pemove dust, dirt, mortar droppings, loose pieces of masonry, and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean

top surface of structural members supporting masonry to ensure bond. After final cleaning and inspection, close clean-out holes and brace closures to resist grout pressures.

5. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.

6. Place grout by pumping into grout spaces.

7. Place grout in lintels or beams over openings in one continuous pour.

8. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 1" of vertically reinforced cavities, during construction of masonry.

9. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2" of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

E. Anchoring:

1. Anchor reinforced masonry work to supporting structure as indicated.

2. Anchor reinforced unit masonry walls to non-reinforced masonry where they intersect, unless shown otherwise.

3.05 QUALITY CONTROL:

A. Masonry Prisms shall be made and tested in accordance with Section 04200 – Unit Masonry.

1. If the coefficient of variation of the compression samples tested exceeds 12%, obtain compressive strength by multiplying average compressive strength of specimens by

$$1 - 1.5\,\frac{(v - 0.12)}{(100)}$$

where v is the coefficient of variation of sample tested.

B. Prism Strength:

1. Compressive Strength, f'm. The compressive strength of reinforced concrete masonry, f'm, as determined by prism tests shall be as indicated below:

Class of Reinforced Unit Masonry	28 Day Compressive Strength, f'm
a. Single Wythe Grouted Masonry	3000 psi

END OF SECTION 04230

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. This Section includes the following:

1. Wood furring, grounds, nailers, and blocking.
2. Plywood backing panels.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

1.4 SUBMITTALS

A. Material certificates for dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's (ALSC) Board of Review.

B. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:

1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.
3. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

C. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.

D. Warranty of chemical treatment manufacturer for treatment.

E. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products’ compliance with building code in effect for Project.

1. Fire-retardant-treated wood.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

B. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

C. Roof Related Rough Carpentry: Comply with the requirements of FM-1049, latest edition, for construction of roof related rough carpentry.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

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. Wood-Preservative-Treated Materials:

a. Hickson Corp.
b. Hoover Treated Wood Products, Inc.
c. Osmose Wood Preserving, Inc.

2. Fire-Retardant-Treated Materials, Interior Type A:

a. Hickson Corp.
b. Hoover Treated Wood Products, Inc.

3. Fire-Retardant-Treated Materials, Exterior Type:

a. American Wood Treaters, Inc.
b. Hoover Treated Wood Products, Inc.

2.2 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. SPIB - Southern Pine Inspection Bureau.
2. WWPA - Western Wood Products Association.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.

D. 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.

1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

1. Do not use chemicals containing chromium or arsenic.
2. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items 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.
4. Wood floor plates installed over concrete slabs directly in contact with earth.

C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40-lb/cu. ft.

D. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products

Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.
2. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

B. Interior Type A: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:

1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
3. Contact with treated wood does not promote corrosion of metal fasteners.

C. Exterior Type: Use for exterior locations and where indicated.

D. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.5 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.

2.6 BOARDS

A. Concealed Boards: Where boards will be concealed by other work, provide lumber with 19 percent maximum moisture content and of following species and grade:

1. Species and Grade: Mixed southern pine, No. 2 per SPIB rules.
2. Species and Grade: Hem-fir, Standard per WCLIB rules or No. 3 Common per WWPA rules.
3. Species and Grade: Spruce-pine-fir, Standard per WCLIB rules or No. 3 Common per WWPA rules.
4. Species and Grade: Western woods, Standard per WCLIB rules or No. 3 Common per WWPA rules.
5. Species and Grade: Any species above.

2.7 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: For dimension lumber sizes; provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.8 STRUCTURAL-USE PANELS FOR BACKING

A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch thick.

2.9 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Provide 300 Series stainless steel fasteners where in contact with pressure treated materials.
2. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide stainless steel fasteners.

B. Power-Driven Fasteners: CABO NER-272.

C. Lag Bolts: ASME B18.2.1.

D. Bolts: Stainless steel bolts.

E. Nails: TYPE 316 stainless steel annular or ring shank.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Florida Building Code 2010.

F. Use common annular or ring shank s.s. nails, unless otherwise indicated. Use finishing nails for finish work. 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.

G. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Install permanent grounds of dressed, preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

D. Joint Installation: Layer to layer board joints no less than 4’ apart and all layered blocking at corner conditions be woven.

3.3 CHEMICAL REACTANT MATERIAL CONTACT.

A. In contract, do not install P.T. Wood in contact with carbon steel, aluminum galvanized steel. Wrap P.T. Wood Material in Perma Barrier or similar self adhering modified Bitumen membrane before installation.

END OF SECTION 06100

SECTION 07193
VAPOR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 DESCRIPTION

A. The work under this Section includes all labor, material, equipment, and services necessary to complete the vapor barrier work as shown on the drawings and herein specified. Under all concrete slabs and concrete foundations.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, prepacking and treating substrate, technical data, and test physical and performance properties of waterproofing.

PART 2 - PRODUCTS

2.1 VAPOR BARRIER UNDER SLABS

A. Minimum 15-mil thickness, "stego wrap," or approved equal.

2.2 TAPE

A. Tape as recommended by the manufacturer of vapor barrier.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not install vapor barrier until soil compaction and termite treatment is complete.

3.2 INSTALLATION

A. Placing: Vapor barrier shall be unrolled allowing for a minimum overlap of 6" over the treated, compacted subgrade, and turned down at the inside perimeter of foundations at vertical surfaces provide a minimum overlap of 6” and tape at overlap continuous.

B. Penetration: Where pipes and conduits pass through the membrane, it shall be doubled in thickness and sealed with a pressure-sensitive tape or cement as recommended by the manufacturer.

C. Do not puncture vapor barrier with steel reinforcement. Repair all punctures with tape or another layer of visqueen over puncture.

D. Install continuous tape at all vertical wall overlaps.

3.3 ADJUST AND CLEAN

A. Inspect the membrane thoroughly and repair all punctures immediately before placing concrete or insulation on walls. Equipment, tools, and procedures that might puncture the membrane shall not be used while placing and finishing concrete or installing insulation.

END OF SECTION 07193

SECTION 07210
BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. Insulate roof and walls to the extent shown on the drawings and specified here in.

B. This Section includes the following:
   1. Batt insulation.
   2. Other misc insulation as required by project conditions and drawings

1.3 SUBMITTALS

A. Product Data: Each type of insulation product specified.

B. Product Test Reports: From and based on tests performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

C. Research or Evaluation Reports: Reports of the model code organization acceptable to authorities having jurisdiction that evidence compliance of foam-plastic insulations with building code in effect for Project.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section 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.
   3. Combustion Characteristics: ASTM E 136.

1.5 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

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide insulation products by one of the following:

1. Batt and Sound Attenuation Insulation:

a. CertainTeed Corporation.
b. Knauf Fiber Glass GmbH.
c. Owens-Corning Fiberglas Corporation.
d. Schuller International, Inc.

2.2 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thickness, widths, and lengths.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

1. Thickness: As Required by the R value.
2. R-Value: Roof insulation R-38, Wall insulation R-19.

C. Sound Attenuation Blanket Insulation: 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, with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

1. Thickness: As indicated.

2.3 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.4 INSULATION FASTENERS

A. 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 thick by 2 inches square.
2. Spindle: Copper-coated low carbon steel, fully annealed, 0.105 inches in diameter, length to suit depth of insulation indicated.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle, capable of holding insulation securely in position indicated with self-locking washer in place, and complying with the following requirements:

1. Angle: Formed from 0.030-inch- thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
2. Spindle: Copper-coated low carbon steel, fully annealed, 0.105 inches in diameter, length to suit depth of insulation indicated.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- 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 square or in diameter.

1. Where spindles will be exposed to human contact after installation, protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.3 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

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. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

E. Install with fasteners/ clips and or place supporting wire to keep in place between frame members.

3.4 PROTECTION

A. General: Protect installed insulation from damage due to weather exposures, physical abuse, subsequent construction activities, 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 07210

SECTION 07620
SHEET METAL FLASHING AND TRIM

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 sheet metal flashing and trim in the following categories:

1. Metal flashing

2. Self-adhering flashing

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

B. Shop Drawings: Of each item specified showing layout, profiles, methods of joining, and anchorage details.

C. Samples: Of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of two (2) or more units showing the full range of variations expected.

1. 8" square Samples of specified sheet materials to be exposed as finished surfaces.

2. 12" long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

D. 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.

1.5 QUALITY ASSURANCE

A. Quality Control Standard: Sheet Metal & Air Conditioning Contractor's National Association (SMACNA), latest edition, and the Florida Building Code, latest edition.

B. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Mockups: Prior to installing sheet metal flashing and trim, construct mockups indicated to verify selections made under Sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.

2. Notify Architect one (1) week in advance of the dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Construct mockups for the following type of sheet metal flashing:

a. Valley flashing

b. Shingle roof to metal wall flashing

5. Obtain Architect's approval of mockups before start of final unit of Work.

6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

a. When directed, demolish and remove mockups from Project site.

b. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.6 WARRANTY

A. All warranted work under this section will be part of warranty coverage under Section 07311.

1.7 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:

1. Factory-Painted Aluminum Sheet: ASTM B209, 3003-H14, with a minimum thickness of 0.040", unless otherwise indicated.

2. Extruded Aluminum: ASTM B221, alloy 6063-T52, with a minimum thickness of 0.080" for primary legs of extrusions that are anodized, unless otherwise indicated.

B. Stainless-Steel Sheet: ASTM A167, Type 304, soft annealed, with No. 2D finish, except where harder temper is required for forming or performance; minimum 0.0187" thick, unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened. Use S.S. 316 fasteners when connecting to P.T. Wood Nailers.

B. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."

C. Self-Adhering Flashing/Weather Barrier: Self-adhering rubberized asphalt membrane integrally bonded to polyethylene sheeting, formed into uniform flexible sheets of not less than 40 mils thick.

1. Product and Manufacturer - Basis of Design: VYCOR 40 Wall Flashing; Grace Construction Products.

a. Surface Conditioner: Type as recommended by the manufacturer for substrates indicated.

D. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

2.3 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

E. Expansion Provisions: Space movement joints at maximum of 10' with no joints allowed within 24" of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

G. Separate metal from noncompatible metal or corrosive substrates with self-adhering flashing material.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Exposed Trim, Gravel Stops, and Fasciae: Fabricate from the following material:

1. Aluminum: 0.050" thick.

C. Copings: Fabricate from the following material:

1. Aluminum: 0.050" thick.

D. Base Flashing: Fabricate from the following material:

1. Stainless Steel: 0.01" minimum thickness.

E. Counterflashing: Fabricate from the following material:

1. Stainless Steel: 0.01" minimum thickness.

F. Flashing Receivers: Fabricate from the following material:

1. Stainless Steel: 0.01" minimum thickness.

G. Equipment Support Flashing: Fabricate from the following material:

1. Stainless Steel: 0.0187" thick.

H. Concealed Flashing and Thru-Wall Flashing: Fabricate from the following material:

1. Stainless Steel: 0.0187" thick; mill finish.

2.5 ALUMINUM FINISHES

A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.

B. High-Performance Organic 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 manufacturers' written instructions.

1. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70% polyvinylidene fluoride resin by weight; complying with AAMA standards.

a. Colors: Custom to be selected by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

1. Install exposed sheet metal Work that is without oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

B. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10' with no joints allowed within 24" of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).

C. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant. Use joint adhesive for nonmoving joints specified not to be soldered.

D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

E. Separations: Separate metal from noncompatible metal or corrosive substrates using self-adhering flashing material.

F. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2" and bed with sealant.

G. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Seal flashing to equipment support member.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07620

SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

a. Control and expansion joints in cast-in-place concrete.
b. Control and expansion joints in unit masonry.
c. Joints between different materials listed above.
d. Perimeter joints between materials listed above and frames of doors and windows.
e. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:

a. Control, expansion, and isolation 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 control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
e. Perimeter joints between interior wall surfaces and frames of interior doors, and windows.
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. Control and expansion joints in cast-in-place concrete slabs.
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

1.3 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.

1.4 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.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturers written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

C. Preinstallation Conf: Include, manufacturer, installer, general contracting OAR and architect to review product, installation and warranty requirements.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: 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.
2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F.
3. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 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.

B. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing 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: As specified, beginning from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the following products indicated for each type in the sealant.

1. One-Part Silicone Sealant: For poured-in-place concrete and concrete-to-masonry; one-part silicone sealant, having a joint movement capability of plus-or-minus 100% elongation, minus 50% compression, and Shore A durometer hardness of 15.

a. Product and Manufacturer: "No. 790"; Dow Corning Corp. or equal product as manufactured by General Electric Co.
b. Warranty: Manufacturer's standard 20 year warranty.

2. One-Part Silicone Sealant: For masonry-to-aluminum, steel-to-aluminum, concrete-to-aluminum, steel-to-steel, and other metal-to-metal joints (including KYNAR coatings); one-part silicone sealant having a joint movement capability of plus-or-minus 50% elongation, and Shore A durometer hardness of 30.

a. Products and Manufacturers: Provide one of the following.

1) "Dow Corning 795"; Dow Corning Corp.
2) "Silpruf SCS 2000"; General Electric Co.

b. Warranty: Manufacturer's 5 year warranty.

3. Two-Part, Pourable Urethane Sealant: For horizontal joints, exterior and interior; provide joint sealant with a joint movement capability of plus-or-minus 25%.

a. Products and Manufacturers: Provide one of the following.

1) "Vulkem 245"; Tremco, Inc.
2) "NR200 Urexpan"; Pecora Corp.
3) "Sikaflex 2c SL"; Sika Corp.
4) "THC-900"; Tremco, Inc.

b. Warranty: Manufacturer's extended 5 year warranty.

4. Two-Part Urethane Non-Sag Sealant: For general interior use; provide joint sealant with a joint movement capability of plus-or-minus 50%.

a. Products and Manufacturers: Provide one of the following:

1) "Vulkem 922"; Tremco, Inc.
2) "Dynatrol II"; Pecora Corp.
3) "Sikaflex 2c NS"; Sika Corp.
4) "NP II"; Sonneborne Building Products Division, ChemRex, Inc.

b. Warranty: Manufacturer's extended 5 year warranty.

5. One-Part Silicone - Sanitary Sealant: For Interior use at plumbing fixtures in toilets and janitor closets, and horizontal and vertical joints of dissimilar materials in toilets and other wet areas.

a. Products and Manufacturers: Provide one of the following.

1) "786"; Dow Corning Corp.
2) "SCS 1700"; General Electric Co.
3) "898"; Pecora Corp.
4) "600"; Tremco, Inc.

b. Warranty: Manufacturer's extended 3 year warranty.

6. One-Part Latex Sealant: For interior use for horizontal and vertical joints around door frames, and joints between dissimilar materials.

a. Products and Manufacturers: Provide one of the following.

1) "AC-20"; Pecora Corp.
2) "Sonolac"; Sonneborn Building Products Div., ChemRex, Inc.
3) "Tremco Acrylic Latex 834"; Tremco, Inc.

b. Warranty: Manufacturer's standard warranty.

2.2 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.

2.3 JOINT-SEALANT BACKING

A. General: 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. Backer Rod (Joint Fillers, Compressible Filler): Preformed, compressible, resilient, non-staining, reticulated, closed-cell polymeric foam, nonoutgassing, with a density of 2.5 pcf and tensile strength of 35 psi per ASTM D 1623, and with water absorption less than 0.02 g/cc per ASTM C 1083.

1. Available Products: Subject to compliance with requirements, materials that may be incorporated into the Work include, but are not limited to the following:

a. Product and Manufacturer - Basis of Design: Sof Rod; Nomaco, Inc., Zebulon, NC.

C. 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.

2.4 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 with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates, unless otherwise recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience.

1. 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.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

1. Install sealants by proven techniques and at the same time backings are installed.
2. Place sealants so they directly contact and fully wet joint substrates.
3. Completely fill recesses provided for each joint configuration.
4. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

B. Backing Materials: 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.

C. Bond-Breaker Tape: Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

D. 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 sealants from surfaces adjacent to joint.
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.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Perform field-test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

   a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.
   b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants by hand-pull method described below:

   a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
   b. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
   c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

3. 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.
4. 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.

5. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
6. 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.

3.5 CLEANING

A. Clean off excess sealants 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.

3.6 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 the original work.

END OF SECTION 07920

SECTION 08311
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. This Section includes the following types of access doors:

1. Wall access doors.
2. Fire-rated wall access doors.
3. Ceiling access doors.
4. Fire-rated ceiling access doors.

B. This Section includes all access doors required by code:

1. Electrical Junction and pull boxes.
2. Communications, data, alarm, security, low voltage, CCTV junction, control and pull boxes
3. Access to mechanical equipment for maintenance and replacement.
4. Plumbing valves, devices, and cleanouts.
5. Fire Protection valves and devices.

1.3 SUBMITTALS

A. Product Data: For each type of access door assembly specified, including details of construction relative to materials, individual components, profiles, finishes, and fire-protection ratings (if required).

1. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, latching or locking provisions, and other data pertinent to installation.

B. Shop Drawings: Showing fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage, and accessory items.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain access doors for entire Project from one source and by a single manufacturer.

B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per test method as indicated below, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Test Method for Vertical Installations: ASTM E 152.
2. Test Method for Horizontal Installations: ASTM E 119.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified under "Submittals" Article.

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. J.L. Industries.
2. Karp Associates, Inc.
3. Milcor, Inc.
4. Nystrom, Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 366 commercial-quality, cold-rolled steel sheet with baked-on, rust-inhibitive primer.

2.3 ACCESS DOORS

A. Insulated, Fire-Rated Access Doors: Self-latching units consisting of frame, trim, door, insulation, and hardware, including automatic closer, interior latch release, and complying with the following requirements:

1. Trimless Frame: Perimeter frame complying with the following requirements:

   a. Metal: 0.0598-inch- thick steel sheet.
   b. Frame Configuration: Flange integral with frame and overlapping face of adjoining gypsum board, with surface formed to receive joint compound.

2. Door: 0.0359-inch- thick steel sheet, welded pan type.
3. Hinges: Continuous type.
4. Keyed Latches: Bolt type, operated by flush key device (keyed to match building system).
5. Insulation: 2-inch- thick mineral-fiber insulation.
6. Fire-Protection Rating for Walls: 1-1/2 hours with a temperature rise not exceeding 250 degrees F at the end of 30 minutes.
7. Fire-Protection Rating for Ceilings: 1 hour combustible or 3 hour non-combustible as required for constructed indicated.

B. Noninsulated, Fire-Rated Doors for Walls: Self-latching units consisting of frame, trim, door, and hardware, including automatic closer, interior latch release, and complying with the following requirements:

1. Frame: 0.0598-inch- thick steel sheet.
2. Door: 0.0598-inch- thick steel sheet.
3. Hinge: Continuous type.
4. Keyed Latches: Key opens and closes Access Door (keyed to match building system).
5. Fire-Protection Rating for Walls: 1-1/2 hours.

C. Trimless, Flush Access Doors for Gypsum Board: Units consisting of frame, concealed edge trim, door, hardware, and complying with the following requirements:

1. Frame: 0.0598-inch- thick steel sheet.
2. Door: 0.0747-inch- thick steel sheet.
3. Concealed, Gypsum Board Edge Trim: 0.0299-inch zinc-coated or galvanized-steel sheet with face flange formed to receive joint compound.
4. Hinge: Concealed spring pin or continuous type.
5. Keyed Latches: Key opens and closes Access Door (keyed to match building system).

2.4 FABRICATION

A. General: Manufacture each access door assembly as an integral unit ready for installation.

B. Steel Access Doors and Frames: Continuous welded construction. Grind 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. Exposed Flange: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
2. For gypsum board assemblies or gypsum veneer plaster, furnish frames with edge trim for gypsum board or gypsum base.
3. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.

C. Locking Devices: Furnish number required to hold door in flush, smooth plane when closed.

1. For cylinder lock, furnish 2 keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices. Furnish inserts and anchoring devices for access doors that must be built into other construction. Coordinate delivery with other work to avoid delay.

3.2 INSTALLATION

A. General: Comply with manufacturer's instructions for installing access doors.

1. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finished surfaces.
2. Paint exposed surface of access doors and frames to match adjacent surface finish.

3.3 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08311

SECTION 09250
GYPSUM ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board Construction.
2. And to the extent shown on the drawings and specified here in.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer.

D. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

E. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

F. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wall coverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PRODUCT HANDLING

A. Deliver materials in sealed containers and bundles, fully identified with manufacturer's name, brand, type and grade; store in a dry, well ventilated space, protected from the weather, under cover and off the ground.

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. Neatly stack gypsum panels flat to prevent sagging. Handle gypsum board to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.6 JOB CONDITIONS

A. Installer must examine the substrates and the spaces to receive gypsum drywall, and the conditions under which gypsum drywall is to be installed; and shall notify the Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Maintain ambient temperatures at not less than 55 degrees F. for the period of 24-hours before drywall finishing, during installation and until compounds are dry. Ventilation: Ventilate building spaces, as required, for drying joint treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

1.7 HAZARDOUS MATERIAL:

A. Do not use asbestos materials, additives and reinforcement in any products, materials, or accessories required for the project.

PART 2 - PRODUCTS

2.1 MANUFACTURER OF METAL FRAMING:

A. Dale Industries, Inc.

B. Dietrich Industries, Inc.

C. Unimast, Inc.

D. Or Approved Equal

2.2 METAL SUPPORT MATERIALS

A. General: To the extent not otherwise indicated, comply with Gypsum Association Specification GA-203 "Installation of Screw-Type Steel Framing Members to Receive Gypsum board" (as specified and recommended) for metal system supporting gypsum drywall work.

B. Studs: ASTM C 645; 25 gauge x 3-5/8" deep, except as otherwise indicated on drawings and other sections of these specifications.

C. C-T, hot dipped galvanized, 20 gauge x 2 3/8", except as otherwise indicated on drawings and other sections of these specifications.

D. Studs for Tile, Ballistic, Security and Kennel Walls: 20 gauge x 3-5/8" deep, G60 hot-dipped galvanized, except as otherwise indicated on drawings and other sections of these specifications.

E. Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.

F. Stud System Accessories: Provide stud manufacturer's standard clips, shoes, ties, reinforcements, fasteners and other accessories as needed for a complete stud system.

G. Furring Members: ASTM C-645; 20- gauge, hat-shaped, except as otherwise indicated on drawings and other sections of these specifications.

H. Fasteners: Type and size recommended by furring manufacturer for the substrate and application indicated.

2.3 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

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. American Gypsum Co.
    b. G-P Gypsum.
    c. Lafarge North America Inc.
    d. National Gypsum Company.
    e. USG Corporation.

B. Regular Type:

1. Thickness: 5/8 inch
2. Long Edges: Tapered.

C. Type X:

1. Thickness: 5/8 inch
2. Long Edges: Tapered.

D. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

E. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard, regular-type and Type X gypsum board.

1. Core: As indicated on Drawings, Type X

2. Thickness : 5/8" and as indicated on the drawings.
3. Long Edges: Tapered.
4. Georgia-Pacific Gypsum LLC: Impact Resistant Fiberglass-Mat Faced Gypsum Board ; DensArmor Plus Impact Resitant Interior Panel or approved equal.
5. Abuse Resistance ASTM C1629, Surface Abrasion Level 3, Surface Indentation Level 1, Soft Body Impact level 3, hard body impact level2.
6. ASTM C 630, Mold Resistance ASTM D3273, Microbial Resistance (ASTM D6329, EPA 12 week Protocol) Will not support microbial growth.

F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces. ASTM C 630, Mold Resistance ASTM D3273, Microbial Resistance (ASTM D6329, EPA 12 week Protocol) Will not support microbial growth.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

A. GENERAL:

1. Manufacturer's standard galvanized steel beaded units with flanges for concealment in joint compound, including corner beads, edge trim and control joints; except provide semi-finishing type (flange not concealed) where indicated.

2.5 JOINT TREATMENT MATERIALS

A. GENERAL:

1. C-475; type recommended by the manufacturer for the application indicated, except as otherwise indicated.

a. Joint Tape: Perforated type.
b. Joint Compound: Ready-mixed vinyl-type for interior use.
c. Grade: Two separate grades, one specifically for bedding tapes and filling depressions, and one for topping and sanding.

2.6 MISCELLANEOUS MATERIALS

A. GENERAL:

1. Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.
2. Lamination Adhesives: Special adhesive for joint compound specifically recommended for laminating gypsum boards.
3. Gypsum Board Fasteners: Comply with GA-216-00.
4. Concealed Acoustical Sealant: Latex, acrylic, or acrylic-latex type; permanently elastic and paintable.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. 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.

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.

2.7 ACCESSORIES

A. Accessories for Interior Installation: Corner beads, edge trim, and control joints complying with ASTM C1047.

B. Reveal Moldings: The Drawings indicate specific profiles and locations of reveal moldings. The following is a listing of Basis of Design for indicated moldings. Subject to compliance with requirements, other manufacturers offering reveal moldings equal to those indicated may be submitted for consideration.

1. Walls and Ceilings: DRM-625-50; Fry Reglet Corporation, or approved equal

2. Ceiling and Soffits: DRMZ-625-200 and DRMZ-100-100; Fry Reglet Corporation, or approved equal

3. “L” Trim Molding: DRML-625; Fry Reglet Corporation, or approved equal

4. Drywall/Acoustical Reveal: DRMAD-50-75; Fry Reglet Corporation, or approved equal

5. Drywall Molding End Closure: DMEC-47875; Fry Reglet Corporation, or approved equal

6. W-Reveal: DRWT-7575; Fry Reglet Corporation, or approved equal

7. Intersections: All intersections, outside corners, “+” intersections, and “T” intersections shall be factory fabricated. Joints shall be mitered and heliarch-welded with 6” legs measured from the center point of the reveal.

C. Ceiling Expansion Joints:

1. Product and Manufacturer - Basis of Design: Series KX-100 Modified DRMET-58; MM Systems Corporation

2. Other Manufacturers: Subject to compliance with requirements, other manufacturers offering products equal to the Basis of Design indicated may be submitted for consideration.

D. Preformed Metal Corners:

1. Product and Manufacturer - Basis of Design: SOC-9-400; Pittcon; custom 90°, 4" radius; 0.090"-thick aluminum, custom color; provide backing plate and associated hardware; edges and ends milled to allow pieces to be finished flush to adjacent surfaces.

2. Other Manufacturers: Subject to compliance with requirements, other manufacturers offering products equal to the Basis of Design indicated may be submitted for consideration.

E. Preformed Control Joints: Install galvanized metal control joint as indicted on Drawings and wall with greater than 30' in length.

2.8 EXPOSED GYPSUM BOARD FINISH

A. Level 5 for new construction of wall and ceilings.

B. At renovated areas to match existing adjacent finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF METAL SUPPORT SYSTEMS

A. General:

1. To the extent not otherwise indicated, comply with GA-203, and manufacturer's instructions.
2. Do not bridge building expansion joints with support system, frame both sides of joints with furring and other support as indicated.
3. Isolate stud system from transfer to structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.
4. Install runner tracks at floors, ceiling and structural walls and columns where gypsum drywall stud system abuts other work.
5. Space studs 24" O.C., except as otherwise indicated.
6. At all intersections use solid plate and sill members to provide firestop and draftstop as required by the building code.

B. Door Frames:

1. Install additional Jamb studs at door frames as indicated, but not less than 2 studs at each jamb. Space jack studs over door frames at same spacing as partition studs.
2. Wire -tie or clip furring members to main ceiling runners and to other structural supports as indicated.
3. Space wall furring members 16" o.c., except as otherwise indicated.
4. Nail or screw furring members to structural support where possible; otherwise wire-tie to clip as recommended by manufacturer.
5. Install supplementary framing, runners, furring, blocking and bracing at opening and terminations in the work, and at locations required to support fixtures, equipment, handicap accessories, toilet accessories, heavy trim, furnishing and similar work which cannot be adequately supported directly on gypsum board alone.

3.2 GENERAL GYPSUM BOARD INSTALLATION REQUIREMENTS

A. Pre-Installation Conference: Meet at the project site with the installers of related work and review the coordination and sequencing of work to ensure that everything to be concealed by gypsum drywall has been accomplished, and that chases, access panels, openings, supplementary framing and blocking and similar provisions have been completed.

B. General Standards: In addition to compliance with GA-216, comply with manufacturer's instructions and requirements for fire-resistance UL rating.

C. Install wall/partition boards vertically to avoid end-butt joints wherever possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.

D. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

E. Cover both faces of steel studs with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls, which are properly braced internally.

F. Except where concealed application is required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq.ft. and limited not less than 75% of full coverage.

1. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4" to 1/2" space and trim edge with J-type semi-finishing edge trim. Seal joints with acoustical sealant. Do not fasten drywall directly to stud system runner tracks.

3.3 FLOATING CONSTRUCTION

A. Where feasible, including where recommended by manufacturer, install gypsum board with "floating" internal corner construction, unless isolation of the intersecting boards is indicated or unless control or expansion joints are indicated.

B. Where sound-rated drywall work is indicated (STC rating), including double-layer work and work on resilient furring, seal the work at perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with manufacturer's recommendations for location of beads, and close off sound-flanking paths around or through the work, including sealing of partitions above acoustical ceilings.

C. Space fasteners in gypsum boards in accordance with GA-216 and manufacturer's recommendations, except as otherwise indicated.

3.4 INSTALLATION OF DRYWALL TRIM ACCESSORIES

A. GENERAL: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.

1. Install metal corner beads at external corners of drywall work. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install "L" type trim where work is tightly abutted to other work, and install special kerf-type where other work is kerfed to receive long leg of "L" type trim. Install "U"type trim where edge is exposed, revealed, gasketed, or sealant filled (including expansion joints).
2. Install "J" type semi-finishing trim where indicated, and where exterior gypsum board edges are not covered by applied moldings. Install plastic edge trim where indicated on wall panels at juncture with ceilings. Install metal control joint (beaded-type) where indicated. Install "H" molding in exterior gypsum drywall work where control joints are indicated.

3.5 INSTALLATION OF DRYWALL FINISHING

A. GENERAL: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fasteners, heads, surface defects and elsewhere as required to prepare work for decoration. Prefill open joints and rounded or beveled edges, using type of compound recommended by manufacturer. Apply joint compound in two coats (not including prefill of openings in base), and sand after last coat.

1. Surface Wall Texture: Texture shall be in accordance with design specifications (e.g., Orange Peel), and shall be such that all irregularities in the drywall surface are imperceptible.
2. Partial Finishing: Omit third coat (if specified) and sanding on concealed drywall work which is indicated for drywall finishing, including sound, fire, air and smoke-rated work.
3. Installer shall advise Contractor of required procedures for protection of the gypsum drywall work from damage and deterioration during the remainder of the construction period.
4. Surface Wall Texture at Existing Wall or Within Rooms to be remodeled: Texture shall be to match existing adjacent walls at renovated and remodeled rooms.

END SECTION 09250

SECTION 09511
ACOUSTIC PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Install system to match existing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:

C. Samples: For each exposed finish.

D. Product test reports.

E. Research/evaluation reports.

F. Maintenance data.

1.4 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.

B. Fire-Test-Response Characteristics:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

2. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Space Enclosure:

1. All ceiling products and suspension systems must be installed and maintained in accordance with Armstrong written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions. Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.
2. HumiGuard Plus Ceilings: Installation of the products shall be carried out where the temperature is between 32°F (0°C) and 120°F (49°C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc) must be complete and dry. The ceilings must be maintained to avoid excessive dirt or dust buildup that would provide a medium for microbial growth on ceiling panels. Microbial protection does not extend beyond the treated surface as received from the factory, and does not protect other materials that contact the treated surface such as supported insulation materials.

1.6 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:

1. Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
2. Grid System: Rusting and manufacturer's defects
3. Grid: Ten (10) years from date of substantial completion.

B. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Acoustical Panel Standard: Comply with ASTM E 1264.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Fine Fissured Fire Guard (High NRC) or a comparable product by one of the following:

1. BPB USA.
2. Chicago Metallic Corporation.
3. Ecophon CertainTeed, Inc.
4. Tectum Inc.
5. USG Interiors, Inc.

2.2 ACOUSTICAL CEILING UNITS

A. Acoustical Panels to match existing or

B. Acoustical Panels: Armstrong Fine Fissured Fire Guard (High NRC)

1. Material: Wet formed mineral fiber.
2. Surface Finish: Factory applied vinyl latex paint.
3. Color: White
4. Light Reflectance (LR): ASTM E1477; Actual Light Reflectance: 0.85
5. Size: 24” x 24” x 3/4”
6. Weight 1.25/ SF
7. Edge Detail: Angular tegular
8. NRC: .70
9. CAC: Minimum 35
10. Flame Spread: ASTM E1264; Class A (UL)
11. Dimensional Stability: HumiGuard Plus - Temperature is between 32°F (0°C) and 120°F (49°C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc) must be complete and dry.
12. Antimicrobial Protection: BioBlock Plus - Resistance against the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.

2.3 METAL SUSPENSION SYSTEM, GENERAL

A. Metal Suspension System Standard: Comply with ASTM C 635HD.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors fabricated from corrosion-resistant materials, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 9 gauge diameter wire.

D. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. To match existing or

B. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Prelude XL 15/16 FireGuard or a comparable product by one of the following:

1. BPB USA.
2. Chicago Metallic Corporation.
3. Ecophon CertainTeed, Inc.
4. Tectum Inc.
5. USG Interiors, Inc.

C. Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16-inch wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Cap Material: Steel cold-rolled sheet.
4. Cap Finish: Painted white.

D. Attachment Devices: Size for five (5) times design load indicated in ASTM C635, Table 1, Direct Hung, unless otherwise indicated.

1. Wire for hangers and ties: ASTM A641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three (3) times design load, but not less than 9 gauge.
2. Edge moldings and trim: to match existing.
3. Accessories: to match existing.
4. Ceiling expansion joint: to match existing.
5. Lay-in ceiling to wall expansion joint: to match existing

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, gypsum board, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

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.

B. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
2. Do not attach hangers to steel deck tabs.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. 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.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Ceiling Touch-Up Paint, latex paint should be used to hide minor scratches and nicks in the surface and to cover field tegularized edges that are exposed to view.

C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage

END OF SECTION 09511

SECTION 09900
PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General conditions provisions of the contract including contractual conditions, and division 1 specifications.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of the following:

1. Exposed exterior items and surfaces.
2. Exposed interior items and surfaces.
3. 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 the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment installed under Division 15 and Division 16 and application of paint coats to all finish coated mechanical and electrical equipment in exterior locations, except as otherwise indicated.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

D. Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Material List: Provide 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: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1. After color selection, the Architect will furnish color chips for surfaces to be coated.

C. Samples for Verification: Of 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.
3. On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. On at least 100 square feet of surface, as directed, provide full-coat finish samples until required sheen level., color and texture is obtained; simulate finished lighting conditions for review of in-place work.

D. 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.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.

3. Final approval of color selections will be based on benchmark samples:

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the 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 containers used in storage 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. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 degrees F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 degrees F.

C. Do not apply paint in snow, rain, fog, or mist; or when the 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers Specified:
1. The Sherwin-Williams Company

B. Other Acceptable Manufacturers:

1. Benjamin Moore & Company (Moore)
2. PPG Industries, Inc. (PPG)
3. Pratt and Lambert

2.2 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. Colors: Refer to the Finish Legend.

1. Where colors are not indicated they will be selected by the Architect from manufacturer’s full range.

D. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as the 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 the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: 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 the 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 the substrates of substances that could impair the 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.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the 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.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 PAINT SCHEDULE

A. Wet areas such as toilet room, and janitor closets

a. Primer: 1-coat; ProGreen 200 Latex Primer; Sherwin Williams.
b. Finish Coats: 2-coats Gloss; Pro-Industrial High Performance Epoxy; Sherwin Williams.

B. Interior masonry

a. Primer: 1 coat; Loxon Block Surfacer; Sherwin Williams.
b. Finish Coats: 2-coats Gloss; Pro-Industrial High Performance Epoxy; Sherwin Williams.

C. Gypsum Drywall – Walls:

a. Primer: 1-coat; ProMar 200 wall primer; Sherwin Williams
b. Finish Coats: 2-coats; Pro-Mar 200 Low Sheen Eg-Shel Interior Latex; Sherwin Williams

D. Gypsum Drywall – Ceilings:

a. Primer: 1-coat; ProMar 200 wall primer; Sherwin Williams
b. Finish Coats: 2-coats; Pro-Mar 200 Flat Interior Latex; Sherwin Williams

E. Ferrous Metal: Includes steel doors and frames, handrails and railings.

a. Primer: 1-coat; Devguard 4160 Metal Primer; Glidden Professional
b. Finish Coats: 2-coats; Dulux Alkyd Semigloss 1507; Glidden Professional

3.7 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal – Primed and Unprimed:

1. Paint System, Application and Finish: Alkyd/Latex; two finish coats over prime coat; semi-gloss finish. Pre-primed requires top finish only; prime coat damaged surfaces.

a. Primer: Devguard 4160 Metal Primer; Glidden Professional
b. Finish Coat: 4308 Devguard Alkyd Gloss Industrial Enamel; Glidden Professional

B. Zinc Coated Metal, Primed and Unprimed:

1. Paint System, Application and Finish: Alkyd; two finish coats over prime coat; Gloss finish. Pre-primed requires top finish only; prime coat damaged surfaces.

a. Primer: 4120 Devguard Galvanized Metal Primer; Glidden Professional
b. Finish Coat: 4308 Devguard Alkyd Gloss Industrial Enamel; Glidden Professional

C. EXTERIOR SMOOTH CONCRETE BLOCK AND SPLIT FACE CMU.
a. One coat, Dulux Paints, Dulux Ultra Hide Blockaid No. 3110-1200.
b. Two coats, Dulux Paints, Decra-Flex Elastomeric coat system 2260-xxxx

END OF SECTION 09900

SECTION 10200
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Extent of louvers and vents is indicated on drawings, including indications of sizes and locations.

B. Sealants and Sheet Metal Flashing and Trim including installation are specified in Section 07920 “Sealants” and 07620 "Sheet Metal Flashing & Trim".

C. See Mechanical and Electrical Drawings and specification sections for ducts attached to the louvers.

1.2 SUMMARY

A. Types of louvers and vents include the following to the extent of extruded aluminum louvers to match the profile, function, appearance, and finish as shown on the drawing and specification herein.

B. Louver assemblies furnished to include Florida Product Approval assembly and or NOA.

1.3 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA Standard 500-L Laboratory Methods of Testing Louvers for Rating

2. AMCA Publication 501, Application Manual for Louvers

B. The Aluminum Association, Inc.:

1. Aluminum Standards and Data

2. Specifications and Guidelines for Aluminum Structures

C. American Society of Civil Engineers (ASCE):

1. Minimum Design Loads for Buildings and Other Structures

D. American Society for Testing and Materials (ATSM):

1. ASTM B209

2. ASTM B211

3. ASTM B221

4. ASTM E90-90

E. FBC/Miami-Dade County Test Protocols:

1. TAS-100A Wind Driven Rain Test.

2. TAS-201 Large Missile Impact Test.

3. TAS-202 Uniform Static Pressure.

4. TAS-203 Cyclic Pressure Test.

F. Architectural Aluminum Manufacturers Association (AAMA):

1. AAMA AAMA 800 Voluntary Specifications and Test Methods for Sealants

2. 605.2 Voluntary Specifications for High Performance Organic Coating on Aluminum Extrusions and Panels

3. AAMA 2605-998 Superior performing Organic Coatings on Aluminum Extrusions and Panels.

1.4 QUALITY ASSURANCE

A. Performance Requirements: Where louvers are indicated to comply with specific performance requirements, provide units whose performance ratings have been determined in compliance with Air Movement and Control Association (AMCA) Standard 500.

B. AMCA Certification: Where indicated, provide louvers with AMCA Publication 511 Rating Seal evidencing that product complies with above requirements.

C. Comply with SMACNA "Architectural Sheet Metal Manual" recommendation for fabrication, construction details and installation procedures, except as otherwise indicated.

D. The louvers shall have Florida Product Approval and NOA.

E. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and ship assembly of units. Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping handling limitations and field installation. Clearly mark units for reassembly and coordinated installation.

1.5 SUBMITTALS

A. As per Section 01300, provide six (6) copies as follows.

B. Product Data: Submit manufacturer's specifications; certified test data, where applicable: and installation instructions for required products, including finishes.

C. Shop Drawings: Submit 6" square samples of each required finish. Prepare samples on metal of the same gauge and alloy to be used in the work. Where normal color and texture variations are to be expected, include two (2) or more units in each sample showing limits of such variations. Field measure before submittal of shop drawings and fabrication of louvers.

D. Certification: Provide certification that the fabricator has made site visits to obtain existing field measurements of all proposed openings. Attached Certification letter signed by the fabricator and the General Contractor with shop drawing submittal.

E. Product Acceptance: Florida Product Approval certificate for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. RUSKIN, 3900 DR. Greaves Road, Kansas City, MO 64030. 816-761-7476.

B. Or approved equal.

2.2 PRODUCT

A. Model # EME520MD

B. Or approved equal.

2.3 MATERIALS

A. Frame: Aluminum 6" deep extruded .095".

B. Blades: 6063T6 extruded aluminum

C. Screen: 1/2" x.063”square mesh aluminum bird screen in removable frame

D. Finish: 2-coat 70% Kynar 500 / Hylar 5000 – color to match existing exterior panel wall color.

E. Anchors and Inserts: Use non-ferrous metal or stainless-steel anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use stainless-steel expansion bolt devices for drilled-place anchors. Furnish inserts, as required to be set into concrete or masonry work. Use fasteners compatible with adjacent materials.

F. Bituminous Paint: SSPC-Paint 12 (cold-applied mastic).

2.3 FABRICATION, GENERAL

A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal thicknesses indicated, or if not indicated, as required for optimum performance with respect to airflow; water penetration; air leakage where applicable (for adjustable units, if any); strengths; durability; and uniform appearance.

B. Fabricate frames including integral sills to suit adjacent construction with tolerances for installation, including application of sealants in joints between louvers and adjoining work.

C. Include support, anchorages, and accessories required for complete assembly. Provide and install additional aluminum channels, angles, girts to span the opening.

D. Provide sill extensions and loose sills made of the same materials as the louver, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

E. Join frame members to one another and to stationary louver blades by welding, except where indicated otherwise or where necessary by size of louvers. Maintain equal blade spacing including separation between blades and frames at head and still to produce uniform appearance.

F. Provide additional structural aluminum framing as indicated on the drawings.

G. Louver Screens: Provide removable screens for louvers. Mount on the exterior color to match louvers.

H. Metal Finishes: General: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations, except as otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces with protective covering, prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Finishes of all louvers exposed to exterior view are to be of color to match frames.

I. Ferrous Metal Finishes: Preparation: clean surfaces of dirt, grease, and loose rust or mill scale, including items fabricated from galvanized steel, if any. Apply finish to surfaces of fabricated and assembled units, where exposed or concealed when installed, after pretreating with a conversion coating suited to organic coating applied over it.

J. Coordinate with Mechanical Contractor for the inter phase detail of louver and duct.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION

A. Locate and place louver units plumb, level, and in proper alignment with adjacent work.

B. Use concealed anchorage wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Repair finishes damage by cutting, welding, soldering and griding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items that cannot be refinished in the field to shop make required alternations, and refinish entire unit, or provide new units, at Contractor's option.

E. Protect galvanized and non-ferrous metals surfaces from corrosion or galvanic action by application of heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry or dissimilar metals.

F. Provide concealed gaskets, flashings joints fillers, and insulations, and install as work progresses to make the installations weathertight.

G. Refer to Division 7 section for sealants in connection with installations of louvers.

H. Provide and install 1/8”-thick Stainless Steel ‘Z’ Flashing with soldered vertical sides (three (3) sides) and drip with clip to exterior for louver/damper drainage.

END OF SECTION 10200

ORANGE COUNTY - WILLOW STREET COMMUNITY CENTER
HVAC REPLACEMENT

SECTION 15010

MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. The work covered under this Division of the Specifications is intended to include the furnishing of all materials, equipment and labor necessary for or reasonably incidental to, the installation of a complete and fully operative mechanical and plumbing systems as indicated on the drawings and specified in this section.

1. The work shall consist generally of, but is not limited to, the following major items:

a. HVAC Equipment
b. Ductwork and Insulation
c. Piping and Insulation
d. Plumbing
f. Temperature Controls
g. Test and Balance

B. Work Not Included:

The following work is not included in this Section:

1. Electrical

C. Fees and Permits:

1. Obtain all permits required for his/her work and include the cost of same in his/her bid.

D. Certificate of Inspection:

1. The Contractor shall, at his/her expense, have a final inspection made of the complete mechanical installation and shall deliver a certificate of approval of the complete work to the Owner before receiving his/her final payment.

1.02 SUBMITTALS:

A. Submit properly identified manufacturer's literature and technical data to the form defined in Section 01300, before commencing work.

B. Shop Drawings:

1. Submit copies of manufacturer's drawing of HVAC equipment, piping, insulation, plumbing fixtures and any other special mechanical equipment to be installed, and shall receive the Project Engineer's acceptance before ordering the same for installation.
2. All shop drawings shall be submitted in 3-ring binders with each specification section indicated with tabs or can be submitted electronically in PDF format.
3. SUBSTITUTION OF MATERIAL AND/OR EQUIPMENT

The Contract will be awarded based on the design, methods, materials and/or

equipment as addressed in the Contract Drawings and/or described in the Contract Specifications, without any consideration for substitution or "or-equal" replacement. Addressing, describing or naming an item is intended to establish the type, function, characteristics and quality required in order to establish a base for bidding.

a. Within thirty (30) days after Contract award, the Contractor may submit for approval substitutes for any equipment and/or material. In addition to the product documents, a written certification shall accompany the documentation indicating that the proposed substitute will have the same characteristics, will perform in accordance with the design requirements and that complies with all the requirements set for in the Contract. Any additional information required by the Engineer or the Owner shall be provided by the Contractor. Rejection of any proposed substitute will be considered final and the Contractor shall not get into any agreement with manufacturers or providers until the submittal has been finally approved.

b. The submission of this documentation shall follow the requirements set for by this Contract Specifications for this purpose.

1.03 QUALITY ASSURANCE:

A. Qualifications of manufacturers, materials and equipment:

1. Material and equipment, except as herein otherwise noted, shall be new and conform to standards specified herein defined to include equipment, piping, insulation, and the like.
2. Materials and equipment shall be of an approved design.

a. Similar materials shall be of one manufacturer wherever possible.

3. Equipment offered under these Specifications shall be limited to products regularly produced and recommended for service ratings in accordance with manufacturer's catalogs, engineering data, or other comprehensive literature made available to the public and in effect at the time of opening of bids.
4. Install equipment in strict accordance with manufacturer's instruction for type, capacity and suitability of each piece of equipment used.

a. Obtain these instructions which shall be considered a part of these Specifications.

B. Qualifications of supervisor, workmanship and installers:

1. The Contractor shall have a master mechanic constantly supervising the work covered by these Specifications, and so far as possible shall keep the same foreman on the job from start to finish.

a. The workmanship of the entire job shall be first class in every way and only experienced and competent workers shall be employed for the work.

1.04 CODES AND REGULATIONS:

A. Work shall be installed in accordance with the regulations and requirements of the Life Safety Code NFPA No. 101, 2010 Florida Building Code, 2010 Florida Building Code Mechanical, as well as all rules, state and local codes regulations and requirements.

B. Where ducts and/or pipes penetrate fire rated walls, ceilings or floors, the penetrations shall

be firestopped in accordance with Chapter 7, Section 705 of the 2010 Florida Building Code.

1. The above shall be ascertained and fully coordinated before the installation of any material, equipment, and the like, and any discrepancy shall be immediately brought to the attention of the Project Architect in writing, and the Contractor shall receive a disposition of same before proceeding with the work.
2. Furnish, without additional charge, any additional materials and labor that may be required for compliance with these codes, law, rules, regulations or requirements even though the work is not mentioned in these Specifications or shown on the Drawings.

C. Material and equipment shall bear the label of approval of the National Board of Fire Underwriters Laboratory.

1.05 INSPECTIONS:

A. All work and materials covered by these Specifications and shown on the Drawings shall be subject to inspection at any and all times by representatives of the Project Architect or Owner.

B. If the Project Engineer or Owner's inspectors find that any material does not conform with these Specifications, the Contractor shall within three days after being notified by the Project Engineer or Owner, remove the material from the premises, and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.

C. Tests:

The Owner reserves the right to inspect and test any portion of the equipment during the progress of this work.

1. The Contractor shall test the entire system in the presence of the Owner or the Owner's representative when the work is completed to insure that all portions are free from defects.
2. All equipment, material and labor necessary to conduct the above tests shall be furnished at the Mechanical Contractor's expense.

1.06 PRODUCT HANDLING:

A. Protection of Equipment, Material and Work: The Contractor shall effectively protect, at his/her own expense, much of his/her work, materials or equipment, as is liable to injury during the construction period.

1. Openings into any part of the duct and piping system as well as associated fixtures, equipment, and the like, both before and after being set in place, shall be securely covered or otherwise protected to prevent obstruction or injury due to carelessness or maliciously dropped tools or materials, grit, dirt, or any foreign matter.

a. The Contractor will be held responsible for all damage done until his/her work is fully and finally accepted.

2. Cover duct and pipe ends with capped bushings.

B. Repair of damage: In the event of damage, repair shall be made immediately, to the Project Architect's satisfaction and at no additional cost to the Owner.

C. Special Handling: Special care, storage and handling of new and existing plumbing fixtures shall be taken to minimize breakage.

1.07 JOB CONDITIONS:

A. Accuracy of Data: The data given herein and on the Drawings are as exact as could be secured.

1. The Specifications and Drawings are for the assistance and guidance of the Contractor.
2. Exact locations, distances, levels, and the like, will be governed by the building field conditions and the Contractor shall use the data contained herein with this understanding.

B. Drawings:

1. The mechanical drawings are diagrammatic, but shall be followed as closely as actual construction and work of other Contractors will permit.
2. Deviations from drawings required to make the work of the Contractor conform to the building as constructed, and to the work of other contractors, shall be made by the Contractor at his/her expense.
3. It is not the intention of the drawings or specifications to indicate each piece of pipe, ductwork, fittings and the like, required for the satisfactory operation of the installation and whereby one is indicated, but not specified, or specified but not indicated on the drawings, it shall be considered to be both specified and indicated.

C. Measurements:

1. Review the Contract Drawings and Specifications and visit the job site to ascertain all conditions, including conduit runs, interfacing, interferences, conflicts, discrepancies, etc., and shall report the same to the Engineer for clarification ten days prior to submittal of the bid.
2. Failure to comply with this condition shall constitute an acceptance of the conditions and any necessary changes will be at Contractor's expense.
3. The Contractor shall make all measurements necessary for his/her work and shall assume responsibility for their accuracy.

D. Structural difficulties: Should any structural difficulties prevent the setting of equipment, and the like, at points indicated on the drawings, the necessary deviation therefrom, as determined by the Project Architect will be permitted and shall be made without additional cost.

E. Cooperation with Other Contractors

1. The Contractor shall arrange all parts of his/her work in proper relation to the work of other contractors.
2. Where interferences occur, the Contractor shall, before installing the work involved, consult with the Project Engineer as to exact location and level of his/her work.
3. The Project Architect's decision will be final.
4. The Contractor shall be responsible for arrangement of his/her work and equipment and maintenance of proper headroom under this work.
5. Should work installed by him/her require any modifications to avoid interference with the other work, such changes shall be made without additional cost.
6. The Engineer's decision as to determination or allocation or responsibility where conditions require changing of work, shall be final.

7. If any work of the Contractor is dependent for its proper execution on contiguous work, examine such work and report in writing any defect thereon or conditions rendering it unsuitable.
8. The beginning of work, without making such report, shall constitute an acceptance of such work, and any defects in his/her own work consequently shall be his/her responsibility.

1.08 CLEANING:

A. Keep the premises free of debris and unusable materials resulting from the work, and immediately upon completion of the work remove such debris and material from the site and leave floors broom clean in areas affected by the work.

1.09 GUARANTEE:

A. Leave the mechanical installation in proper working order and without charge, replace any work or materials which develop defects within one year from date of final inspection and acceptance by the Owner.

1.10 DEFINITIONS:

A. In this Division "provide" is used as a term contraction meaning "to furnish, install and connect up completely in the specified or in an approved manner for the item and/or material described".

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION Not Used

END OF SECTION 15010

SECTION 15030
ELECTRICAL PROVISIONS OF MECHANICAL WORK

PART 1 - GENERAL

1.01 Standards: For electrical equipment and products, comply with applicable NEMA Standards, and refer to NEMA standards for definitions of terminology herein. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

PART 2 - PRODUCTS

2.01 MOTORS:

A. Manufacturer: Except where item of mechanical equipment (which otherwise complies with requirements) must be integrally equipped with motor produced by another manufacturer, provide motor for mechanical equipment by one of the following single manufacturers:

1. Allis Chambers
2. U.S. Motors
3. Century Electric
4. General Electric
5. Louis Allis
6. Marathon Electric
7. Reliance Electric
8. Westinghouse Electric

B. Motor Characteristics: Except where more stringent requirements are indicated, and except where required item of mechanical equipment cannot be obtained with fully complying motor, comply with the following requirements for motors of mechanical work:

1. Temperature Rating: Rated for 40 deg. environment with maximum 50 deg. temperature rise for continuous duty at full load (Class A Insulation).
2. Starting Capability: Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts/hour for manually controlled motors.
3. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 1/2 hp and larger, and provide capacitor-start single phase motors for 1/3 hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split phase type. Coordinate current characteristics with power specified in Division 16 sections, and with individual equipment requirements specified in other Division 15 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
4. Service Factor: 1.15 for polyphase motors, and 1.35 for single phase motors.

C. Motor Construction: Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.

1. Frame: NEMA No.48.
2. Bearing: Ball or roller bearing with inner and outer shaft seals, regreasable except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division 15 for fractional-hp light duty motors where sleeve type bearings are permitted.

3. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 15 for other enclosure requirements.
4. Overload Protection: Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: Provide "Quiet" rating on motors located in occupied spaces of building.
6. Efficiency: All motors shall be "Energy Efficient", provide motors having minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency is not scheduled, provide motor with higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, test Method B.

D. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, rating, characteristics, construction, special features, and similar information.

E. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

2.02 STARTERS, ELECTRICAL DEVICES AND WIRING:

A. Motor Starter Manufacturer: Except where item of mechanical equipment must be integrally furnished with motor starter produced by another manufacturer, provide motor starters for mechanical equipment manufactured by only one of the following manufacturers:

1. Allen Bradley
2. Cuttler Hammer
3. General Electric
4. Square D
5. Westinghouse Electric
6. Or approved equal

B. Motor Starter Characteristics: Comply with NEMA standards and NEC. Provide Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor, or panel as indicated. Where starter location is not within sight of motor, provide disconnect switch within sight of motor. Provide type and size of starter recommended by motor manufacturer and equipment manufacturer for applicable protection and start-up conditions; refer to individual equipment sections for basic load requirements.

1. Manual Switches: provide manual switch and pilot light for motors 1/3 hp and smaller, except where interlocked or automatic operation is indicated. Provide extra switch positions and pilot lights for multi-speed motors.
2. Overload Protection: Provide melting alloy type thermal overload relays.

C. Magnetic Starters: Provide magnetic starters for motors 1/2 hp and larger, and for smaller motors where interlock or automatic operation is indicated. Include the following:

1. Maintained contact push-button and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

2. Trip-free thermal overload relays, each phase.
3. Interlocks, switches, and similar devices as required for coordination with control requirements of Division 15 Controls section.
4. Built-in 120 volt control circuit transformer, fused from line side, where services exceed 240 volts.
5. Externally operated manual reset.
6. Undervoltage release or protection.

D. Deliver starters and wiring devices which have not been factory installed on equipment to electrical installer for installation.

E. Electrical Heating Elements: Where electric resistance coils and other heating elements are included in mechanical equipment, or otherwise indicated as mechanical work, and except as otherwise indicated, provide 120 volt units where rating is less than 2 KW, higher voltage single phase units where rating is 2 KW but less than 5 KW and higher voltage 3 phase units where rating is 5 KW and greater.

F. This Contractor shall furnish all motor starters except those in the motor control center which are provided under Division 16. This Contractor shall coordinate and supply all technical information to electrical on the equipment with starters in the motor control center.

PART 3 - EXECUTION

3.01 EQUIPMENT FABRICATION:

A. General: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives, arranged for lubrication and similar running maintenance without removal of guards.

END OF SECTION 15030

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

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 this Section.

B. Requirements specified in Division 15 Section "Basic Mechanical Requirements" apply to this Section.

1.02 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:

1. Mechanical equipment nameplate data.
2. Miscellaneous metals for support of mechanical materials and equipment.
3. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
4. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
5. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for the following products:

1. Access panels and doors.
2. Joint sealers.

C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.

D. Coordination drawings for access panel and door locations in accordance with Division 15 Section "Basic Mechanical Requirements."

E. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.

F. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

G. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer for the installation and application joint sealers, access panels, and doors.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

1. Provide UL Label on each fire-rated access door.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.06 PROJECT CONDITIONS

A. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do no apply joint sealers to wet substrates.

1.07 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.

B. Notify the Architect at least 5 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS

2.01 MECHANICAL EQUIPMENT NAMEPLATE DATA

A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.02 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

B. Steel Pipe: ASTM A 53, Schedule 40, welded.

C. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.

D. Fasteners: Zinc-coated, type, grade, and class as required.

2.03 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 15/32 inches.

2.04 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
3. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following.
4. Products: Subject to compliance with requirements, provide one of the following:

a. One-Part, Nonacid-Curing, Silicone Sealant:

1) "Chem-Calk N-Cure 2000," Bostic Construction Products Div.
2) "Dow Corning 790," Dow Corning Corp.
3) "Silglaze N SCS 2501," General Electric Co.
4) "Silpruf SCS 2000," General Electric Co.
5) "864," Pecora Corp.
6) "Rhodorsil 5C," Rhone-Poulenc, Inc.
7) "Spectrum 1," Tremco, Inc.
8) "Spectrum 2," Tremco, Inc.
9) "Dow Corning 795," Dow Corning Corp.
10) "Rhodorsil 6B," Rhone-Poulenc, Inc.
11) "Rhodorsil 70," Rhone-Poulenc, Inc.
12) "Omniseal," Sonneborn Building Products Div.
13) "Chem-Calk 100," Bostik Construction Products Div.

14) "Gesil N SCS 2600," General Electric Co.

b. One-Part, Mildew-Resistant, Silicone Sealant:

1) "Dow Corning 786," Dow Corning Corp.
2) "SCS 1702 Sanitary," General Electric Co.
3) "863 #345 White," Pecora Corp.
4) "Rhodorsil 6B White," Rhone-Poulenc, Inc.
5) "Proglaze White," Tremco Corp.
6) "OmniPlus," Sonneborn Building Products Div.

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a "Chem-Calk 600," Bostik Construction Products Div.
b. "AC-20," Pecora Corp.
c. "Sonolac," Sonneborn Building Products Div.
d. "Tremco Acrylic Latex 834," Tremco, Inc.

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire- rated walls and floors. Sealants and accessories shall have fire- resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. "Dow Corning Fire Stop Foam," Dow Corning Corp.
b. "Pensil 851," General Electric Co.
c. Or approved equal.

2.05 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

C. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

D. Locking Devices: Flush, screwdriver-operated cam locks.

E. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

F. 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:

E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bar-Co., Inc.
2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div. Inryco, Inc.
5. Nystrom, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.04 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not 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 members.

C. Attach to substrates as required to support applied loads.

3.05 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
2. Comply with recommendations of ASTM C 790 for use of acrylic- emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around mechanical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.06 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

END OF SECTION 15050

SECTION 15055
BASIC PIPING MATERIALS AND METHODS

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 specifies piping materials and installation methods common to more than one section of Division 15 and includes joining materials, piping specialties, and basic piping installation instructions.

B. Related Sections:

1. Division 15 Basic Mechanical Requirements section applies to the work at this Section.
2. Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Divisions 2 and 15.
3. Valves are specified in a separate section and in individual piping system sections of Division 15.
4. Expansion Compensation is specified in a separate section of Division 15.
5. Supports and Anchors are specified in a separate section of Division 15.
6. Mechanical Identification is specified in a separate section of Division 15.
7. Fire Barrier Penetration Seals are specified in Division 7.

1.03 SUBMITTALS:

A. Refer to Division 1 and Basic Mechanical Requirements for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:

1. Escutcheons
2. Dielectric Unions and Fittings
3. Mechanical Sleeve Seals
4. Strainers

C. Quality Control Submittals:

1. Submit welders' certificates specified in Quality Assurance below.

1.04 QUALITY ASSURANCE:

A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

B. Welding procedures and testing shall comply with ANSI Standard B31.1.0 - Standard Code for Pressure Piping, Power Piping, and The American Welding Society, Welding Handbook.

C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturer Uniformity: Conform with the requirements specified in Basic Mechanical Requirements, under "Product Options."

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering piping materials and specialties which may be incorporated in the work include, but are not limited to, the following:

C. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:

1. Pipe Escutcheons:

   a. Chicago Specialty Mfg. Co.
   b. Sanitary-Dash Mfg. Co.
   c. Grinnell
   d. Or approved equal.

2. Dielectric Waterway Fittings:

   a. Epco Sales, Inc.
   b. Victaulic Company of America
   c. Or approved equal.

3. Dielectric Unions:

   a. Eclipse, Inc.
   b. Perfection Corp.
   c. Watts Regulator Co.
   d. Or approved equal.

4. Strainers:

   a. Armstrong Machine Works.
   b. Hoffman Specialty ITT; Fluid Handling Div.
   c. Metraflex Co.
   d. R-P&C Valve; Div. White Consolidated Industries, Inc.
   e. Spirax Sarco.
   f. Trane Co.
   g. Victaulic Co. of America. (low pressure applications only)

h. Watts Regulator Co.

5. Mechanical Sleeve Seals:

a. Thunderline Corp.
b. Or approved equal.

2.02 PIPE AND FITTINGS:

A. Refer to the individual piping system specification sections in Division 15 for specifications on piping and fittings relative to that particular system.

2.03 JOINING MATERIALS:

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

2.04 PIPING SPECIALTIES:

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

D. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per square inch.

1. Provide strainers with 125 psi working pressure rating for low pressure applications, and 250 psi pressure rating for high pressure application.
2. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blow down fitted with pipe plug.

E. Sleeves:

1. Sheet-Metal Sleeves: 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATIONS:

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.

I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained. Refer to Division 7 for special sealers and materials

3.03 FITTINGS AND SPECIALTIES:

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.

C. Install strainers on the intake side of each chilled water pump, and elsewhere as indicated.

D. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.

E. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).

G. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.04 JOINTS:

A. Steel Pipe Joints:

1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.

B. Non-ferrous Pipe Joints:

1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.1.0 - Standard Code for Pressure Piping, Power Piping and ANSI B9.1 - Standard Safety Code for Mechanical Refrigeration.
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
2. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

C. Joints for other piping materials are specified within the respective piping system sections.

3.05 FIELD QUALITY CONTROL:

A. Testing: Refer to individual piping system specification sections.

END OF SECTION 15055

SECTION 15060
PIPES AND PIPE FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to pipes and pipe fittings specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of pipes and pipe fittings required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of pipes and pipe fittings specified in this section include the following:

1. Steel Pipes.
2. Copper Tube.
3. Plastic Pipe.
4. Grooved Piping Products.
5. Miscellaneous Piping Materials/Products.

C. Pipes and pipe fittings furnished as part of factory fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar services for not less than 5 years.

1.04 CODES AND STANDARDS:

A. Welding: Qualify welding procedures, welders, and operations in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

1. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).

B. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job site brazing of piping work.

1.05 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

B. Welding Certifications: Submit reports as required for piping work.

C. Brazing Certifications: Submit reports as required for piping work.

D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of Division 1.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Except for concrete, corrugated metal, hub and spigot, clay and similar units of pipe, provide factory applied plastic end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings: Provide factory fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.02 STEEL PIPES AND PIPE FITTINGS:

A. Black Steel Pipe: ASTM A 54, A 106 or A 120; except comply with ASTM A 53 or A 106 where close coiling or bending is required.

B. Seamless Steel Pipe: ASTM A 53, A 106, or A 120; except comply with ASTM A 53 or A 106 where close coiling or bending is required.

C. Electric Resistance Welded Steel Pipe: ASTM A 135.

D. Electric Fusion Welded Steel Pipe: ASTM A 671.

E. Threaded Pipe Plugs: ANSI B16.14.

F. Forged Steel Socket Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.

G. Wrought Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.

H. Forged Branch Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.

I. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (no close-nipples).

2.03 COPPER TUBE AND FITTINGS:

A. Copper Tube: ASTM B 88; Type (wall thickness) as indicated for each service; hard drawn temper, except as otherwise indicated.

B. ACR Copper Tube: ASTM B 280.

C. Cast Copper Solder Joint Fittings: ANSI B16.18.

D. Wrought Copper Solder Joint Fittings: ANSI B16.22.

E. Cast Copper Solder Joint Drainage Fittings: ANSI B16.23.

F. Wrought Copper Solder Joint Drainage Fittings: ANSI B16.29.

G. Cast Copper Flared Tube Fittings: ANSI B16.26.

H. Bronze Pipe Flanges/Fittings: ANSI B16.24.

I. Copper Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.04 PLASTIC PIPES AND PIPE FITTINGS:

A. Plastic Piping:

1. Schedule 40 PVC in accordance with ASTM D-2241.
2. Fittings: PVC, Schedule 40.
3. PVC solvent cement shall be in accordance with ASTM D2564.

2.05 GROOVED PIPING PRODUCTS:

A. General: As Installer's option, mechanical grooved pipe couplings and fittings may be used for piping systems having operating conditions not exceeding 230 degrees F. (110 deg. C.), excluding any other service not recommended by manufacturer, in lieu of welded, flanged, or threaded methods, and may also be used as unions, flexible connections, expansion joint, or expansion compensators.

B. Coupling Housing: Malleable iron conforming to ASTM A 47.

C. Coupling Housing: Ductile iron conforming to ASTM A 536.

D. Coupling Housing Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature.

E. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D 2000.

1. Water Services: EDPM Grade E, with green color code identification.
2. Other Services: As recommended by manufacturer.

F. Bolts and Nuts: Heat treated carbon steel, ASTM A 183, minimum tensile 110,000 psi.

1. Exposed Locations: Tamper resistant nuts.

G. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.

H. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.

1. Malleable Iron: ASTM A 47.
2. Ductile Iron: STM A 536.
3. Fabricated Steel: ASTM A 53, Type F for 3/4" to 1-1/2"; Type E or S, Grade B for 2" to 20".
4. Steel: STM A 234.

I. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt hole alignment.

1. Malleable Iron: ASTM A 47.
2. Ductile Iron: ASTM A 536.

J. Grooves: Conform to the following:

1. Standard Steel: Square cut.
2. Lightweight Steel: Roll grooved.
3. Cast Iron: Radius cut grooved, AWWA C606.

K. Available Manufacturers: Subject to compliance with requirements, manufacturers offering grooved piping products which may be incorporated in the work include, but are not limited to the following:

1. ITT Grinnell Corp.
2. Stockham Valves & Fittings, Inc.
3. Victaulic Co. of America.

2.06 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.

1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements.

1. Tin Lead Solder: ASTM B 32, Grade 50A (copper drainage).
2. Tin Antimony Solder: ASTM B, Grade 95TA (domestic water).
3. Silver Lead Solder: ASTM B 32, Grade 96TS (refrigerant piping).

C. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined

by Installer to comply with installation requirements.

1. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.

D. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.

1. Available manufacturers: Subject to compliance with requirements, manufacturers offering piping connectors which may be incorporated in the work include, but are not limited to the following:

a. Fernco, Inc.
b. Or approved equal

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping system, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.

1. Comply with ANSI B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Located runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

3.02 PIPING SYSTEM JOINTS:

A. General: Provide joints of type indicated in each piping system.

B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

C. Braze copper tube and fitting joints where indicated, in accordance with ASME B31.

D. Solder copper tube and fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into depth fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

E. Mechanically Formed Tee Connections: In lieu of providing tee fittings in copper tubing, Installer may, as option, provide mechanically formed tee connections, providing they are in accordance with the following:

1. Size and wall thickness of both run tube and branch tube are listed by Manufacturer of forming equipment as "Acceptable Application".
2. Height of drawn collar is not less than 3 times wall thickness of run tubing.
3. End of branch tube is notched to conform to inner curve of run tube, and dimpled to set exact penetration depth into collar.
4. Resulting joint is minimum of 3 times as long as thickness of thinner joint member, and brazing using B-CuP series filler metal.

F. Mechanically Formed Couplings: In lieu of providing couplings in copper tubing, Installer may, as option, provide mechanically formed couplings, provided they are in accordance with the following:

1. Form couplings by first annealing area at end of tube where expansion will occur. Insert tube expander to die size required and expand tube end to accept tubing of same size.
2. Resulting joint is minimum of 3 times as long as thickness of tube, and brazed using B-CuP series filler metal.

G. Weld pipe joints in accordance in with ASME Code for Pressure Piping, B31.

H. Weld pipe joints in accordance with recognized industry practice and as follows:

1. Weld pipe joints only when ambient temperature is above 0 deg. F. (-18 deg. C.) where possible.
2. Bevel pipe ends at a 37.5 deg. angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
3. Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
4. Build up welds with stringer bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow holes and non-metallic inclusions.
5. Do no weld-out piping system imperfections by tack welding procedures; refabricate to comply with requirements.
6. At Installer's option, install forged branch connection fittings wherever branch pipe is indicated; or install regular "T" fittings.

I. Weld pipe joints of steel water pipe in accordance with AWWA C206.

J. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

K. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

3.03 CLEANING, FLUSHING, INSPECTING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31.

3.05 PIPING TESTS:

A. Test pressure piping in accordance with ASME B31.

B. General: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

1. Required test periods is 2 hours.
2. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are lower Class or pressure rating.
3. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
4. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

C. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

D. Drain test water from piping systems after testing and repair work has been completed.

3.06 PIPING

A. Chilled Water Piping: black steel or copper above and below ground.
B. Condensate Drainage Piping: PVC above or below ground.

END OF SECTION 15060

SECTION 15097
PIPE, ESCUTCHEONS AND GUARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.02 SCOPE:

A. Contractor shall be responsible for reviewing and complying with all local code and installation procedures.

B. Provide materials, equipment, labor and supervision necessary to install Pipe Sleeves, Escutcheons and Guards as required by the Drawings and this Section.

1.03 SUBMITTALS:

A. Provide submittal data on pipe sleeves, escutcheons and guards and all specified optional equipment indicating weight, dimensions, and required clearances. Refer to Section 15050 for submittal procedures and be governed accordingly.

PART 2 - PRODUCTS

2.01 SLEEVES:

A. Sleeves passing through non-load bearing and non-fire rated walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows:

1. For pipes 2-1/2" size and smaller - 24 gauge;

B. Sleeves passing through non-fire rated load bearing walls, concrete beams, foundations, footings and waterproof walls and floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.

C. For penetrations through fire-rated floor and walls see subsection titled 'Fire Proofing' in Part 2 of this section.

D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.

E. In finished areas, where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2" above finished floors. Extend sleeves 1" above finished floors in areas likely to entrap water. Fill space between sleeves and pipe with graphite packing and caulking compound.

F. Sleeves passing through membrane waterproofing or lead safing shall be provided with 4 pound sheet lead flashing extending 12" beyond sleeve in all directions, flashing shall be secured and sealed to membrane or lead safe and turned down into space between pipe and sleeve, fill space between pipe and sleeve with oakum, pour lead and caulk watertight. Sleeves passing through roof shall be installed in same manner except sleeves shall extend to 8" above roof.

2.02 ESCUTCHEONS:

A. Provide chrome plated escutcheons at each sleeved opening into finished spaces. Escutcheons shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension. Secure escutcheons or plates to sleeve but not to insulation with setscrews or other approved devices.

2.03 GUARDS:

A. Where exposed insulated piping extends to floor, provide sheet metal guard around insulation to extend up from floor 24". Guard to be galvanized sheet steel not less than 26 gauge.

2.04 FIRE PROOFING:

A. All combustible pipe and fixtures not in fire-rated chases that penetrate through fire-rated floors and walls shall be sleeved and firestopped using through-penetration firestop devices and methods meeting or exceeding ASTM E814 requirements and accepted by local jurisdiction. The fire rating of the firestop device/method to be equivalent or greater than fire rating of the floor or wall penetrated. Cavity between pipe and sleeve to be filled with a alumina/silica bulk ceramic fiber (or equal firesafing material) and both ends to be plugged with the same fire-rating as floor/wall.

B. All non-combustible pipe and fixtures not in fire-rated chases that penetrate through fire-rated floors and walls shall be sleeved with manufactured fire-sleeve coupling or schedule 40 galvanized steel or cast iron pipe. Cavity between pipe and sleeve to be filled with alumina/silica bulk ceramic fiber (or equal fire safing material). Both ends to be sealed with plugs or 3M fire caulking 612 or approved equal to maintain rating of the walls/ceiling/floor.

C. Other sections of this specification complement the requirements of this section.

PART 3 - EXECUTION

3.01 SLEEVES:

A. Install sleeves for piping passing through floors, roof, walls, concrete beams and foundations.

3.02 ESCUTCHEONS:

A. Install escutcheons for pipes entering finished spaces.

B. Seal all penetrations through walls, ceilings and floors to prevent water from entering walls, ceilings or floors.

END OF SECTION 15097

SECTION 15100
VALVES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to valves specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of valves required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of valves specified in this section include the following:

1. Gate Valves.
2. Ball Valves.
3. Check Valves (Swing Check and Wafer Check).

C. Valves furnished as part of factory fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of valves, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Valve Types: Provide valves of same type by same manufacturer.

C. Valve identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

D. Codes and Standards:

1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".
2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged or welded end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".
3. UL and FM Compliance: Provide valves used in fire protection piping, which are UL listed and FM approved.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing Manufacturer's figure number, size, location, and valve features for each required valve.

B. Shop Drawings: Submit manufacturer's assembly type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of valve. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 VALVES:

A. General: Provide factory fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

C. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, 6" and smaller, other than plug valves. Provide one wrench for every 10 plug valves. Provide gear operators for quarter-turn valves 8" and larger.

2.02 GATE VALVES:

A. Comply with the following standards:

1. Cast Iron Valves: MSS Sp-70.
2. Bronze Valves: Mss Sp-80
3. Steel Valves: ANSI B16.34

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering gate valves which may be incorporated in the work include, but are not limited to the following:

1. Crane Co.
2. Fairbanks Co.
3. Hammond Valve Corp.
4. ITT Grinnell Valve Co., Inc.
5. Jenkins Bros.
6. Lunkenheimer Co.
7. Milwaukee Valve Co., Inc.
8. Nibco, Inc.
9. Stockham Valves and Fittings
10. Walworth Co.

2.03 BALL VALVES:

A. Comply with the following standards:

1. Cast Iron Valves: MSS SP-72.
2. Steel Valves: ANSI B16.34.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering ball valves which may be incorporated in the work include, but are not limited to the following:

1. Conbraco Industries, Inc.
2. Crane Co.
3. Fairbanks Co.
4. Hammond Valve Corp.
5. ITT Grinnell Valve Co., Inc.
6. Jamesbury Corp.
7. Jenkins Bros.
8. Metraflex Co.
9. Nibco, Inc.
10. Stockham Valves and Fittings, Inc.
11. Walworth Co.
12. Watts Regulator Co.

2.04 SWING CHECK VALVES:

A. Comply with the following standards:

1. Cast Iron Valves: MSS SP-71.
2. Bronze Valves: MSS SP-80.
3. Steel Valves: ANSI B16.34.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering swing check valves which may be incorporated in the work include, but are not limited to the following:

1. Crane Co.
2. Fairbanks Co.
3. Hammond Valve Corp.
4. Jenkins Bros.
5. Lunkenheimer Co.
6. Milwaukee Valve Co., Inc.
7. Nibco, Inc.
8. Stockham Valves and Fittings.
9. Walworth Co.

2.05 WAFER CHECK VALVES:

A. General: Provide wafer style, butterfly type, spring actuated check valves designed to be installed with gaskets between 2 standard Class 125 flanges.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering wafer check valves which may be incorporated in the work include, but are not limited to the following:

1. Center Line; Mark Controls Corp.
2. ITT Bell & Gossett.
3. Mission Mfg. Co., TRW Inc.
4. Metraflex Co.

2.06 VALVE FEATURES:

A. General: Provide valves with features indicated and where no otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with

ASME B31.9 for building service piping, and ASME B31.1 for power piping.

B. Threaded: Valve ends complying with ANSI B2.1.

C. Butt-Welding: Valve ends complying with ANSI B16.25.

D. Socket Welding: Valve ends complying with ANSI B16.11.

E. Solder Joint: Valve ends complying with ANSI B16.18.

F. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Except as otherwise indicated, comply with the following requirements:

1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.

C. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:

1. Pipe Size 2" and Smaller: One of the following, at Installer's option:

a. Threaded valves.
b. Grooved-end valves.

D. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.

E. Non-Metallic Disc: Limit selection and installation of valves with non-metallic disc to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

F. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

G. Fluid Control: Except as otherwise indicated, install gate, ball, globe, and butterfly valves to comply with ANSI B31.9. Where throttling is indicated or recognized as principal reason for valve, install globe or butterfly valves.

H. Installation of Check Valves:

1. Swing Check Valves: Install in horizontal position with hinge pin horizontally

perpendicular to center line of pipe. Install for proper direction of flow.

2. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position, position for proper direction of flow.

3.02 ADJUSTING AND CLEANING:

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve is leak persists.

B. Valve Identification: Tag each valve in accordance with Division 15 section "Mechanical Identification".

C. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surface with manufacturer's touch-up paint.

3.03 VALVE SCHEDULE:

A. General: Provide the following valves for various valve types listed in Division 15 piping sections.

B. Gate Valves:

1. 2" and Smaller: Class 125, bronze, screw-in bonnet, non-rising stem, solid wedge.

	Threaded Ends
Crane	438
Fairbanks	0250
Grinnell	3000
Hammond	IB645
Jenkins	370
Lunkenheimer	2129
Milwaukee	105
Nibco	T-113
Stockham	B-103
Walworth	55

2. Threaded End; 2" and Smaller: FM, UL Listed, 175 psi, bronze body, solid wedge, outside screw and yoke, rising stem. Provide cap and chain.

Crane:	459
Fairbanks:	0222
Hammond:	IB681
Jenkins:	275U
Nibco:	T-104-O
Stockham:	B-133
Walworth:	904

C. Ball Valves:

1. 1" and Smaller: 150 psi, bronze body, standard port, bronze trim, 2-piece construction, TFE seats and seals.

	Threaded Ends
Conbraco	70
Crane	2182
Grinnell	3700
Jamesbury	21-1100
Jenkins	900T
Metraflex	IT
Nibco	T-585
Powell	4520R20
Stockham	S-216BRRT
Watts	B-6000

2. 1-1/4" to 2": 150 psi, bronze body, standard port, 3-piece body, TFE seats with bronze trim.

	Threaded Ends
Conbraco	82
Fairbanks	0851
Nibco	T-595-Y
Watts	B-6800

D. Check Valves:

1. 2" and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc.

	Threaded Ends
Crane	37
Fairbanks	0640
Grinnell	3300
Hammond	IB940
Jenkins	92-A
Lunkenheimer	2144
Milwaukee	509
Nibco	T-413
Stockham	B-319
Walworth	3406

E. Wafer Check Valves:

1. All Sizes: 125 psi, cast iron body, aluminum bronze or plated iron plates, stainless steel stem, Buna-N seat, stainless steel springs.

Bell & Gossett:	NS
Center Line:	CLC
Metraflex:	Chexx
Mission:	12HMP
Stockham:	WG970
Grooved Ends:	Victaulic Series 711.

END OF SECTION 15100

SECTION 15125
EXPANSION COMPENSATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to expansion compensation products specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of expansion compensation products required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of expansion compensation products specified in this section include the following:

1. Packless Expansion Joints.
   a. Expansion Compensators.
   b. Rubber Expansion Joints.

C. Expansion compensation products furnished as part of factory fabricated equipment are specified as part of equipment assembly in other Division 15 sections.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications; Firms regularly engaged in manufacture of expansion compensation products of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. EJMA Compliance: Construct expansion compensation products in accordance with standards of the Expansion Joint Manufacturer's Association (EJMA).

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of expansion compensation product. Submit expansion compensation schedule showing Manufacturer's figure number, size, location, and features for each required expansion compensation product.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings for each type of expansion compensation product, indicating dimensions, weight, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of expansion compensation product. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 PACKLESS EXPANSION JOINTS:

A. General: Provide packless expansion joints where indicated for piping systems, with materials and pressure/temperature ratings selected by Installer to suit intended service. Select packless expansion joints to provide 200% absorption capacity of piping expansion between anchors.

B. Expansion Compensators: Pressure rated for 60 psi for low pressure systems, 175 psi for high pressure systems; 2-ply phosphor bronze bellows, brass shrouds and end fittings for copper piping systems, or 2-ply stainless steel bellows, carbon steel shrouds and end fittings for steel piping systems. Provide internal guides and anti-torque device, and removable end clop for proper positioning.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering expansion compensators which may be incorporated in the work include but are not limited to the following:

a. Flexonics Div.; UOP, Inc.
b. Hyspan Precision Products, Inc.
c. Keflex, Inc.
d. Metraflex Co.
e. Vibration Mountings and Controls, Inc.

C. Rubber Expansion Joints: Construct of duck and butyl rubber with full faced integral flanges, internally reinforced with steel retaining rings. Provide steel retaining rings over entire surface of flanges, drilled to match flange boltholes, and provide external control rods.

1. Available Manufacturers; Subject to compliance with requirements, manufacturers offering rubber expansion joints which may be incorporated in the work include, but are not limited to the following:

a. Garlock; Mechanical Packing Div.
b. Keflex, Inc.
c. Metraflex Co.
d. Vibration Mountings and Controls, Inc.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which expansion compensation products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 EXPANSION JOINTS:

A. General: Install expansion joints where indicated, and elsewhere as determined by Installer for adequate expansion of installed piping systems. Install in accordance with manufacturer's instructions. Provide pipe anchors and pipe alignment guides as indicated, and in accordance with manufacturer's recommendations. Align units properly to avoid end loading and torsional stress.

END OF SECTION 15125

SECTION 15135
METERS AND GAGES

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.

B. This section is Division 15 Basic Mechanical materials and Methods section, and is part of each Division 15 section making reference to meters and gages specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of meters and gages required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of meters and gages specified in this section include the following:

1. Temperature Gages and Fittings:

a. Glass Thermometers
b. Thermometer Wells
c. Temperature Gage Connector Plugs.

2. Pressure Gages and Fittings:

a. Pressure Gages.
b. Pressure Gage Cocks.
c. Pressure Gage Connector Plugs.

3. Flow Measuring Meters:

a. Calibrated Balance Valves.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of meters and gages, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. UL Compliance: Comply with applicable UL standards pertaining to meters and gages.
2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions of each type of meter and gage. Include scale range and ratings. Submit meter and gage schedule showing manufacturer's figure number, scale range, location and accessories for each meter and gage.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gage. Include this data and product data in Maintenance Manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 GLASS THERMOMETERS:

A. General: Provide glass thermometers of materials, capacities and ranges indicated, designed and constructed for use in service indicated.

B. Case: Die cast aluminum finished in baked epoxy enamel, glass front, spring secured, 9" long.

C. Adjustable Joint: Die cast aluminum, finished to match case, 180deg. adjustment in vertical plane, 360 deg. adjustment in horizontal plane, with locking device.

D. Tube and Capillary: Mercury filled, magnifying lens, 1% scale range accuracy, shock mounted.

E. Scale: Satin faced, non-reflective aluminum, permanently etched markings.

F. Stem: Copper=plated steel, or brass, for separate socket, length to suit installation.

G. Range: Conform to the following:

1. Hot Water: 30 – 240 deg. F with 2 deg. F scale divisions (0 – 160 deg. C with 2 deg. C scale divisions).

2. Chilled Water: 30 – 180 deg. F with 2 deg. F scale divisions (0 – 100 deg. C with 1 deg. C scale divisions).

H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering glass thermometers which may be incorporated in the work include, but are not limited to the following:

1. Ernst Gage Co.
2. Marshalltown Instruments, Inc.
3. Trerice (H.O.) Co.
4. Weiss Instruments, Inc.

2.02 THERMOMETER WELLS:

A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

B. Manufacturer: Same as thermometers.

2.03 TEMPERATURE GAGE CONNECTOR PLUGS:

A. General Provide temperature gage connector plugs pressure rated for 500 psi and 200 deg. F (93 deg. C). Construct of brass and finished in nickel-plate, equip with ½" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and

chain. Provide extension, length equal to insulation thickness, for insulted piping.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering temperature gage connector plugs which may be incorporated in the work include, but are not limited to the following:

1. Peterson Equipment Co.

2.04 PRESSURE GAGES:

A. General: Provide pressure gages of materials, capacities and ranges indicated, designed and constructed for use in service indicated.

B. Type: General use, 1% accuracy, ANSI B40.1 Grade A, phospher bronze, bourdon type, bottom connection.

C. Case: Brass, glass lens, 4-1/2" diameter.

D. Connector: Brass with ¼" male NPT. Provide protective siphon when used for steam service.

E. Scale: White coated aluminum, with permanently etched markings.

F. Range: Conform to the following:

1. Water: 0 – 100 psi.

G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gages which may be incorporated in the work include, but are not limited to the following:

1. Ametek/U.S. Gauge
2. Marsh Instrument Co., Unit of General Signal
3. Marshalltown Instruments, Inc.
4. Trerice (H.O.) Co.
5. Weiss Instruments, Inc.

2.05 PRESSURE GAGE COCKS:

A. Provide pressure gage cocks between pressure gages and gage tees on piping systems. Construct gage cock of brass with ¼" female NPT on each end, and "T" handle brass plug.

B. Siphon: ¼" straight coil constructed of brass tubing with ¼" male NPT on each end.

C. Snubber: ¼" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

D. Manufacturer: Same as for pressure gages.

2.06 PRESSURE GAGE CONNECTOR PLUGS:

A. General Provide pressure gage connector plugs pressure rated for 500 psi and 200 deg. F (93 deg. C). Construct of brass and finish in nickel plate equip with ½" NPS fittings, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion pressure gage. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering pressure gage connector plugs which may be incorporated in the work include, but not limited tot he following;

1. Peterson Equipment Co.
2. Or approved equal.

2.07 CALIBRATED BALANCE VALVES:

A. General: Provide as indicated, calibrated balance valves equipped with readout valves to facilities connecting of differential pressure meter to balance valves. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate to indicate degree of closure of precision machined orifice. Construct balancing valve with internal EPT O-ring seals to prevent leakage around rotating element. Provide balance valves with pre-formed polyurethane insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.

B. Available Manufacturers; Subject to compliance with requirements, manufacturers offering calibrated balance valves which may be incorporated in the work include, but are not limited to the following:

1. Bell & Gossett ITT, Fluid Handling Div.
2. Taco, Inc.
3. Trush Products, Inc.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which meters and gages are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF TEMPERATURE GAGES:

A. General: Install temperature gages in vertical upright position, and tilted so as to be easily read by observer standing on floor.

B. Locations: Install in the following locations, and elsewhere as indicated:

1. At inlet and outlet of each chiller (chilled and condenser water systems).
2. At inlet and outlet of each hydronic coil in air handling units, and built-up central systems.
3. At inlet and outlet of each hydronic heat recovery unit.
4. At inlet and outlet of each thermal storage tank.

3.03 INSTALLATION OF PRESSURE GAGES:

A. General: Install pressure gages in piping tee with pressure gage cock, located on pipe at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated:

1. At suction and discharge of each pump.
2. At inlet and outlet of pressure booster system.
3. At inlet and outlet of water cooled chillers.

C. Pressure Gage Cocks: Install in piping tee with snubber.

D. Pressure Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

END OF SECTION 15135

SECTION 15140
SUPPORTS AND ANCHORS

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.

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to supports and anchors specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of supports and anchors specified in this section include the following:

1. Horizontal Piping Hangers and Supports.
2. Vertical Piping Clamps.
3. Hanger Rod Attachments.
4. Building Attachments.
5. Saddles and Shields.
6. Spring Hanger and Supports.
7. Miscellaneous Materials.
8. Anchors.
9. Equipment Supports.

C. Supports and anchors furnished as part of factory fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable plumbing codes, pertaining to product materials and installation of supports.
2. UL and FM Compliance: Provide products which are UL listed and FM approved.
3. MSS Standard Compliance:

a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
b. Select and apply pipe hangers and supports, complying with MSS SP-69.
c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
d. Terminology used in this section is defined in MSS SP-90.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 HORIZONTAL PIPING HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper plated hanger and supports for copper piping systems.

B. Adjustable Steel Clevis Hangers: MSS Type 1.

C. Steel Double Bolt Pipe Clamps: MSS Type 3.

D. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast iron floor flange.

E. Adjustable Roller Hangers: MSS Type 43.

F. Adjustable Pipe Roll Stands: MSS Type 46.

2.02 VERTICAL PIPING CLAMPS:

A. General: Except as otherwise indicated, provide factory fabricated vertical piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper plated clamps for copper piping systems.

B. Two Bolt Riser Clamps: MSS Type 8.

C. Four Bolt Riser Clamps: MSS Type 42.

2.03 HANGER ROD ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory fabricated hanger rod attachments complying with MSS SP-58 of one of the following MSS types listed, selected by Installer to suit horizontal piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger rod attachments to suit hanger rods. Provide copper plated hanger rod attachments for copper piping systems.

B. Steel Turnbuckles: MSS Type 13.

2.04 BUILDING ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper plated building attachments for copper piping systems.

B. Concrete Inserts: MSS Type 18.

C. Center Beam Clamps: MSS Type 21.

D. Welded Beam Attachments: MSS Type 22.

E. Steel Brackets: One of the following for indicated loading:

1. Medium Duty: MSS Type 32.

2.05 SADDLES AND SHIELDS:

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39, fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

D. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

1. Elcen Metal Products Co.
2. Pipe Shields, Inc.
3. Or approved equal.

2.06 SPRING HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory fabricated spring hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Spring Cushion Hangers: MSS Type 48.

2.07 MANUFACTURERS OF HANGERS AND SUPPORTS:

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

1. B-Line Systems, Inc.
2. Carpenter and Patterson, Inc.
3. Corner & Lada Co., Inc.

4. Elcen Metal Products Co.
5. Fee & Mason Mfg. Co.; Div. Figgie International.
6. ITT Grinnel Corp.

2.08 MISCELLANEOUS MATERIALS:

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No.2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION:

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors, and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 INSTALLATION OF BUILDING ATTACHMENTS:

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforced bars through openings at top of inserts.

3.04 INSTALLATION OF HANGERS AND SUPPORTS:

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install

hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire water piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

E. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
4. Insulated Piping: Comply with the following installation requirements.

a. Clamps: Attach clamps, including spacers (if any) to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
b. Shields: Where low-compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8" and over, install wood insulation saddles.
c. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.05 INSTALLATION OF ANCHORS:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instruction, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required accommodating both expansion and contraction of piping.

3.06 EQUIPMENT SUPPORTS:

A. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory fabricated tank saddles for tanks mounted on steel stands.

3.07 ADJUSTING AND CLEANING:

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to

proper level and elevations.

C. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15140

SECTION 15190
MECHANICAL IDENTIFICATION

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.

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to identification devices specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of identification devices specified in this section include the following:

1. Painted identification materials.
2. Plastic pipe markers.
3. Plastic duct markers.
4. Valve tags.
5. Engraved plastic laminate signs.
6. Plastic equipment markers.
7. Plasticized tags.

C. Mechanical identification furnished as part of factory fabricated equipment is specified as part of equipment assembly in other Division 15 sections.

D. Refer to other Division 15 sections for identification requirements at central station mechanical control center; not work of this section.

E. Refer to Division 16 sections for identification requirements of electrical work; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut off and similar special uses, by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical identification materials which may be incorporated in the work include, but are not limited to the following:

1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

2.02 MECHANICAL IDENTIFICATION MATERIALS:

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.03 PAINTED IDENTIFICATION MATERIALS:

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated of, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.04 PLASTIC PIPE MARKERS:

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color coded pipe markers, complying with ANSI A13.1.

B. Pressure Sensitive Type: Provide manufacturer's standard preprinted, permanent adhesive, color-coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1.

C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 deg. around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

D. Large Pipes: For external diameters of 6" and larger (including insulation, if any) provide either full band or strip type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
3. Strapped to pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Manufacturer's standard preprinted nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with name as shown or specified.

F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions) or as separate unit of plastic.

2.05 PLASTIC DUCT MARKERS:

A. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:

1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside return, and mixed air.

B. Nomenclature: Include the following:

1. Direction of air flow.
2. Duct service (supply, return, exhaust, etc.)
3. Duct origin (from).
4. Duct destination (to).
5. Design cfm.

2.06 PLASTIC TAPE:

A. General: Provide manufacturer's standard color coded pressure sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1 except where another color selection is indicated.

2.07 VALVE TAGS:

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32" hole for fastener.

1. Provide 1-1/2" diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

B. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and number corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.08 ENGRAVED PLASTIC LAMINATE SIGNS:

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16", except as otherwise indicated.

C. Thickness: 1/8" except as otherwise indicated.

D. Thickness: 1/16" for units up to 20 sq.in. or 8" length; 1/8" for larger units.

E. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.09 PLASTIC EQUIPMENT MARKERS:

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible.

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 1-1/2" x 4 markers for control devices, dampers, and valves, and 4-1/2" x 6" for equipment.

2.10 PLASTICIZED TAGS:

A. General: Manufacturer's standard pre-printed or partially pre-printed accident prevention

tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large size primary wording (as examples: DANGER, CAUTION, DO NOT OPERATE).

2.11 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations, and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No.3, Air Supply No.1H, Standpipe F12).

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS:

A. Coordination: Where identification is to be applied or surfaces which require insulation, painting or other covering or finish, include valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceiling and similar removable concealment.

3.02 DUCTWORK IDENTIFICATION:

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment) and at 50' spacing along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housing, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specific signs, at Installer's option.

3.03 PIPING SYSTEM IDENTIFICATION:

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow.

1. Stenciled markers, including color coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2" beyond ends of lettering.
2. Stenciled markers with lettering color complying with ANSI A13.1.
3. Plastic pipe markers with application systems as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated

pipes.

4. Stenciled markers, black or white for best contrast, wherever continuous color coded painting of piping is provided.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine room, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.04 VALVE IDENTIFICATION:

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, convenience and lawn watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION:

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operation devices.

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gages, thermometers and similar units.
3. Pumps, compressors, chillers, condensers and similar motor-driven units.
4. Heat exchangers, coils, evaporators, cooling towers, heat recovery units and similar equipment.
5. Fans, blowers, primary balancing dampers and mixing boxes.
6. Packaged HVAC central station and zone type units.
7. Tanks and pressure vessels.
8. Strainers, filter, humidifiers, water treatment systems and similar equipment.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater

distances. Provide secondary lettering 2/3 or 3/4 of size of principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceiling or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

3.06 ADJUSTING AND CLEANING:

A. Adjusting : Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.07 EXTRA STOCK:

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION 15190

SECTION 15220
WATER TREATMENT

PART 1 - GENERAL

1.01 MECHANICAL GENERAL PROVISIONS

A. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.02 WORK INCLUDED

A. Feeding and control equipment with all piping and wiring for each system.

B. Pre-operation cleaning of each system.

C. Initial water analysis and recommendations.

D. Water treatment chemicals for each system.

E. Test equipment.

F. Training of operating personnel including written instructions, log sheet and record forms.

G. Follow-up service for full year from date of start-up including laboratory assistance.

1.03 SYSTEMS TO BE TREATED

A. Chilled water (CHWS/CHWR).

B. All wiring shall conform to the NEC.

C. The pre-cleaning and chemical charging shall be by or supervised by personnel trained in the field of water treatment. Chemical shall be charged into the system with 24 hours of flushing and before circulation.

D. All chemicals shall be compatible with system materials of construction and shall comply with all applicable EPA and regulatory agency standards.

E. After charging of the system and for a period of 1 full year after the date of startup the water treatment supplier shall periodically inspect the system and perform all necessary tests (minimum of 4) to properly evaluate the chemical concentration.

F. After completion of the system the water treatment supplier shall train the owner in the proper maintenance procedures and future system requirements.

G. After completion of the system water treatment, the contractor shall provide a water analysis and certify in writing to the Owners representative that the system or systems have been properly flushed, cleaned and charged with the proper chemical concentration and that the Owner has been instructed in proper maintenance procedures.

1.04 SUBMITTALS

A. Submit schedule indicating make, model and size by system.

B. Produce data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.

C. Refer to Section 15010, Mechanical General Provisions for requirements.

D. Submit letter of certification as described in 1.04, G.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Dexter Water Management Systems Div. (Mogul).

B. Chem-Treat, Inc.

C. Betz

D. Mitco

E. Nalco

2.02 PIPING SYSTEMS AND WATER TREATMENT SYSTEMS

A. Chilled water (CHWS/CHWR): Closed loop.

2.03 TREATMENT REQUIREMENTS

A. Closed Loop:

1. General: Manual feeding of chemicals into shot feeder and in turn into system in accordance with initial water evaluation and continuing test result requirements.

2. Feeding and Control Equipment:

a. Five gallon combination filter-feeders. Equal to Efficiency Dynamics, Ft. Worth, Tx 76101, FF-100, including steel shell with stainless steel basket, filter bag capable of 40 GPM flow with filter efficiency of 5 microns at 3 psi pressure drop and hand removable cap. Suitable for 150 psi and temperatures to 200 deg. F.
b. Twelve filter bags.
c. Corrosion coupon assembly including corrosion probe connection fittings, one carbon steel and one copper corrosion coupon with holders and two (2) corrosion coupon tees.
d. Installation accessories including piping, fittings, shut off valves, drain valves, pressure gauges to measure pressure loss thru filter and automatic flow control valve set for 8 GPM as specified in Section 15055, Basic Piping Material and Methods and Section 15060, Pipe and Pipe Fittings.

3. Water Treatment Chemicals:

a. All chemicals necessary for flushing and pre-cleaning.

b. All chemicals, in liquid form, necessary to control scale, corrosion, microbiological growth and water PH. Quantity to last 1 full year from date of start up.

2.04 TEST EQUIPMENT

A. Test equipment to properly evaluate the chemical levels within the system. The test equipment shall include but not be limited to: Carrying case or cabinet, all necessary reagents for determination of corrosion inhibitor level pH, P & M, alkalinity and chlorides as well as microbiological colony population and biocide effectiveness.

PART 3 - EXECUTION

3.01 GENERAL

A. Each piping system is to be provided with the specified hardware. Where multiple evaporative condensers or closed circuit fluid coolers are specified, each is to be provided with its own chemical feed equipment.

B. All products shall be installed or services performed in strict accordance with the manufactures written installation/procedure instructions.

C. All piping systems and related equipment shall be thoroughly flushed with pre-cleaning detergent and dispersant designed to remove deposition from construction, such as pipe dope, oils, most loose mill scale, and other extraneous materials. The products used shall inhibit corrosion of the various metals in the system and shall be safe to handle and use. Effectiveness of the product shall be such that the water need only be at ambient temperatures. Add recommended dosages of chemicals and circulate for 48 hours. During the first 24 hours, all strainers shall have their 0.25" perforated screens installed. After the first 24 hours, the final perforated screens shall be installed. During the entire flushing process, the strainers shall be cleaned as necessary. System shall then be drained from the lowest point in the system with make-up water fed to the system. During the draining process, the circulating pumps shall be in continuous operation to prevent settling, and circulation and draining shall continue until the total alkalinity and pH of the water is equal to the makeup water. Contractor is cautioned to be sure temperature and pressure in system during flushing does not cause rupture disc on chiller or relief valves etc. to blow.

D. Install chemicals required for treatment of each system within 24 hours of completion of cleaning prior to start-up and operation of the system. Contractor shall measure water quantity required to fill system and provide this information to water treatment equipment supplier and tabulate this data in the operation and maintenance manuals.

E. After cleaning and filling the mechanical system, operate the system for a period of not less than 120 hours continuously during which time water treatment samples shall be taken at 24-hour intervals and the results plotted on a graph. Testing and sampling shall continue until the graph indicates the water treatment is maintaining the specified levels of chemical within plus or minus 10% under all conditions of load.

F. After the system is flushed, pre-cleaned and chemically stabilized the Contractor shall:

1. Turn the test kits over to the owner.
2. Instruct the owner in proper maintenance procedures.

G. Fulfill all obligations for the specified period of 2 full years from the date of start up including four (4) service calls during the cooling season and two (2) service calls during the heating season.

H. Where the owner provides the chemicals for treatment, notify the owner well in advance of the cleaning process and when completed advise in writing that it is recommended that the

chemicals be charged immediately to prevent damage to the system.

END OF SECTION 15220

SECTION 15250
MECHANICAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Division 15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of mechanical insulation required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Piping System Installation:
   a. Cellular Glass.
   b. Fiberglass

2. Ductwork System Insulation:
   a. Fiberglass

3. Equipment Insulation:
   a. Fiberglass
   b. Cellular Glass.

C. Refer to Division 15 section 15140 "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields; not work of this section.

D. Refer to Division 15 section 15190 "Mechanical Identification" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instruction for

each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

C. Samples: Submit manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged, or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. 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:

1. Armstrong World Industries, Inc.
2. Knauf Fiber Glass GmbH.
3. Manville Products Corp.
4. Owens-Corning Fiberglass Corp.
5. Pittsburg Corning Corp.

2.02 PIPING INSULATION MATERIALS (CHILLED WATER):

A. Cellular Glass Piping Insulation: ASTM C52, Type II, Class 2.

1. Type I - flat block; Type II - pipe and tubing insulation.

B. Adhesives, Sealers, and Protective Finished: As recommended by insulation manufacturer for application indicated.

C. Jacket (in building) Pittcoat 400.

D. Jacket (outdoor above ground and in mechanical room) aluminum jacket.

2.03 DUCTWORK INSULATION MATERIALS:

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1.

1. Class 1 - 400 deg. F (204 deg. C.)

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, type 1, Class B-4.

1. Type I - Resilient, flexible.

C. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures

below ambient; Type II for ductwork with temperatures above ambient.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.04 EQUIPMENT INSULATION MATERIALS:

A. Rigid Fiberglass Equipment Insulation: ASTM C 612, Class 2.

B. Cellular Glass Equipment Insulation: ASTM C 552, Type I.

1. Type I - flat block.

C. Jacketing Material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per sq. yd., or metal jacket at Installer's option, except as otherwise indicated.

D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.01 INSPECTIONS:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 HVAC PIPING SYSTEM INSULATION:

A. Insulation Omitted: Omit insulation on cold piping within unit cabinets provided piping is located over drain pan.

B. Cold Piping (40 deg. F.) (4.4 deg. C) to ambient:

1. Application Requirements: Insulate the following cold HVAC piping systems:

a. HVAC chilled water supply and return piping above ground.
b. Air conditioner condensate drain piping.

2. Insulate each piping system specified above with the following type and thickness of insulation:

a. Cellular Glass: 2" thick for pipe sizes up to and over 4" (above ground) and in building.
b. Jacket (in building) Pittcoat 400.
c. Jacket (outdoor above ground and in mechanical room) aluminum jacket.

C. Hot Piping (90 deg. or above).

1. Application requirements: Insulate the following hot HVAC piping Systems:

a. HVAC hot water supply and return piping above ground.
b. Glycol piping (in building).
c. Domestic hotwater piping.

2. Insulate above piping with thick premold high density fiberglass with overlap jacket.

3.03 DUCTWORK SYSTEM INSULATION:

A. Cold Ductwork (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold ductwork:

a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.
b. HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet.
c. HVAC return ductwork between room terminal inlet and AHU, or HVAC unit inlet.
d. HVAC plenums and unit housings not pre-insulated at factory or lined.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Rigid Fiberglass: 1-1/2" thick mandatory on all ductwork in mechanical rooms.
b. Flexible Fiberglass: 2" thick, R-6

3.04 EQUIPMENT INSULATIONS:

A. Cold Equipment (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold equipment:

a. Refrigerant equipment, including chillers, tanks and pumps.

2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:

a. Cellular Glass: 2" thick for surfaces above 35 deg. F. (2 deg. C.).

3.05 INSTALLATION OF PIPING INSULATION:

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purposes.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with single cut piece to complete run. Do not use

cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulations joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor barrier jackets on pipe insulation and protect to prevent puncture or other damage.

F. Cover valves, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

3.06 INSTALLATION OF DUCTWORK INSULATION:

A. General: install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through wall, floors, and similar ductwork penetrations, except where otherwise indicated.

F. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.07 INSTALLATION OF EQUIPMENT INSULATION:

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purposes.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

E. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored blocks, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

F. Cover insulated surfaces with all service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

G. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

3.08 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 15250

SECTION 15682
AIR COOLED WATER CHILLERS

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. Microprocessor controlled, air-cooled liquid chiller utilizing HFC-134a or R22, screw compressors, and electronic expansion devices.

1.02 QUALITY ASSURANCE

A. Unit shall be rated in accordance with ARI Standard 590, latest revision (U.S.A.).

B. Unit construction shall comply with ASHRAE 15 Safety Code, NEC, and ASME applicable codes (U.S.A. codes).

C. Unit shall be manufactured in a facility registered to ISO 9002/BS5750, Part 2 Manufacturing Quality Standard.

D. Unit shall be full load run tested at the factory.

1.03 RELATED SECTIONS

A. Section 15050 - Basic Mechanical Materials & Methods

B. Section 15055 – Basic Piping Materials and Methods

C. Section 15060 - Pipe and Pipe Fittings

D. Section 15510 - Hydronic Piping - Chilled Water

E. Section 15971 - Building Automation System (BAS) and D.D.C. Controls

F. Section 16142 - Electrical Connections For Equipment

1.04 SUBMITTALS

A. Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate accessories where required for complete system.

B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

C. Submit manufacturer's installation instructions.

1.05 OPERATION, MAINTENANCE DATA AND TRAINING

A. Submit operation data.

1. Included start-up by a factory certified technician.
2. Include start-up instructions, maintenance data, controls, and accessories.
3. Submit maintenance data.
4. Provide 4 hours including video tape of the training seminar for training of OCPS

maintenance.

1.06 REGULATORY REQUIREMENTS

A. Conform to ANSI/ARI 550 code for testing and rating of rotary chillers.

B. Conform to ANSI/UL 465 code for construction of water chillers and provide UL label. In the event the unit is not UL approved, the manufacturer shall, at his expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.

C. Conform to ANSI/ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.

D. Conform to ANSI/ASHRAE 15 code for construction and operation of water chillers.

1.07 STORAGE AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.

C. Unit controls shall be capable of withstanding 150 Deg F (95 Deg C) storage temperatures in the control compartment for an indefinite period of time.

1.08 WARRANTY

A. Provide a full parts warranty for one year from start-up.

B. Provide five-year warranty for replacement compressors including material only.

1.09 MAINTENANCE SERVICE

A. Furnish service and maintenance of complete assembly for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURES

A. The Basis of design is Carrier Corp. Products manufactured by McQuay; or York Corp. are acceptable, provided they meet the requirements of this specification in full, and are submitted in accordance with the procedure for substitutions as outlined in the General Requirements.

2.02 EQUIPMENT

A. General: Factory assembled, single-piece, air-cooled liquid chiller. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge, and special features required prior to field start-up.

1. Unit Cabinet:

a. Frame shall be of heavy-gage galvanized steel.
b. Cabinet shall be galvanized steel casing with a pre-painted finish.
c. Cabinet shall be capable of withstanding 500-hour salt spray test in accordance with the ASTM (U.S.A.) B-117 standard.

2. Fans:

a. Condenser fans shall be direct-driven, 11-blade, shrouded-axial type, and shall be statically and dynamically balanced with inherent corrosion resistance. Air shall be discharged vertically upward.
b. Fans shall be protected by coated steel wire safety guards.

3. Compressors:

a. Unit shall have semi-hermetic twin-screw, gear-driven compressors with internal muffler and check valve. Mono-screw design compressors are unacceptable.
b. Each compressor shall be equipped with a discharge shutoff valve.
c. Capacity control shall be provided by pilot-operated solenoid valve, capable of reducing unit capacity to 10% of full load. Compressor shall start in unloaded condition.
d. Motor cooling shall be provided by direct liquid injection and protected internal overload thermistor.
e. Lube oil system shall include pre-filter and internal filter capable of filtration to 2 microns.

4. Cooler:

a. Cooler shall be tested and stamped in accordance with ASME code (U.S.A.) for a refrigerant working-side pressure of 220 psig and shall be tested for a maximum fluid-side pressure of 300 psig. Shall be mechanically cleanable shell-and-tube type with removable heads. DX evaporators that can not be brushed are not acceptable.
b. Tubes shall be internally-enhanced, seamless-copper type, and shall be rolled into tube sheets.
c. Shall be equipped with weld-on fluid connections.
d. Shell shall be insulated with 3/4 -in. (19 mm) closed-cell, polyvinyl-chloride foam with a maximum K factor of 0.28.
e. Shall incorporate 2 independent refrigerant circuits.
f. Shall have a cooler drain and vent.
g. Shall incorporate a refrigerant level sensing device.

B. Condenser:

a. Coil shall be air-cooled with integral subcooler, and shall be constructed of aluminum fins mechanically bonded to seamless copper tubes. The tubes are then cleaned, dehydrated, and sealed.
b. Condenser coils shall be leak tested and shall be pressure tested at 450 psig.
c. Coil Options:

1) Precoated aluminum fin coils shall have a durable epoxy-phenolic coating to provide protection in mildly corrosive coastal and industrial environments. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube. Epoxy-phenolic barrier

shall minimize galvanic action between dissimilar metals.

C. Refrigeration Components: Refrigerant circuit components shall include oil separator, high and low side pressure relief device, discharge and liquid line shutoff valves, filter drier, moisture indicating sight glass, electronic expansion device, and complete operating charge of both refrigerant compressor oil.

D. Controls, Safeties, and Diagnostics:

1. Controls:

a. Unit controls shall include as a minimum: Microprocessor, LOCAL/OFF/REMOTE switch, and 2-line, 24-character per line diagnostic display with keypad.
b. Shall be capable of performing the following functions:

1 Automatic compressor lead/lag switching.
2 Capacity control based on leaving chilled fluid temperature with return fluid temperature sensing.
3 Limiting the chilled fluid temperature pull-down rate at start-up to an adjustable range of 0.2° F to 2° F (0.11° C to 1.1° C) per minute to prevent excessive demand spikes at start-up.

c. Temperature reset shall be capable of resetting leaving chilled fluid temperature based on return fluid temperature, outdoor ambient temperature, space temperature, 4 to 20 mA external signal, or Carrier Comfort Network input.

2. Diagnostics:

a. Display module shall be capable of displaying set points, time, system status (including temperatures, pressures, and percent loading), and any alarm or alert conditions.
b. Control module, in conjunction with the microprocessor, shall be capable of displaying the output of a full load run test to verify operation of every switch, sensor, potentiometer, fan, and compressor before chiller is started.

3. Safeties:

a. Unit shall be equipped with all necessary components, and in conjunction with the control system shall provide the unit with protection against the following:
1) Loss of refrigerant charge.
2) Reverse rotation.
3) Low chilled fluid temperature.
4) Low oil pressure (each compressor circuit).
5) Voltage imbalance.
6) Ground current fault.
7) Thermal overload.
8) High pressure.
9) Electrical overload.
10) Loss of phase.
11) Current imbalance.

b. Fan motors shall have inherent overcurrent protection.

E. Operating Characteristics:

1. Unit shall be capable of starting and running at outdoor ambient temperatures from 32 to 115 F (0° to 46 C).
2. Unit shall be capable of starting up with 95 F (35 C) entering fluid temperature to the cooler.

F. Motors: Condenser-fan motors shall be totally enclosed 3-phase type with permanently-lubricated bearings and Class F insulation (except Motormaster III control motors which shall be open type and shall have Class B insulation).

G. Electrical Requirements:

1. Control voltage shall be 115-v (60 Hz), single-phase, separate power supply.
2. Unit shall be shipped with factory control and power wiring installed.

H. Special Features:

1. Wye-Delta Starter: Unit shall have a factory-installed, wye-delta start to minimize electrical inrush current.
2. Control Power Transformer: Unit shall be supplied with a field (or factory) in-stalled transformer that will allow supply control circuit power from the main unit power supply.
3. Proof-of-Flow Switch: Unit shall be supplied with field-installed differential pressure type proof-of-flow sensing switch.
4. Non-Fused Disconnect: Unit shall be supplied with factory-installed, non-fused electrical disconnect for main power supply.
5. Demand Limit Control: Unit shall be equipped with a 2-point demand limit control (from 0 to 100%), which shall be activated by a remote contact closure or a 4 to 20 mA signal.
6. Cooler Head Insulation: Unit shall be supplied with field-installed cooler insulation that shall cover the cooler heads.
7. Suction Isolation Valves: Unit shall be supplied with factory-installed suction isolation valves.
8. Sound Reduction Enclosures/Hail Guards: Field-installed accessory kit shall include panels with sound blankets designed to reduce sound levels and protect coils.
9. Cooler Heater: Unit shall have field-installed head-mounted cooler heater that shall help prevent cooler freeze-up for ambient temperatures down to 25 F (-4 C).

2.03 BUILDING MANAGEMENT SYSTEM

A. Provide Integrated Comfort System communication interface utilizing a single twisted wire pair link to the energy management system. All operating codes, monitoring information, setpoint adjustments, chiller sequencing and diagnostic shall be available at energy management system display.

B. Provide 4-20 mA control signal from building automation system for leaving water temperature and demand limiting setpoint adjustment.

2.04 VERTICAL-MOUNTED, SUCTION PUMPS

A. General Description: Dual Vertically-mounted pump, centrifugal, suction, single-stage, bronze-fitted, radially split case design, and rated for 175 psig working pressure and 225 deg F continuous water temperature. Pump shall be provided by the chiller manufacturer as part the chilled water system.

B. Casings Construction: Cast iron, with flanged piping connections, and threaded gage tappings at inlet and outlet flange connections.

C. Impeller Construction: Statically and dynamically balanced, closed, overhung, single-suction, fabricated from cast bronze conforming to ASTM B 584, keyed to shaft and secured by a locking capscrew.

D. Wear Rings: Replaceable, bronze.

E. Pump Shaft and Sleeve Bearings: Steel shaft, with bronze sleeve.

F. Seals: Mechanical seals consisting of carbon steel rotating ring, stainless steel spring, ceramic seat, and flexible bellows and gasket.

G. Seals: Stuffing box consisting of a minimum of 4 rings of graphite impregnated braided yarn with a bronze lantern ring between center 2 graphite rings, and a bronze packing gland.

H. Pump Couplings: Flexible, capable of absorbing torsional vibration and shaft misalignment; complete with metal coupling guard.

I. Mounting Frame: Factory-welded frame and cross members, fabricated of steel channels and angles conforming to ASTM B 36. Fabricate for mounting pump casing, coupler guard, and motor. Grind welds smooth prior to application of factory finish. Motor mounting holes for field-installed motors shall be field-drilled.

J. Motor: Secured to mounting frame with adjustable alignment on mounting frame.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Align chiller package on steel or concrete foundations.

C. Install units on isomode pads.

D. Connect to electrical service.

E. Connect to chilled water piping.

F. Arrange piping for easy dismantling to permit tube cleaning.

3.02 MANUFACTURER'S FIELD SERVICES

A. Supply service of factory trained representative for a period of 1 day to supervise testing, start-up, and instruction on operation and maintenance to Owner.

B. Supply initial charge of refrigerant and oil.

END OF SECTION 15682

SECTION 15855
AIR HANDLING UNITS

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.

B. Division 15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of air handling unit work is indicated on drawings and schedules, and by requirements of this section.

B. Types of packaged air handling units specified in this section include the following:

1. Indoor draw-through.

C. Refer to other Division 15 sections for vibration control units used in conjunction with air handling units; not work of this section.

D. Vibration control units required for air handling units is specified in other Division 15 sections, and is included as work of this section.

E. Refer to other Division 15 sections for field applied insulation to air-handling units; not work of this section.

F. Refer to other Division 15 sections for refrigerant piping and condensate drain piping required in conjunction with packaged air handling units, not work of this section.

G. Refer to other Division 15 sections for balancing of the factory fabricated air-handling units; not work of this section.

H. Refer to Division 16 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory installed by manufacturer.
2. Interlock wiring between electrically operated equipment units; and between equipment and field installed control devices.

a. Interlock wiring specified as factory installed is work of this section.

I. Provide the following electrical work as work of this section, complying with requirements of Division 16 sections.

1. Control wiring between field installed controls, indicating devices, and unit control panels.

a. Control wiring specified as work of Division 15 for Automatic Temperature Controls is work of that section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged air handling units with characteristics, sizes and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards 210 and 500.
2. ARI Compliance: Test and rate air handling units in accordance with Standard 210/240-89, display certification symbol on units of certified models.
3. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
4. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
5. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards.
6. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.
7. Air handling unit shall meet or exceed the requirements of the 2010 Florida Energy Efficiency Code.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finished of materials, and installation instructions.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air handling units. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

D. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 1.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air handling units with factory installed shipping skids and lifting lugs; pack components in factory fabricated protective containers.

B. Handle air-handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air

handling unit manufacturer.

C. Store air handling units in clean dry place and protect from weather and construction traffic. Do not store air-handling units at exterior.

D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air handling units which may be incorporated in the work include, but are not limited to the following:

1. Carrier Corporation
2. Daikin McQuay
3. Lennox Industries
4. The Trane Co.

2.02 AIR HANDLING UNITS:

A. General: Provide factory fabricated and factory tested air handling units as indicated, of sizes and capacities as scheduled, and as specified herein.

B. Casings: Construct casing of 18 ga. minimum mill galvanized steel, designed to withstand specified operating pressures. Provide casing panels and/or access doors that are easily and quickly removable for inspection and access to internal parts.

1. Provide single zone units consisting of fan section, coil section, adjustable fan motor mounting, and drain pan.
2. Provide reinforced points of support for either setting or hanging units.
3. Provide drain pan, located under cooling coil section and humidifier section, extensive enough to catch condensate leaving coil at highest catalogued face velocity. Provide at least one drain connection at low point in drain pan.
4. Cover casing and frame with protective finish on both sides.

C. Coils: Provide cooling coils of scheduled capacity, mounted in unit in manner permitting removal.

1. Construct coils with copper tubing primary surface and aluminum secondary surface bonded to tubes by method approved by specified manufacturer. Provide chilled water coils with threaded connections. Provide chilled water coils with drain and vent connections. Provide direct expansion coils with solder connections, liquid refrigerant distributors, and connections for gravity oil drainage. Pitch coils in unit casing for drainage.
2. Provide separate electric duct heating coil with control cabinet automatic reset thermal cutouts for primary over- temperature protection and with load carrying manual reset thermal cutouts, mercury contacts, air flow switch, SCR controller and cabinet mounted disconnect switch. Electric duct heater shall be field wired in to work in series with air handling unit. Include over-current cutouts and sub-circuiting fusing in assembly, and construct with the following additional construction features:

a. Open-Coil Electric Element: Construct coils with resistance wire of 80%

nickel/20% chromium, insulated by floating ceramic bushings. Recess bushings into casing openings and secure on supporting brackets, spaced 4" o.c. maximum.

D. Coil Sections: Provide common or individual casing cooling coils as required. Design internal structure of coil section to allow for removal of coils, and provide suitable baffles to assure no air bypass around coils. Provide condensate pans and drain connections to cooling coil sections of sufficient size to contain and remove coil condensate. Insulate coil section casings and drain pans as specified in "Insulation" paragraph. Provide hot gas reheat coil for 7.5 ton air handling unit, see schedule.

E. Fan Sections: Provide forward curved fans specifically designed and suitable for class of service indicated. Provide adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts, or similar devices, to secure base in proper position. Provide direct-driven variable speed fans. Fans shall be factory statically and dynamically balanced.

F. Filter: Provide filters with wither hinged access doors or quickly removable panels, at each end. Provide racks to receive filters in either flat or angle type pattern.

G. Insulation: Insulate unit casing from air entrance to coils, to air outlet from unit, including bypass duct if used. Insulate framing angles exposed to air stream. Securely attach insulation, of sufficient thickness and density to prevent condensation from forming on unit casing. Protect insulation against deterioration from air currents.

1. Provide insulation with fire retarding characteristics, complying with NFPA 90A. Insulate drain pans as required to prevent condensate formation on unit exterior at ambient conditions to be encountered.

H. Air Filters: Provide air filters to fit in filter box, of the following type:

1. Disposable Type: Provide disposable type air filters 2" thick, consisting of viscous coated fibers with filtering media encased in fiberboard cell sides having perforated metal grids on each side to provide media support.

a. Provide filters with clean resistance not exceeding 0.10" w.g. at face velocity of 300 fpm, and ASHRAE weight arrestance efficiency of 70-82% based on final operating resistance of 0.5" w.g.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which air-handling units are to be installed and verify required service clearances are met. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF AIR HANDLING UNITS:

A. General: Install air handling units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air handling units with other work.

C. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

D. Mounting: Mount air-handling units on steel support stand or 4" high concrete housekeeping pad. Provide vibration isolators if fan section is not internally isolated, in accordance with manufacturer's instructions.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

F. Piping Connections: Refer to Division 15 HVAC sections. Provide piping, valves, accessories, gages, supports, and flexible connectors as indicated.

G. Duct Connections: Refer to Division 15 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

H. Grounding: Provide positive equipment ground for air handling unit components.

3.03 FIELD QUALITY CONTROL:

A. Testing: Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.04 EXTRA STOCK:

A. Provide one complete set of filters for each air-handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

B. Provide one spare set of belts for each belt-driven air-handling unit, obtain receipt from Owner that belts have been received.

END OF SECTION 15855

SECTION 15870
POWER VENTILATORS (EXHAUST FANS)

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 this Section.

B. Requirements of the following Division 15 Sections apply to this section:

1. "Basic Mechanical Requirements."
2. "Basic Materials and Methods."

1.02 SUMMARY

A. This Section includes the following types of power ventilators:

1. Wall mounted Centrifugal ventilators.
2. Ceiling mounted ventilators

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

1. Division 15 Section "Vibration Control" for vibration hangers and supports.
2. Division 15 Section "Testing, Adjusting, and Balancing" for air-handling systems testing, adjusting, and balancing requirements and procedures.

C. Products furnished but not installed under this Section include roof curbs for roof-mounted exhaust fans.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for selected models, including specialties, accessories, and the following:

a. Certified fan performance curves with system operating conditions indicated.
b. Certified fan sound power ratings.
c. Motor ratings and electrical characteristics plus motor and fan accessories.
d. Materials gages and finishes, including color charts.
e. Dampers, including housings, linkages, and operators.

2. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
3. Coordination drawings, in accordance with Division 15 Section "Basic Mechanical Requirements," for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

a. Roof framing and support members relative to duct penetrations.
b. Ceiling suspension members.
c. Method of attaching hangers to building structure.

d. Size and location of initial access modules for acoustical tile.
e. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

4. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
5. Product certificates, signed by manufacturers of air-handling units, certifying that their products comply with specified requirements.
6. Maintenance data for exhaust fans, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 15 Section "Basic Mechanical Requirements."

1.04 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations specified in Division 7.

B. Coordinate the size and location of structural steel support members.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in 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. Wall Mounted Centrifugal Ventilators:

a. Greenheck Fan Corp.
b. Cook (Loren) Co.
c. Penn Ventilator Co.

2. Ceiling Mounted Ventilators:

a. Greenheck Fan Corp.
b. Cook (Loren) Co.
c. Penn Ventilator Co.

2.02 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.03 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA L (50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

D. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.04 WALL MOUNTED CENTRIFUGAL VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged aluminum base with venturi inlet cone.

1. Up-blast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:

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 mesh, 16-gage, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops.

a. Blades: Die-formed sheet aluminum.
b. Frame: Extruded aluminum, with waterproof, felt blade seals.
c. Linkage: Nonferrous metals, connecting blades to counter weight or operator.
d. Operators: Manufacturer's standard electric motor.
e. Operators: Manufacturer's standard pneumatic motor.

2.05 CEILING MOUNTED VENTILTORS

A. General Description: Direct-drive, fan wheel housing and integral duct collar, wheel, butterfly-type discharge damper, fan shaft, motor, drive assembly, and aluminum inlet grille.

B. Fan Housing: Reinforced injection molded meeting UL requirements. motor and drive assembly, and fan wheel.

C. Fan Wheel: Dynamically and statically balanced, replaceable, injection molded polypropylene resin.

F. Motors: Open drip proof type with permanently sealed bearings and disconnect plug.

G. Aluminum Grille: Prefabricated, heavy-gage, aluminum.

2.06 MOTORS

A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

C. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B.

Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.

1. Bases: Adjustable.
2. Bearings: The following features are required:

    a. Ball or roller bearings with inner and outer shaft seals.
    b. Grease lubricated.
    c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
3. Enclosure Type: The following features are required:

    a. Open drip-proof motors where satisfactorily housed or remotely located during operation.
    b. Guarded drip-proof motors where exposed to contact by employees or building occupants.

4. Overload protection: Built-in, automatic reset, thermal overload protection.
5. Noise rating: Quiet.
6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B.
7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, roof curbs, equipment supports, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Division 15 Section "Vibration Controls."

1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

    a. Installation of roof curbs is specified in Division 7.

2. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.03 CONNECTIONS

A. Duct installations and connections are specified in other Division 15 sections. Make final duct connections with flexible connections.

B. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 16.
2. Temperature control wiring and interlock wiring are specified in Division 15 Section "Electrical Control Systems."
3. Temperature control wiring and interlock wiring are specified in Division 15 Section "Pneumatic Control Systems."
4. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

3.05 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

END OF SECTION 15870

SECTION 15885
AIR CLEANING DEVICES

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.

B. Division 15 Section 1505 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of air cleaning work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of air cleaning equipment specified in this section include the following:

1. Air Filters.
   a. Replaceable (throwaway).
   b. Extended surface, self-supporting.

2. Filter Holding Systems.
   a. Front and Rear Access Filter Frames.
   b. Side Servicing Housings.

3. Filter Gages.

C. Filter sections of packaged air handling units are work of this section.

D. Refer to Division-15 air handling units section for filter boxes and filters associated with air handling units; not work of this section.

E. Refer to Division-15 duct accessories section for duct access door work required in conjunction with air filters; not work of this section.

F. Refer to Division-16 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on air filter units. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

G. Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:

1. Control wiring between field-installed controls, indicating devices, and air filter unit control panels.

   a. Control wiring specified as work of Division 15 for Automatic Temperature Controls is work of that section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air cleaning

equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B, and NEC pertaining to installation of air filters and associated electric wiring and equipment.
2. UL Compliance: Comply with UL Standards pertaining to safety performance of air filter units.
3. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing, and for recording and calculating air flow rates.
4. ARI Compliance: Comply with provisions of ARI Standard 850 pertaining to test and performance of air filter units.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data including, dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for filter rack assemblies indicating dimensions, materials, and methods of assembly of components.

C. Samples: Submit one sample filter cartridge for each type of filter required; in accordance with requirements of
Division-1.

D. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air filter units. Submit manufacturer's ladder-type wiring diagram for control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

E. Maintenance Data: Submit maintenance data and spare parts lists for each type of filter and rack required. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air-cleaning equipment which may be incorporated in the work include; but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide air-cleaning equipment of one of the following:

1. Cambridge Filter Corp.
2. Farr Co.
3. Flanders Filters, Inc.

2.02 AIR FILTERS:

A. Replaceable (Throwaway) Panel Filters: Provide factory- fabricated, viscous-coated, flat

panel type replaceable air filters with holding frames; as indicated, in sizes indicated, with 2" thick UL Class 2 throwaway media material; construct media of interlaced glass fibers, spray with non-flammable adhesive, frame in throwaway fiberboard casings, and sandwich between perforated metal grilles. Construct ductwork-holding frames of 20-ga galvanized steel, capable of holding media and media frame in place, and gasketed to prevent unfiltered air by- passing between media frames and holding members. Provide filters with rated face velocity of 500 fpm, initial resistance of not greater than 0.28" w.g., final rated resistance of 1.5" w.g., Ashrab test standard 52-76 at 25-30% efficiency, arrestance 90-92%. Provide anti-microbial coating.

B. Side Servicing Housings: Provide factory-assembled side servicing housings with flanges for insertion into ductwork system as indicated. Construct of 16-ga galvanized steel. Provide access doors with continuous gasketing on perimeter and positive locking devices. Incorporate positive-sealing gasket material on channels to seal top and bottom of filter cartridge frames to prevent bypass. Arrange so filter cartridge can be loaded from either access door.

1. Leak-test housing by pressurizing to 3" w.g. and soap-bubble test housing joints, door seals, and filter sealing edges. Provide crank-operated spring-loaded filter-sealing mechanism with limit stop, so geared that total pressure of 600 lbs. will be exerted on each filter. Design clamping frame to provide continuous knife-edge seal for all four edges of each individual filter.

2.03 FILTER GAGES:

A. Provide diaphram-type filter gage for each filter bank, with dial and pointer, graduated to read from 0 to 2" w.g.

B. Provide manometer-type filter gage for each filter bank, with logarithmic curve tube gage, with integral leveling gage, graduated to read from 0 to 3" w.g.

1. Provide pressure tips, tubing, gage connections, and mounting bracket.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which air filters and filter housings will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION:

A. General: Comply with installation requirements as specified elsewhere in these specifications pertaining to air filters housing/casings, and associated supporting devices.

B. Install air filters and holding devices of types indicated, and where shown; in accordance with air filter manufacturer's written instructions and with recognized industry practices; to ensure that filters comply with requirements and serve intended purposes.

C. Locate each filter unit accurately in position indicated, in relation to other work. Position unit with sufficient clearance for normal service and maintenance. Anchor filter holding frames securely to substrate.

D. Coordinate with other work including ductwork and air handling unit work, as necessary to interface installation of filters properly with other work.

E. Install filters in proper position to prevent passage of unfiltered air.

F. Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

G. Install air filter gage pressure tips upstream and downstream of filters to indicate air pressure drop through air filter. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level inclined gages if any, for proper readings.

3.03 FIELD QUALITY CONTROL:

A. Operate installed air filters to demonstrate compliance with requirements. Test for air leakage of unfiltered air while system is operating. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.

3.04 EXTRA STOCK:

A. Provide one complete extra set of filters for each air handling system. If system is designed to include pre-filters and after- filters, provide only pre-filters. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

END OF SECTION 15885

SECTION 15891
METAL DUCTWORK

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.

B. Division 15 Section 15050 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. Exterior insulation of metal ductwork is specified in other Division-15 sections, and is included as work of this section.

C. Refer to other Division-15 sections for exterior insulation of metal ductwork; not work of this section.

D. Refer to other Division-15 sections for ductwork accessories; not work of this section.

E. Refer to other Division-15 sections for fans and air handling units; not work of this section.

F. Refer to other Division-15 sections for testing, adjusting, and balancing of metal ductwork systems; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.
3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

D. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Shop Drawings: Submit 1/4" scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how these modifications ensure that free area, materials, and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 1.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings. All open ends of stored ductwork shall be sealed airtight and watertight with plastic/visquine.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS:

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials that are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.

2.02 MISCELLANEOUS DUCTWORK MATERIALS:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch takeoff connections. Where 90-degree branches are indicated, provide conical type tees.

C. Duct Liner: Fibrous glass, complying with Thermal Insulation Manufacturers Association (TIMA) AHC-101; of thickness indicated.

D. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation".

E. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

F. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

G. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

H. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

I. Flexible Ducts: Either spiral-wound spring steel with flameproof vinyl sheathing, or corrugated aluminum; complying with UL 181.

1. Where installed in unconditioned spaces other than return air plenums, provide 1" thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

2.03 FABRICATION:

A. Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards".

C. Shop fabricate ductwork of gages and reinforcement complying with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction".

D. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

E. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Ductwork Accessories" for accessory requirements.

F. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

2.04 FACTORY-FABRICATED LOW PRESSURE DUCTWORK:

A. General: At installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

B. Material: Galvanized sheet steel complying with ASTM A 527, lock-forming quality, with ASTM A 525, G90 zinc coating, mill phosphatized.

C. Gage: 26-gage minimum for round and oval ducts and fittings, 4" through 24" diameter.

D. Elbows: One-piece construction for 90 degrees and 45 degree elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

E. Divided Flow Fittings: 90-degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork that may be incorporated in the work include, but are not limited to, the following:

G. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following:

1. Semco Mfg., Inc.
2. United Sheet Metal Div., United McGill Corp.
3. Or approved equal. spiral lockseam construction, in minimum gages listed per SMACNA low pressure duct construction standards.

PART 3 - EXECUTION

3.01 INSPECTION:

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

B. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

D. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

E. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

F. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

1. Where ducts pass through fire-rated floors, walls, or partitions, provide fire-stopping between duct and substrate, in accordance with requirements of Division-7 Section "Fire-stopping".

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

3.03 INSTALLATION OF DUCT LINERS:

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.04 INSTALLATION OF FLEXIBLE DUCTS:

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 10'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible".

3.05 FIELD QUALITY CONTROL:

A. Leakage Tests: After each duct system, which is constructed for duct classes over 3”, is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than 1% of system design airflow.

3.06 EQUIPMENT CONNECTIONS:

A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.07 ADJUSTING AND CLEANING:

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

C. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

D. Balancing: Refer to Division-15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 15891

SECTION 15900
BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 General

A. All work of this Division shall be coordinated and provided by the single Building Automation System (BAS) Contractor.

B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15 Sections for details.

C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.

D. If the BAS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

E. Refer to attached requirements from the Orange County Information Systems and Services (ISS) division for all Orange County hardware, software, and network requirements.

1.2 BAS Description

A. The Building Automation System (BAS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BAS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

C. The work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

D. The BAS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BAS.

E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

F. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

G. The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BAS functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.

H. Acceptable Manufacturers (NO SUBSTITUTIONS)

1. Johnson Controls
2. Automated Logic Controls
3. The Trane Company

1.3 Quality Assurance

A. General

1. The Building Automation System Contractor shall be the primary manufacturer-owned branch office or primary installer of said manufacturer that is regularly engaged in the engineering, programming, installation and service of total integrated Building Automation Systems.
2. The BAS Contractor shall be a recognized national installer and service provider of BAS.
3. The BAS Contractor shall have a branch facility within a 3-hour response time of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
4. As evidence and assurance of the contractor’s ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last six (6) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
5. The Building Automation System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Automation Systems, and shall be the manufacturer’s latest standard of design at the time of bid.
6. Single source responsibility of supplier shall be the complete installation and proper operation of the BAS and control system and shall include debugging and proper calibration of each component in the entire system both existing and new.
7. The Building Automation System contractor shall provide the Owner with 24 months of future software system upgrades as part of their package. The upgrade period shall begin once the final completion has been signed off by the engineer of record for each project.

B. Workplace Safety And Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The BAS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades shall comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BAS Contractor. At a minimum, the Project Manager shall:

   Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
   Manage the financial aspects of the BAS Contract.
   Coordinate as necessary with other trades.
   Be responsible for the work and actions of the BAS workforce on site.

1.4 Work By Others

Note: Include responsibility matrix as required for project coordination and common practice of the specifier.

A) The demarcation of work and responsibilities between the BAS Contractor and other related trades shall be as outlined in the BAS RESPONSIBILITY MATRIX

BAS RESPONSIBILITY MATRIX				
WORK	FURNISH	INSTALL	Low Volt. WIRING/TUBE	LINE POWER
BAS low voltage and communication wiring	BAS	BAS	BAS	N/A
BAS conduits and raceway	BAS	BAS	BAS	BAS
Automatic dampers	BAS	15	N/A	N/A
BAS Current Switches.	BAS	BAS	BAS	N/A
BAS Control Relays	BAS	BAS	BAS	N/A
All BAS Nodes, equipment, housings, enclosures and panels.	BAS	BAS	BAS	BAS
Smoke Detectors	16	16	16	16
Fire/Smoke Dampers	15	15	16	16
Fire Dampers	15	15	N/A	N/A
Fire Alarm shutdown relay interlock wiring	16	16	16	16
Fire Alarm smoke control relay interlock wiring	16	16	BAS	16
Fan Coil Unit controls	BAS	BAS	BAS	16
Unit Heater controls	BAS	BAS	BAS	16
Packaged RTU space mounted controls	15*	BAS	BAS	16
Packaged RTU factory-mounted controls	15*	15	BAS	16
Packaged RTU field-mounted controls	BAS	BAS	BAS	16
Starters, HOA switches	16	16	N/A	16
Control damper actuators	BAS	BAS	BAS	16

1.5 Submittals

A. Shop Drawings, Product Data, and Samples

1. The BAS contractor shall submit its qualifications to the Orange County's Representative after bidding has been completed but prior to the submittal of shop drawings. These qualifications shall be submitted within 15 days of contract award.

2. Once the BAS contractor receives approval from the Owner for their qualifications, the BAS contractor shall submit a list of all shop drawings with submittals dates within 45 days of contract award.

3. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.

4. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BAS work.

5. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BAS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.

6. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

7. The BAS Contractor shall correct any errors or omissions noted in the first review.

8. At a minimum, submit the following:

a. BAS network architecture diagrams including all nodes and interconnections.
b. Systems schematics, sequences and flow diagrams.
c. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
d. Samples of Graphic Display screen types and associated menus.
e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
h. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
i. Details of all BAS interfaces and connections to the work of other trades.
j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.8 Record Documentation

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BAS provided:

a. Table of contents.
b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings on the latest version of AUTOCADD shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
c. Manufacturers product data sheets or catalog pages for all products including software.
d. System Operator’s manuals.
e. Archive copy of all site-specific databases and sequences.
f. BAS network diagrams.
g. Interfaces to all third-party products and work by other trades.

2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.9 Warranty

A. Standard Material and Labor Warranty:

1. Provide a two-year labor and material warranty on the BAS.

2. If within twenty-four (24) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation,

workmanship or materials, it shall be replaced, repaired or adjusted at the cost of the BAS Contractor.

3. Maintain an adequate supply of materials within 50 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BAS Contractor's normal business hours.

2. PART 2 - PRODUCTS

2.1 Network Area Controllers (NAC)

A. The Network Area Controller (NAC) shall provide a thin-client, Graphical User Interface (GUI) to the Building Automation System (BAS).

1. Local Access. The NAC shall be installed upon the owner's Local Area Network (LAN) and shall support local operator access using standard web browsers including at a minimum Microsoft Internet Explorer 8.

2. Remote Access. A high-speed connection from the NAC to the Wide Area Network (WAN) shall be provided and maintained by the owner to facilitate remote operator access to the BAS using the standard web browsers including at a minimum Microsoft Internet Explorer 8.

B. The NAC(s) shall meet or exceed the requirements of a BACnet® Operator Workstation (B-OWS) and a BACnet® Building Controller (B-BC).

C. The NAC(s) shall not require any hardware, software or firmware licensing agreements.

D. The NAC(s) shall support the following hardware characteristics as a minimum:

1. One (1) ISO-8802.3 Ethernet Port – 10/100 Mbps

2. One EIA-232 Port – 115.2 Kbps maximum

3. Two EIA-485 Ports – 76.8 Kbps maximum

4. Local onboard and/or expandable hardware inputs/outputs (I/O)

a. Expandable to a minimum of 96 Inputs and 64 Outputs

5. 8 MB operating RAM

6. 1 MB non-volatile RAM

7. 128 MB Flash EEPROM

E. The NAC(s) shall support the following communication protocols at a minimum:

1. ASHRAE 135-2008 BACnet®

a. Point-to-Point (PTP)

b. Master Slave/Token Passing (MS/TP)

c. Ethernet

d. BACnet® IP (B/IP)

2. Modbus

a. RTU (master or slave)

b. TCP (master or slave)

3. Simple Mail Transfer Protocol (SMTP)

4. Simple Network Management Protocol (SNMP)

5. Hyper Text Transfer Protocol (HTTP)

6. Short Message Service (SMS) – for GSM / GPRS modems

F. The NAC database and all necessary Graphical User Interface (GUI) resources including animations are to be stored on the NAC. Web-enabled applications that require system graphics to be stored on the client machines will not be acceptable.

G. The NAC shall support unlimited access by five (5) simultaneous clients

H. Multiple NAC devices shall be capable of being installed on the same BACnet® internetwork without any separate server applications, separate network management or additional licensing.

1. Browser clients shall have the ability to access any NAC on the internetwork directly

I. The NAC shall provide native BACnet® communications directly with all BACnet® devices on the BACnet® internetwork. Applications that require translation of data, gateways, or mapping of any kind shall not be acceptable.

1. The NAC shall provide BACnet® client and server functionality on all data links without any additional modules or licensing

J. Real-time values displayed on the web browser shall update automatically without requiring a manual “refresh” of the web page.

K. HTML programming shall not be required to create or display system graphics or data on a web page.

L. A new point displayed on a B-OWS graphic screen shall appear automatically on the identical graphic screen served by the NAC with no further programming or file transfer required.

M. The NAC shall be capable of automatically uploading any changes to existing GUI images or animations.

N. The NAC shall support operator interface via the web browser the following at a minimum:

1. Password Protection

a. Multiple-level password access protection shall be provided.

b. Passwords may be exactly the same for all software applications provided to communicate with the internetwork including the web-based browser interface. Passwords and access credentials shall be able to be imported from the B-OWS to the NAC.

c. A minimum of three (3) levels of access shall be supported with a configurable matrix of operator actions allowed for each access level, broken down into at least 20 possible operator actions

d. A minimum of 128 passwords shall be supported at each NAC

e. Operators will be able to perform only those commands available for their respective passwords.

f. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving an NAC browser interface in an unsupervised logged-in state.

g. The NAC shall be configurable to provide read-only access without requiring log-on

h. Unencrypted passwords shall not be transmitted between the NAC and the client browser

2. Alarming and Event Notification

a. NAC shall be capable of generating configurable automatic and dynamic alarm notification that is presented on-top of any current browsing screens in the form of a pop-up message

b. NAC shall be capable of e-mail and telephonic test message notification of system alarms configurable to include notification class, recipient, inclusive and exclusive times and days as well as transition states (to alarm, to fault, return to normal). Systems that use e-mail and/or text message as the exclusive means of annunciating alarms are not acceptable.

c. System shall provide log of notification messages.

d. Alarm messages shall be in user-definable text and shall be entered either at the B-OWS terminal or via remote communication

e. An alarm summary shall be available to show all alarms including but not limited to whether or not they have been acknowledged

f. System shall provide ability to prioritize and differentiate communications for at least 255 different levels of alarms

g. Alarm messages shall be fully customizable in size, content, behavior and sound.

3. Weekly, Annual and Special Event Exception Scheduling

a. Provide ability to view and modify the schedule for the calendar week and up to 255 special events in a graphical format. Each calendar day

and special event shall provide at least six time/value entries per day.

b. Provide the ability for the operator to select scheduling for binary, analog, or multi-state object values.

c. Provide the ability for the operator to designate days, date ranges, or repeating date patterns as exception schedules.

d. Provide the capability for the operator to define special or holiday schedules and to link the BACnet schedule to a BACnet calendar, thereby over-riding weekly schedule programming on holidays defined in the BACnet calendar.

e. There shall be a provision with proper password access to manually override each schedule.

f. Provide the capability to designate any exception schedule to be “Executed Once” then automatically cleared.

g. Provide the ability to name each exception schedule with a user defined term to describe each special event.

4. Trend Log Graphing

a. All data points (both hardware and software) system-wide shall be assignable to a historical trending program by gathering configurable historical samples of object data stored in the local controller (B-BC, B-AAC, B-ASC).

b. All trend log information shall be displayable in text or graphic format. All information shall be able to be printed in black & white or color and exported directly to a Microsoft Excel Spreadsheet.

5. Runtime Log Information

a. B-OWS Software shall be capable of displaying Runtime and On/Off Cycle data of all Binary data points (both hardware and software) system-wide. Runtime logs shall provide the following at a minimum:

1) Total Accumulated Runtime

2) Accumulated Starts Today

3) Total Accumulated Starts

4) Timestamp each Start/Stop and duration of each on/off cycle

5) Monitor equipment status and generate maintenance messages based upon user designated run time

6. Ability to Manually Override any Database point

a. All hardware and software points may be temporarily overridden for a user adjustable configured time period

7. Custom navigation file tree

8. Color Graphical User Interface (GUI)

a. All color graphic displays shall be dynamic with current point data automatically updated from the BACnet internetwork to the browser without operator intervention. Manual operator intervention shall use the same methodology as on the B-OWS application.

b. Depending upon configured access level; the operator shall be able to manually adjust digital, analog or calculated values in the system, adjust values of control loops, override points or release points to automatic mode.

O. The NAC shall provide the capability to create individual user (as determined by the log-on user identification) home pages. Provide the ability to limit a specific user to a defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

P. The NAC shall include an Audit Trail feature that automatically records the time, date, and user, and action associated with all user changes made via Web Browser clients.

Q. The NAC shall store complete help files describing system configuration, and use of the browser interface, the help files shall be served on-line as part of the browser interface.

1. The web browser interface shall include tool tips to describe the functionality of the interface.

2.2 Advanced Applications Controllers (AAC)

A. General

1. Provide a micro-processor based, networkable, custom programmed, BACnet® Advanced Application Controller for each air cooled water chiller, air handling unit, etc, wall-mounted where shown on floor-plans. Each AAC shall include an LCD user interface and all input/output points required to monitor and control each unit as a stand-alone system, according to the specified sequence of operation. In addition AAC's shall allow monitoring and remote control via a supervisory network (BACnet) with a WEB-Based Browser-accessible front end.

2. Provide a 5 year standard manufacturer's warranty for the AAC

B. Network Protocol and Operator Connections

1. The AAC's shall allow direct connection to a host network using BACnet® MS/TP (EIA-485) protocol. The network communication speed shall be operator selectable up to 76.8 kbps.

2. Each AAC shall be BTL tested, and listed to meet the B-AAC Standard Device Profile including BIBBs for this level of device. A Protocol Implementation Conformance statement for the AAC proposed shall be submitted along with shop drawings. Network points to be viewable on each AAC are listed in the sequence of operation, however provide a minimum of 32 Read/Write objects per AAC.

3. Each AAC shall include an externally mounted port allowing operators to connect a laptop computer directly to the AAC for network configuration, custom programming, and trouble-shooting.

C. Hardware Components

1. Provide the following hardware input points at minimum in each AAC:
   a. Room temperature sensor, local or remote 10K thermistor with an accuracy of +/- 0.1 Deg C
   b. User set-point adjustment control with programmable set-point limits
   c. On-board room humidity sensor, with replaceable CMOSense element, overall accuracy of +/- 1.8 % over 10 – 90 % range
   d. On-board room passive infra-red occupancy sensor, with a maximum detection distance of 5m (16.4 ft), and 64 detection zones
   e. In addition to the above, provide 4 user-definable universal inputs capable of accepting 0 -5 VDC, 4 – 20 mA, 10K thermistor, or dry contacts. Refer to the sequence of operation for specific input point requirements.

2. Provide hardware analog and digital output points as required by the sequence of operation, however include the following point types at minimum to allow for future expansion:
   a. Six universal outputs, user-definable as analog or digital
   b. Two additional digital output points
   c. Digital output points shall be dry contacts capable of switching 0.5 Amps at 24 VAC.
3. Provide a large LCD screen for display and adjustment of AAC points and mapped network points. Security codes MUST be provided to prevent unauthorized access from the local LCD screen. Minimum LCD size shall be 128 x 64 pixels. The screen shall be back-lit, however the light may be configured to shut off after a programmable inactive time.

4. Provide push-buttons on the panel face to facilitate navigation, point adjustment, data entry, and switching of operational modes (password protected).

5. AAC memory shall include a minimum 64 Kb RAM for logs and temporary data, and 512 kb flash EEPROM for non-volatile storage of firmware configuration and custom database. Provide a 24 hour clock and 365 day calendar on-board. Clock accuracy shall be +/- 1 second over 24 hours, and system time shall be retained during power outages exceeding 7 years.

6. Provide a software configurable buzzer which shall be set-up to trigger on the occurrence of selected alarms, and shall be audible and acknowledgeable either to all users, or only to those users with sufficient password authority.

7. AAC’s shall be capable of monitoring and controlling at least 4 networked, remote temperature sensors, each with adjustable set-point and outputs for zone controls. These networked sensors shall not consume input/output points in the AAC.

D. Custom Configuration

1. Each AAC shall allow custom setup of the primary user interface screen; definition of all points to be monitored, controlled and displayed; alarms;

schedules; trends; password access; and programmed sequence of operation as required to optimize the AAC for the specific requirements of this project, and also to allow future modification by the owner. AAC's using canned programs for pre-determined HVAC applications are not acceptable.

2. Each AAC shall allow the following custom set-up at minimum:
   a. Primary User Interface screen set-up, including display of time, system mode, fan mode, primary temperature display, and display of up to 3 additional operator-defined AAC or network points.
   b. ALL physical Inputs AND Outputs of the controller MUST be able to be overridden at the LCD screen for technician checkout of the system locally.
   c. Seven additional user defined point groups, each including up to six AAC or network points per group, to be displayed and adjusted by system users with sufficient password authority. Each group, and each individual point shall be defined to allow/disallow editing and manual override by users, and the password level required. Point definition shall also determine if units are to be displayed, and whether point names are displayed as text, or alternatively using an icon chosen from an on-board list of industry standard symbols.
   d. custom programs of 2000 bytes each, using a BASIC control language, with source code stored on board.
   e. The AAC may be defined with full access by all users without password protection, or with three levels of password protected access. Each level of access shall be enabled by entering a 4 digit password via the front panel keys. AAC's that require removal of the faceplate to unlock the keyboard are not acceptable.
   f. Alarm states shall be defined using AAC custom programming, with the definition including the password level required to acknowledge, reset, and clear alarms. When an AAC alarm condition exists, an alarm icon shall be displayed on all screens.
   g. 48 user-definable program-driven variables, with selectable ranges and standard or custom units.
   h. user-definable PID controls loops
   i. user-definable trend logs, each with 150 samples of 6 points each, and programmable sampling times
   j. 8 user-definable runtime logs to accumulate the run-times of selected digital points, and record the time and date of the last 100 changes of state
   k. 2 user-definable system groups, 50 points per group, allowing related points to be grouped together on one display for use in network graphics
   l. 1 user-definable weekly schedule, including 4 on/off pairs for each weekday, and two additional daily schedules triggered by the annual schedule or by custom programming
   m. Override of the unoccupied schedule for a programmed period of time shall be triggered via a front panel button
   n. 1 annual schedule, allowing pre-programming of holidays 365 days in advance

2.3 Input Devices

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

2. Outside Air Sensors
    a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
    b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
    c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
3. Duct Mount Sensors
    a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
    b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
    c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
4. Averaging Sensors
    a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
    b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
    c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
5. Acceptable Manufacturers: Setra or approved equal.

B. Humidity Sensors
1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Veris Industries, and Mamac.

C. Differential Pressure Transmitters
1. General Air and Water Pressure Transmitter Requirements:

a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

2. Building Differential Air Pressure Applications (-1" to +1" w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
◊ -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
◊ 4-20 mA output.
◊ Maintain accuracy up to 20 to 1 ratio turndown.
◊ Reference Accuracy: +0.2% of full span.
c. Acceptable Manufacturers: Setra or approved equal.

3. Low Differential Air Pressure Applications (0" to 5" w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
◊ (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
◊ 4-20 mA output.
◊ Maintain accuracy up to 20 to 1 ratio turndown.
◊ Reference Accuracy: +0.2% of full span.
c. Acceptable Manufacturers: Setra or approved equal.

4. Medium Differential Air Pressure Applications (5" to 21" w.c.)

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
◊ Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
◊ Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
◊ Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low

connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

c. Acceptable manufacturers: Setra or approved equal.

D. Flow Monitoring

1. Air Flow Monitoring

a. Duct Air Flow Measuring Stations

◊ Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.

◊ Airflow measuring stations shall be fabricated of 14-gauge galvanized steel welded casing with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.

◊ The total pressure measurement side (high side) will be designed and spaced to the Industrial Ventilation Manual 16th Edition, Page 9-5. The self-averaging manifolding will be manufactured of brass and copper components.

◊ The static pressure sensing probes (low side) shall be bullet-nosed shaped, per detailed radius, as illustrated in Industrial Ventilation Manual 16th Edition, Page 9-5.

◊ The main take-off point from both the total pressure and the static pressure manifolds must be symmetrical.

◊ Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.

◊ Installation Considerations

(i) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065" w.c. at 1000 feet per minute, or .23" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. – GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area.

(ii) The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated.

(iii) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges

shall be two inch to three inch to facilitate matching connecting ductwork.

(iv) Where control dampers are shown as part of the airflow measuring station, opposed blade precision controlled volume dampers integral to the station and complete with actuator, pilot positioner, and linkage shall be provided.

(v) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.

◊ Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ebtron, and Dietrich Standard.

b. Static Pressure Traverse Probe

◊ Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.

◊ Acceptable manufacturers: Cleveland Controls

c. Shielded Static Air Probe

◊ A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

E. Power Monitoring Devices

1. Current Measurement (Amps)

a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.

b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.

◊ Operating frequency – 50 - 400 Hz.
◊ Insulation – 0.6 Kv class 10Kv BIL.
◊ UL recognized.
◊ Five amp secondary.
◊ Select current ration as appropriate for application.
◊ Acceptable manufacturers: Veris Industries

c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:

◊ 6X input over amp rating for AC inrushes of up to 120 amps.
◊ Manufactured to UL 1244.
◊ Accuracy: +.5%, Ripple +1%.
◊ Minimum load resistance 30kOhm.
◊ Input 0-20 Amps.
◊ Output 4-20 mA.
◊ Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
◊ Acceptable manufacturers: Veris Industries or approved equal.

F. Status and Safety Switches

1. General Requirements

a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.

b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

d. Acceptable manufacturers: Veris Industries or approved equal.

3. Air Filter Status Switches

a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.

b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.

c. Provide appropriate scale range and differential adjustment for intended service.

d. Acceptable manufacturers: Cleveland Controls or approved equal.

4. Air Flow Switches

a. Differential pressure flow switches shall be snap acting micro-switches with appropriate scale range and differential adjustment for intended service.

b. Acceptable manufacturers: Cleveland Controls or approved equal.

5. Air Pressure Safety Switches

a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.

b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.

c. Acceptable manufacturers: Cleveland Controls or approved equal.

6. Low Temperature Limit Switches

a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.

b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.

c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.4 Output Devices

A. Actuators

1. General Requirements

a. Damper and valve actuators shall be electronic as specified in the System Description section.

2. Electronic Damper Actuators

a. Electronic damper actuators shall be direct shaft mount.

b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.

c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

e. Acceptable manufacturers: Belimo or approved equal.

B. Control Dampers

1. The BAS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BAS Contractor or as specifically indicated on the Drawings.

2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.

4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width.

Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48”x48” size shall not leak in excess of 8.0 cfm per square foot when closed against 4” w.g. static pressure when tested in accordance with AMCA Std. 500.

5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5” w.g., but no more than 4000 FPM or 6” w.g. Acceptable manufacturers are Ruskin CD50 and Vent Products 5650.

6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Ruskin CD36 and Vent Products 5800.

7. Multiple section dampers may be jack-shafted to allow mounting of direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. Control Relays

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
b. Mounting Bases shall be snap-mount.
c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
d. Contacts shall be rated for 10 amps at 120VAC.
e. Relays shall have an integral indicator light and check button.
f. Acceptable manufacturers: Lectro or approved equal.

2. Lighting Control Relays

a. Lighting control relays shall be latching with integral status contacts.
b. Contacts shall be rated for 20 amps at 277 VAC.
c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
d. Lighting control relays shall be controlled by:
   ◊ Pulsed Tri-state Output – Preferred method.
   ◊ Pulsed Paired Binary Outputs.
   ◊ A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

D. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BAS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.

2. The signal isolation transducer shall provide ground plane isolation between systems.

3. Signals shall provide optical isolation between systems.

4. Acceptable manufacturers: Advanced Control Technologies or approved equal.

E. External Manual Override Stations

1. External manual override stations shall provide the following:

a. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.

b. A status input to the Facility Management System shall indicate whenever the switch is not in the automatic position.

c. A Status LED shall illuminate whenever the output is ON.

d. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.

e. Contacts shall be rated for a minimum of 1 amp at 24 VAC.

2.5 Miscellaneous Devices

A. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.

2. Input: 120 VAC +10%, 60Hz.

3. Output: 24 VDC.

4. Line Regulation: +0.05% for 10% line change.

5. Load Regulation: +0.05% for 50% load change.

6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.

7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.

8. A power disconnect switch shall be provided next to the power supply.

3. PART 3 – EXECUTION

3.1 BAS Specific Requirements

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .

B. Custom Reports:

1. Provide custom reports as required for this project:

C. Actuation / Control Type

1. Primary Equipment

a. Controls shall be provided by equipment manufacturer as specified herein.

b. All damper and valve actuation shall be electric.

2. Air Handling Equipment

a. All air handlers shall be controlled with a HVAC-DDC Controller
b. All damper and valve actuation shall be electric.

3. Terminal Equipment:
   a. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.
   b. All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 Installation Practices

A. BAS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
   a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
   b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5’ from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BAS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Automation System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BAS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2”.
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.

2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.

4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

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E. BAS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BAS Panel Installation

1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

2. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation

2. Locate components of the BAS in accessible local control panels wherever possible.

H. HVAC Input Devices – Genera1

1. All Input devices shall be installed per the manufacturer recommendation

2. Locate components of the BAS in accessible local control panels wherever possible.

3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

5. Outside Air Sensors

a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.

b. Sensors shall be installed with a rain proof, perforated cover.

6. Medium to High Differential Water Pressure Applications (Over 21" w.c.):

a. Air bleed units, bypass valves and compression fittings shall be provided.

7. Building Differential Air Pressure Applications (-1" to +1" w.c.):
   a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
   b. The interior tip shall be inconspicuous and located as shown on the drawings.
8. Air Flow Measuring Stations:
   a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
   b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
9. Duct Temperature Sensors:
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
   b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
   c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
   d. The sensor shall be mounted to suitable supports using factory approved element holders.
10. Space Sensors:
   a. Shall be mounted per ADA requirements.
   b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
11. Low Temperature Limit Switches:
   a. Install on the discharge side of the first water or steam coil in the air stream.
   b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
12. Air Differential Pressure Status Switches:
   a. Install with static pressure tips, tubing, fittings, and air filter.

I. HVAC Output Devices

1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Automation System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation

transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 Training

A. The BAS contractor shall provide the following training services:

1. A minimum of one and a half days (12 hours total) of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BAS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

2. Operational training of the BAS shall include at a minimum: changing set points, overrides, starting and stopping equipment, log in to field controllers when the server or PC is down. The BAS contractor shall be required to develop a training outline for this procedure. The training outline, including the lesson plans and course materials, shall be reviewed and approved by the engineer of record through the submittal process.

3.4 Sequence of Operations

A. Refer to the drawings for the Sequence of Operations.

ATTACHMENT I

DMZ SECURITY STANDARD

1.0 Purpose - The purpose of this document is to establish requirements that will better manage and secure all platforms within the Orange County Government Board of County Commissioners (OCGBCC). The DMZ is a secure environment with limited access to the OCGBCC internal network.

2.0 Scope - The scope of this document applies to all platforms located within the OCGBCC DMZ.

3.0 Policies

3.1 Activity - Any and all activity within and through the OCGBCC DMZ shall require direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.2 Web Servers - All internal ISS-ESU policies apply to the OCGBCC DMZ and are augmented by the DMZ Security Standard. The following differences are noted:

3.2.1 Microsoft Internet Information Server (IIS) version 5.0 or higher shall be the only platform within the OCGBCC DMZ to run as a Web or FTP server.
3.2.2 All platforms within the OCGBCC DMZ shall be patched immediately upon the release and testing by the ISS-ESU.

3.3 Administrative Rights - ISS-ESU shall be the only group with administrative rights to servers in the DMZ.

3.4 Production Servers - The OCGBCC DMZ shall host production servers only.

3.5 Remote Access - Remote Access to the OCGBCC DMZ shall be allowed only using Microsoft Terminal Services or Microsoft Remote Desktop protocols.

3.6 Traffic

3.6.1 Internet Activity - HTTP/HTTPS/FTP/SMTP/IMAPS are the only protocols allowed from the Internet into the DMZ.
3.6.2 Internal Activity - Traffic using the following protocols from the DMZ to the internal network shall not be allowed: Kerberos, NetBIOS, Microsoft-DS, Microsoft's Well Known Ports (88, 135, 137, 138, 139, 389, 445, 464, 530, 543, 544, 636, 749, 3389), LDAP, RPC, SMB, RDP, HTTP, HTTPS, DNS, JOLT.
3.6.3 Routing

3.6.3.1 All approved access from the DMZ to the internal network shall be routed through a proxy server residing in the DMZ.
3.6.3.2 The Enterprise DMZ proxy server shall only use firewall conduits to access approved resources within the OCGBCC network.

3.7 Data

3.7.1 Any data accessible within the OCGBCC DMZ or directly accessible from it should be encrypted.
3.7.2 Any data accessible within the OCGBCC DMZ or directly accessible from it meeting the following criteria shall be encrypted: Name, addresses, phone

numbers, email addresses, birthdates, federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information.

3.7.3 The OCGBCC DMZ shall not have access to data containing bank information.

3.7.4 The OCGBCC DMZ shall not have access to social security information.

3.7.5 The OCGBCC DMZ shall have read only access to live data, if such data is also used by applications residing in the internal OCGBCC network.

4.0 Guidelines

4.1 Should databases in policy 3.7.4 need to receive updates by the OCGBCC DMZ, the write operations should be made to a physically separate “staging” data repository. This separate data repository should contain only updates for the specific records being changed. An application server within the internal network should be used to apply the changes in the staging data repository to the live database.

4.2 The DMZ should access data repositories in the internal OCGBCC network using SQL database calls.

5.0 Enforcement - Any server found within the OCGBCC DMZ that does not met the above criteria shall be immediately disconnected from the OCGBCC DMZ. Any employee found to have violated this policy may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
Bank Information	Checking account numbers, credit card numbers, or any unique number from a bank institution.
HTTP	HyperText Transfer Protocol – The underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions web servers and browsers should take in response to various commands.
HTTPS	HyperText Transfer Protocol over Secure Socket Layer (SSL) – By convention, URLs that require an SSL connection start with https: instead of just http:.
FTP	File Transfer Protocol – The protocol for exchanging files over the Internet. FTP works in the same way as HTTP for transferring web pages from a server to a user's browser and SMTP for transferring electronic mail across the Internet in that, like these technologies, FTP uses the Internet's TCP/IP protocols to enable data transfer. FTP is most commonly used to download a file from a server using the Internet or to upload a file to a server.
SMTP	Simple Mail Transfer Protocol – A protocol for sending e-mail messages between servers. In addition, SMTP is generally used to send messages from a mail client to a mail server.
IMAPS	Internet Message Access Protocol – A protocol for retrieving e-mail messages. With IMAP4, you can search through your e-mail messages for keywords while the messages are still on mail server and, then, choose which messages to download to your machine.
LDAP	Lightweight Directory Access Protocol – A set of protocols for accessing information directories.

DNS	Domain Name System (or Service or Server) – An Internet service that translates domain names into IP addresses. Because domain names are alphabetic, they're easier to remember. The Internet however, is really based on numeric IP addresses. Every time you use a domain name, therefore, a DNS service must translate the name into the corresponding IP address.
SQL	Structured query language – SQL is a standardized query language for requesting information from a database.
DMZ	Demilitarized Zone – A computer term used for a protected network that sits between the Internet and the corporate network.
SSL	Secure Sockets Layer – A protocol for transmitting private documents via the Internet. SSL uses a cryptographic system that uses two keys to encrypt data - a public key known to everyone and a private or secret key known only to the recipient of the message.

ATTACHMENT II
ENCRYPTION AND CERTIFICATION AUTHORITIES

1.0 Purpose - The purpose of this document is to ensure that all Orange County Government Board of County Commissioner's (OCGBCC) sensitive data is secured by using strong encryption algorithms that have received substantial public review and have been proven to work effectively. Orange County Information Systems and Services Enterprise Security unit (ISS-ESU) provides access to a variety of Encryption Services and Enterprise Certification Authorities (CA).

2.0 Scope - This document applies to all data transmitted and stored within the OCGBCC information systems. It applies to all OCGBCC employees, consultants, and all other affiliated third parties operating within the OCGBCC information systems and networks.

3.0 Policies

3.1 Activity

3.1.1 Any and all activity within and through the OCGBCC information systems involving encryption shall require direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.1.2 The ISS-ESU shall approve the storage and transfer of any data containing personal information and/or residing in the DMZ.

3.2 Encryption Algorithms

3.2.1 One of the following standard encryption ciphers shall be used to encrypt data. The key length for these algorithms shall be no less than 128bits:

- Triple-DES (3DES)
- Rijndael (AES)
- RSA
- Blowfish
- Twofish
- CAST

3.2.2 PGP is an approved encryption standard provided that the PGP private key used to encrypt and /or sign data has been generated using a cipher meeting the requirements in section 3.2.1.

3.3 Data Hashing - The following standard data hashing algorithms shall be used to hash data. The key length for the algorithms shall be no less than 128bits.

- MD5
- SHA-1
- SHA-2

3.4 SSL Certificates - Web Server, SSH, IMAPS, SMTPS SSL certificates should have key lengths of no less than 128bits.

3.5 Sensitive Data - Any data containing sensitive information, including, but not limited to: name, addresses, phone numbers, email addresses, birthdates, federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information, should be encrypted when stored and during network transfers.

3.6 DMZ

3.6.1 Any and all activity within and through the OCGBCC DMZ shall require direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).
3.6.2 Any data accessible within the OCGBCC DMZ or directly accessible from it should be encrypted.
3.6.3 Any data accessible within the OCGBCC DMZ or directly accessible from it meeting the following criteria shall be encrypted: name, addresses, phone numbers, email addresses, birthdates, federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information.

3.7 Data Backups

3.7.1 Any backup of OCGBCC should be encrypted. Sensitive data as listed in 3.5 of this document shall be backed up using encryption algorithm standards found in 3.2.

3.8 Laptops and Removal Devices

3.8.1 All laptop hard drives should be encrypted.
3.8.2 Any sensitive data (see section 3.5 of this document) stored on laptops and removable devices shall be encrypted.
3.8.3 All individuals who work with sensitive data (see section 3.5 of this document) shall have their laptop hard drives encrypted.

4.0 Guidelines

4.1 SSL certificates issued to servers and applications used by internet users should be provided by commercial CA authorities (i.e. Verisign, Thawte) to avoid security warnings from being presented to the end users.
4.2 SSL certificates issued to servers and applications used by internal OCGBCC resources should be issued by OCGBCC's Certification Authority.

5.0 Enforcement - Any employee found to have violated these policies may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
Encryption	Transforming understandable data into a form that is incomprehensible and that looks like random noise.
Hashing	An algorithm that takes an entire message and, through process of shuffling, manipulating, and processing the bytes using logical operations, generates a small message digest of the data.
DMZ	De-Militarized Zone – A computer term used for a protected network that sits between the Internet and the corporate network.

Certification Authority (CA) In cryptography, a certificate authority or certification authority (CA) is an entity which issues digital certificates for use by other parties.

ATTACHMENT III
ANTIVIRUS STANDARDS

1.0 Purpose - The purpose of this document is to establish requirements which must be met by all computers connected to the Orange County Government Board of County Commissioners (OCGBCC) network to ensure effective virus detection and prevention.

2.0 Scope - This document applies to all OCGBCC computers running any version of the Microsoft Windows Operating Systems. This includes, but is not limited to, all servers, desktop computers, laptop computers, PC-based printers and appliances.

3.0 Policy

3.1 Virus Software – Servers
Trend Micro Server Protect or Trend Micro OfficeScan shall be installed and enabled on all OCGBCC computers running any server version of the Microsoft Windows Operating Systems.

3.2 Virus Software – Workstations
Trend Micro OfficeScan shall be installed and enabled on all OCGBCC computers running any non-server version of the Microsoft Windows Operating Systems.

3.3 Virus Software – Exchange Servers
Trend Micro ScanMail shall be installed and enabled on all OCGBCC computers running Microsoft Exchange Server.

3.4 Virus Software – Internet Mail
All incoming and outgoing internet email shall be scanned by Trend Micro Interscan Messaging Security Suite before being delivered.

3.5 Virus scanning
Antivirus software shall be running at all times on the computers on which it is installed. Real-time scanning of incoming and outgoing files shall be enabled at all times. Antivirus scans of servers shall be executed on a weekly basis in accordance with the schedules set in Trend Micro Server Protect. Antivirus scans of workstations shall be executed on a weekly basis in accordance with the schedules set in Trend Micro OfficeScan.

4.0 Guidelines

- When employees receive unwanted and unsolicited emails, they should be deleted and should avoid replying to the sender. These messages should not be forwarded.
- Employees should never open any files or macros attached to an email from an unknown, suspicious or untrustworthy source. These attachments should be deleted immediately. These messages should not be forwarded.
- Employees should never download files from unknown or suspicious sources.

5.0 Enforcement - Trend Micro's antivirus products are installed on all servers and workstations during the initial installation of the operating systems, and are continuously monitored to ensure they are running. Any employee or temporary found to have willfully stopped and/or paused these programs will be considered to be violating these policies and may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
Virus	A program or piece of code that is loaded onto your computer without your knowledge and runs against your wishes. Viruses can also replicate

themselves. All computer viruses are manmade. A simple virus that can make a copy of its self over and over again is relatively easy to produce. Even such a simple virus is dangerous because it will quickly use all available memory and bring the system to a halt. An even more dangerous type of virus is one capable of transmitting itself across networks and bypassing security systems.

ATTACHMENT IV

WEB SECURITY STANDARD

1.0 Purpose - The purpose of this document is to establish requirements that will better manage and secure all web server platforms within the Orange County Government Board of County Commissioners (OCGBCC).

2.0 Scope - The scope of this document applies to all web server platforms located within the OCGBCC.

3.0 Policies

3.1 Activity - Any and all web server installations, removals or modifications shall require the direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.2 Hardware

3.2.1 All hardware platforms operating as a web server shall abide by all standards, policies and guidelines of the OCGBCC Enterprise Systems unit.

3.2.2 All hardware platforms operating as a web server shall reside on server hardware. Any exception shall require a documented wavier by the Information Systems and Services Enterprise Security unit (ISS-ESU).

3.3 Software

3.3.1 Web Server Platforms

3.3.1.1 Microsoft - Microsoft's Internet Information Server (IIS) is the approved, supported web server platform for OCGBCC.

3.3.1.2 Apache Software Foundation - Apache Software Foundation's HTTP Server (Apache) is approved but is unsupported. Any production use of (Apache) shall include an appropriate support model that is approved by the ISS-ESU.

3.3.1.3 Other - Other web server platforms may qualify for use, but shall require an evaluation, approval and a documented wavier by the ISS-ESU.

3.3.2 Databases

3.3.2.1 Location - A database server shall not reside on the same hardware platform as a web server.

3.4 Security

3.4.1 General - All web servers shall comply with all other documented ISS-ESU standards to include, but not limited to: virus, patch and account management.

3.4.2 Account Management

3.4.2.1 Local Account Access - Only accounts with local administrator privileges shall be allowed to log on locally to a web server.

3.4.2.2 Process/Application Accounts - All web server processes and applications shall run only under a low privilege local account. Web server processes shall not run under an account with domain, power user or a local administrator privileges.

3.4.2.3 Web Server Anonymous Accounts - Web server anonymous accounts shall only have read and execute permissions to folders/files within the web server directories. Change and delete permissions to folders/files that are directly accessible via a web browser shall not be granted to web server anonymous accounts.

3.4.3 Permissions

3.4.3.1 Operating System Permissions - ISS-ESU shall secure the operating system's file/folder permissions and security policies of all web servers. These permissions are to be modified solely by ISS-ESU.

3.4.3.2 Vendor/Third Party Access - Local administrator privileges on web servers are for authorized personnel only. Access to vendors and any other third party shall be provided solely on a temporarily, case-by-case basis through ISS-ESU.

3.4.3.3 Developer Access - Developer access to web server content directories shall be available by WebDav or FrontPage server extensions only. Developers shall be granted "Author Pages" rights with the FrontPage Server Extensions

3.4.4 Java Server Engines - Java server engines are approved but are not supported. Any production use of a Java server engine shall include an appropriate support model that is approved by (ISS-ESU).

3.4.5 FTP - Web servers that also run an FTP server shall not map FTP directories to directories accessible via a web browser.

3.4.6 IIS Virtual Directories, Application Pools, Settings - Any and all creations, removals or modifications to IIS Settings, Virtual Directories, Application Directories, and Application Pools shall require the direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.4.7 Other

- Shares are not allowed on any directory accessible via web browser.
- Microsoft Windows web servers and any web application shall not be installed on the same drive as the host operating system.
- Executable files (.exe, .com, .bat, .dll, etc) shall not be placed into directories accessible via a web browser without the direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISSESU).

4.0 Guidelines - It is recommended that all web applications use the enterprise FTP and SMTP servers for all FTP/SMTP traffic.

5.0 Enforcement - Any web server not meeting the above criteria may be immediately disconnected from the OCGBCC network. Any employee found to have violated these policies may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
FTP	File Transfer Protocol – The protocol for exchanging files over the Internet. FTP works in the same way as HTTP for transferring Web pages from a server to a user's browser and SMTP for transferring electronic mail across the Internet in that, like these technologies, FTP uses the Internet's TCP/IP protocols to enable data transfer. FTP is most commonly used to download a file from a server using the Internet or to upload a file to a server.
WebDav	Web-based Distributed Authoring and Versioning – Extensions to HTTP that allows users to collaboratively edit and manage files on remote Web servers.
Front Page Extensions	A series of scripts that can be employed using Microsoft FrontPage, a visual HTML editor.
SMTP	Simple Mail Transfer Protocol – A protocol for sending e-mail messages between servers. In addition, SMTP is generally used to send messages from a mail client to a mail server.

ATTACHMENT V

STANDARDS SUMMARY

The following is a summary of key points in the Orange County Government Board of County Commissioners (OCGBCC) security standards. It is necessary for vendors to completely understand and follow these requirements in order for products or services to be considered for placement within the OCGBCC environment. Complete details about these standards can be found in the Orange County Government Standards and Guidelines packet.

WEB SERVERS

Web and Database Placement
A database server shall not reside on the same hardware platform as a web server.

Anonymous Accounts
Web server anonymous accounts shall only have read and execute permissions to folders/files within the web server directories. Change and delete permissions to folders/files that are directly accessible via a web browser shall not be granted to web server anonymous accounts.

DMZ

Web Server Platforms
Microsoft Internet Information Server (IIS) version 5.0 or higher shall be the only platform within the OCGBCC DMZ to run as a Web or FTP server.

Services and Protocols
Traffic using the following protocols from the OCGBCC DMZ to the internal network shall not be allowed: Kerberos, NetBIOS, Microsoft-DS, Microsoft's
Well Known Ports, LDAP, RPC, SMB, RDP, HTTP, HTTPS, DNS, JOLT.

Encrypted Data
Any data accessible within the OCGBCC DMZ or directly accessible from it meeting the following criteria shall be encrypted: Name, addresses, phone numbers, email addresses, birthdates, federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information. The OCGBCC DMZ shall not have access to data containing bank information. The OCGBCC DMZ shall not have access to social security information.

Data Access
The OCGBCC DMZ shall have read only access to live data, if such data is also used by applications residing in the internal OCGBCC network.

ANTIVIRUS

Virus scanning
Antivirus software shall be running at all times on the computers on which it is installed.

MICROSOFT SECURITY PATCHES

Patch Installation
MS Security patches may be applied immediately upon release by Microsoft. All vendors must support their applications in this environment.

ATTACHMENT VI

DESKTOP COMPUTING STANDARDS

AUTHORIZED PRODUCTS

1: HARDWARE

Dell Desktop minitower and small form factor (SFF) PC

- Dell GX960
  - Energy Smart system enabled
  - Intel Core 2 Duo processor or better
  - Minimum 2 Gb of Memory
  - Maximum 4 Gb Memory
  - USB Keyboard and Mouse
  - 160 GB SATA Hard drive
  - DVD+/- RW
  - 4 Year Basic Limited Warranty and 4 year Onsite Service
  - Intel vPro enabled

Dell Laptop

- Dell Latitude e6510
  - Intel Core 2 Duo processor or better
  - Minimum 2 Gb of Memory
  - Maximum 4 Gb of memory
  - CD-RW/DVD
  - 80 GB Hard Drive
  - 4 Year Limited Warranty and 4 year Onsite Service
  - Intel vPro enabled
- Dell Latitude e4300
  - Intel Centrino Core 2 Duo processor
  - Minimum 2 Gb memory
  - Maximum 4 Gb memory
  - CD-RW/DVD
  - 80 Gb Hard Drive
  - 4 Year Limited Warranty
  - Intel vPro enabled
    - *All PCs with 4yr limited warranty*

- PDAs- Blackberry Devices Only

2: OPERATING SYSTEMS and PROTOCOLS

Desktop/Laptop

- Microsoft Windows 7 Professional with IE 8 (for new PCs)
- Microsoft Windows XP Service Pack 3 (for existing PCs)
- Internet Explorer 8.0- *IE8 is current County Standard included with Windows 7. IE7 is available for backwards compatibility.*
  - *Application software may specifically require a certain Internet Explorer version. Contact ISS for assistance as needed.* ServiceCenter@ocfl.net
- Microsoft Office 2003 or greater (Standard or Professional Suite)

Portable Devices

- Blackberry OS

Network Connectivity

- Cisco Wireless Access Points, Cisco 802.11 LAN Card
- TCP/IP
- Sprint Wireless AirCard

3: CLIENT DATABASES

Desktop/Workstations Only, Single User Only

- Microsoft Access (user databases not supported)
- Oracle Client
- SQL Server Client

4: PERIPHERALS and ACCESSORIES

- HP LaserJet series
  - Black and White LaserJet
    - P1606dn < 4 users
    - P3015dn (supports secure printing – PIN)
    - P4015dn 8+ users (supports secure printing – PIN)
  - Color LaserJet
    - CP2025dn
    - CP4525dn 7+ users (supports secure printing – PIN)
    - 5550dn 15+ users (supports secure printing – PIN)
- *Desktop Copier and combo unit purchases directly connected to the PC must be reviewed and approved by ISS. Contact ServiceCenter@ocfl.net for more information and assistance.*

UNSUPPORTED PRODUCTS

1: HARDWARE

- Pre-Pentium class desktop systems
- Non-Dell PCs
- Non-Blackberry Smartphones

2: OPERATING SYSTEMS AND PROTOCOLS

- Microsoft Windows 2000
- Microsoft Windows NT 4.0
- Microsoft Windows 3.x, Windows 95 and 98
- MAC OS

3: CLIENT DATABASES

- Dbase
- RBASE
- Paradox
- FOXPRO

4: DESKTOP APPLICATIONS

Desktop/Workstation

- MS Office platforms prior to Office 2000
- ProComm
- Microsoft Internet Explorer, 4.x, 5.x
- McAfee Viruscan **Trend Micro is OCGOV standard*
- WordPerfect
- Quattro
- Hotmetal
- Freelance

- Harvard Graphics
- Lotus Suite
- Netscape, Opera, Firefox Browsers
- Rumba
- LAN Workplace
- Exceed
- Visio 3.x and older
- SHL Vision & Vision Express, WIN9x/WINNT/UNIX
- McAfee Remote Desktop32
- Reflection version 9 or lower
- PC Anywhere

5: PERIPHERALS AND ACCESSORIES

- HP LaserJet Series 4 and older printers
- Inkjet printers

PROHIBITED PRODUCTS

1: HARDWARE

- Personal (non-County) PCs
- Any network (voice or data) device not operated, administered or expressly approved by Orange County ISS.
- Any internet access device not operated, administered or expressly approved by Orange County ISS.

2: OPERATING SYSTEM AND PROTOCOLS

- Windows 9x
- Windows Vista
- 64 bit operating systems

Network Protocols

- NETBUI
- AppleTalk
- Token Ring
- Any network (voice or data) software or service not operated, administered or expressly approved by Orange County ISS.
- Any internet access service not operated, administered or expressly approved by Orange County ISS.

3: APPLICATIONS

- Any Alpha/Beta Software not operated, administered or expressly approved by Orange County ISS
- Anti-virus products other than Trend Micro
- Personal firewall products
- Network scanning tools
- Remote access software other than ISS authorized VPN
- User installed screen savers
- Games
- 3rd Party Desktops
- Disk Compression
- Non-Static BITMAP Backgrounds or screen savers
- iTunes (or other content sharing applications)
- P2P software

4: PERIPHERALS AND ACCESSORIES

- Portable music devices
- Personal (non-County) mass storage devices (hard drives, thumb drives, etc)
- Webcams

END OF SECTION 15900

SECTION 15910
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including Division 1 Specification section apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Dampers:

a. Low pressure manual dampers.
b. Control dampers.

2. Turning vanes.
3. Duct hardware.
4. Duct access doors.
5. Flexible connections.

C. Refer to other Division 15 sections for testing, adjusting and balancing of ductwork accessories; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction
Standards, Metal and Flexible".
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems" pertaining to installation of ductwork accessories.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction and installation instructions.

B. Shop Drawings: Submit manufacturers assembly type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts list for each type of duct accessory. Include this data, product data, and shop drawing in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS:

2.01 DAMPERS:

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

2.02 TURNING VANES:

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

B. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set at 2" o.c., and set into side strips suitable for mounting in ductwork.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusions with perforated faces and fiberglass fill.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering turning vanes which may be incorporated in the work include, but are not limited to the following:

1. Aero Dyne Co.
2. Airsan Corp.
3. Anempstat Products Div.; Dynamics Corp. of American
4. Barber -Coleman Co.
5. Duro Dyne Corp.
6. Environmental Elements Corp.; Subs. Koppers Co., Inc.
7. Hart & Cooley Mfg. Co.
8. Register & Grille Mfg. Co., Inc.
9. Souther, Inc.

2.03 DUCT HARDWARE:

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to, the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.
3. Or approved equal.

2.04 DUCT ACCESS DOORS:

A. General: Provide where indicated, duct access doors of size indicated.

B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle type latch for doors 12" high and smaller, 2 handle type latches for larger doors.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access doors which may be incorporated in the work include, but are not limited to the following:

1. Air Balance, Inc.
2. Duro Dyne Corp.
3. Register & Grille Mfg. Co., Inc.
4. Ruskin Mfg. Co.
5. Ventfabrics, Inc.
6. Zurn Industries, Inc.; Air Systems Div.

2.05 FLEXIBLE CONNECTIONS:

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene coated flameproof fabric crimped into duct flanges for attachment to duct equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering flexible connections which may be incorporated in the work include, but are not limited to, the following:

1. American/Elgen Co.; Energy Div.
2. Duro Dyne Corp.
3. Flexaust (The) Co.
4. Ventfabrics, Inc.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES:

A. Install ductwork accessories in accordance with manufacturer's installation instruction, with applicable portions of details of construction as shown in SMACNA Standards, and in accordance with recognized industry practices to ensure that products serve intended functions.

B. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL:

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.04 ADJUSTING AND CLEANING:

A. Adjusting ductwork accessories for proper settings.

1. Label access doors in accordance with Division 15 section "Mechanical Identification".
2. Final positioning of manual dampers is specified in Division 15 section 'Testing, Adjusting and Balancing".

B. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch up paint.

3.05 EXTRA STOCK:

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 15910

SECTION 15932
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 DESCRIPTION OF WORK:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of air outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall Registers and grilles.

C. Refer to other Division 15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division 15 sections for balancing of air outlets and inlets; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.04 CODES AND STANDARDS:

A. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

B. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

C. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

D. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.

E. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating System".

1.05 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size and accessories furnished.

2. Data sheet for each type of air outlet and inlet and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Samples: Submit 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 CEILING AIR DIFFUSERS:

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffuser where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have as minimum, temperature and velocity traverses, throw and drop, and noise criteria rating for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Diffuser Faces:

a. Panel (PL): Square or rectangular aluminum housing extended to form panel to fit in ceiling system module, core of square or rectangular concentric louvers, round duct connection.
b. Linear (R): Extruded aluminum continuous slot, single or multiple.

2. Diffuser Mountings:

a. Flush (FL): Diffuser housing above ceiling surface with flush perimeter

flange and gasket to seal against ceiling.

b. Lay-In (L-I): Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

3. Diffuser Patterns:

a. Fixed (FX): Fixed position core with concentric rings or louvers for radial airflow around entire perimeter of diffuser.

4. Adjustable (ADJ): Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical air flow.

5. All diffusers shall be constructed of aluminum. Steel diffusers or aluminized steel diffusers are not allowable on this project.

E. Diffuser Dampers:

1. Opposed Blade (OBD): Adjustable opposed blade damper assembly, key operated from face of diffuser.

F. Diffuser Accessories:

1. Operating Keys (OP-KY): Tools designed to fit through diffuser face and operate volume control device and/or pattern adjustment.

G. Diffuser Finishes:

1. Aluminum Enamel (A-E): Air dried aluminum enamel prime finish.

H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to the following:

1. Titus Products Div.; Philips Industries, Inc.
2. Price Companies
3. Metal Air Industries, Inc.

2.02 WALL OR CEILING REGISTERS AND GRILLES:

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall or ceiling systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register

and grille.

D. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

E. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register and Grille Materials:

a. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades. All registers and grilles shall be constructed of aluminum. Steel registers and grilles or aluminized steel registers and grilles are not allowable on this project.

2. Register and Grille Faces:

a. ½" x ½" x ½" aluminum egg crate pattern core.
b. Horizontal Straight Blades (H-S): Horizontal blades, individually adjustable, at manufacturer's standard spacing.

3. Register and Grille Dampers:

a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of register.

4. Register and Grille Accessories:

a. Operating Keys (OP-KY): Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustment.
b. Filters: 1" frame for mounting 30% efficiency filter media. Provide hinged face grille for filter access.

5. Register and Grille Finishes:

a. Aluminum Enamel (A-E): Air-dried aluminum enamel prime finish.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering registers and grilles which may be incorporated in the work include, but are not limited to the following:

1. Titus Products Div.; Philips Industries, Inc.
2. Price Companies
3. Metal Air Industries, Inc.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans" or as shown on HVAC drawings. Unless otherwise indicated, locate unite in center of acoustical ceiling modules.

3.03 SPARE PARTS:

A. Furnish to owner, with receipt, operating keys for each type of air outlet and inlet that require them.

END OF SECTION 15932

SECTION 15990
TESTING, ADJUSTING AND BALANCING

PART 1 – GENERAL

1.01 SUMMARY

A. This section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Reporting results of the activities and procedures specified in this section.

1.02 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person’s skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting

the testing, adjusting, and balancing procedures.

M. AABC: Associated Air Balance Council.

N. AMCA: Air Movement and Control Association.

O. NEBB: National Environmental Balancing Bureau.

P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.03 SUBMITTALS

A. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

B. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

C. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

D. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.04 QUALITY ASSURANCE

A. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
   1. Agenda Items: Include at least the following:
      a. Submittal distribution requirements.
      b. Contract Documents examination report.
      c. Testing, adjusting, and balancing plan.
      d. Work schedule and Project site access requirements.
      e. Coordination and cooperation of trades and subcontractors.
      f. Coordination of documentation and communication flow.

B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

   1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
   2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

C. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

D. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently

if required by the instrument manufacturer.

1.05 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.06 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 testing, adjusting, and balancing activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.07 WARRANTY

A. General Warranty: The national project performance guarantee 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.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
2. 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 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 the 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.

D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

E. Examine system and equipment test reports.

F. Examine HVAC system and equipment installations to verifyh 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 their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

H. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operations.

I. Examine strainers for clean screens and proper perforations.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate 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.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-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 design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

M. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 PREPARATION

A. Prepare a testing, adjusting, and balancing 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. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so design conditions for system operations can be met.

3.03 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in 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 the insulation Specifications for this project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.04 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

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. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. Check the airflow patterns from the outside-air louvers and dampers and the return and exhaust air dampers, through the supply fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling unit components.

3.05 CONSTANT VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply, return, and exhaust air systems.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the 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 air-handling unit component.

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. Adjust fan speed higher or lower than design with the approval of the Architect. 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design 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 submains 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 submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer’s written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the

dampers at the air terminals.

1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 FUNDAMENTAL 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.

3.07 MOTORS

A. Motors, ½ 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 if high-efficiency motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.08 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report 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 2 successive 8-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.

3.09 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. Verify operation of limiting controllers (i.e., high and low temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify 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. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.14 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.15 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in “Examination” Article above, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

A. General: Typewritten, or computer printout in letter quality font, on standard bond paper, in 3-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 the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the 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 approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.

2. Name and address of testing, adjusting, and balancing Agent.
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 testing, adjusting and balancing Agent who certifies the report.
10. Summary of contents, including the following:

    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. 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 with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturers serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.

2. Motor Data: Include the following:

    a. Make and frame type size.

b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm) and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat coil static-pressure differential in inches wg (Pa).
g. Cooling coil static-pressure differential in inches wg (Pa).
h. Heating coil static-pressure differential in inches wg (Pa).
i. Outside airflow in cfm (L/s).
j. Outside air damper position.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following:

1. Coil Data: Include the following:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm o.c.).
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outside air, wet and dry bulb temperatures in deg. F (deg C).
e. Return air, wet and dry bulb temperatures in deg. F. (deg. C).
f. Entering air, wet and dry bulb temperatures in deg. F (deg. C).
g. Leaving air, wet and dry bulb temperatures in deg. F (deg C).
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig (kPa).
j. Refrigerant suction temperature in deg. F (deg. C).

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:

a. System identification.
b. Location.
c. Make and type.

d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

2. Motor Data: Include the following:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

I. Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross section and record the following:

1. Report Data: Include the following:

a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg. C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Design airflow rate in cfm (L/s).
h. Design velocity in fpm (m/s).
i. Actual airflow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

J. Air Terminal Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal device make.
f. Air-terminal device number from system diagram.
g. Air terminal device type and model number.
h. Air terminal device size.
i. Air terminal device effective area in sq. ft. (sq. m).

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary airflow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final airflow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg. F (deg. C).

K. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.17 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15990

SECTION 16010
GENERAL PROVISIONS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work covered under this Division of the Specifications is intended to include the furnishing of all materials, equipment and labor necessary for or reasonably incidental to, the installation of a complete and fully operative electrical system as indicated on the drawings and specified in this section.

1. The work shall consist generally of, but is not limited to, the following major items:

a. Conduit and Wiring.
b. Disconnect Switches
c. Panelboards.
d. Temporary lighting and power.
e. Lighting
f. Fire Alarm System Components

B. Work Not Included:

The following work is not included in this Section:

1. Temperature controls and related wiring.

C. Fees and Permits:

1. Obtain all permits required for his/her work and include the cost of same in his/her bid.
2. The contractor shall also include in his/her bid the cost for the power company service.

D. Certificate of Inspection:

The Contractor shall, at his/her expense, have a final inspection made of the complete electrical installation and shall deliver a certificate of approval of the complete work to the Owner before receiving his/her final payment.

1.02 SUBMITTALS

A. Submit properly identified manufacturer's literature and technical data before commencing work.

B. Shop Drawings:

1. Submit copies of manufacturer's drawing of lighting fixtures, main distribution boards, safety switches, panelboards, conduit, wire, wiring devices, fire alarm and voice evacuation system, lighting control system and any other special electrical equipment to be installed, and shall receive the Project Architect's acceptance before ordering the same for installation.
2. All shop drawings shall be submitted in 3-ring binders with each specification section indicated with tabs.
3. If shop drawings are submitted intermittingly and not in 3-ring binders, they will not be reviewed and will be returned to contractor for proper submittal.

4. Accepted Equivalent:

   Any manufacturer and/or catalog number listed on the drawings or in the Project Manual shall be construed to mean "or accepted equivalent".

   a. Any substitutions to be considered as "Accepted Equivalent" shall be submitted with both the cut of the proposed substitution and a cut of the specified equipment to the Project Architect in writing, and returned to the Contractor at least ten days prior to bid opening.

   b. No substitutions shall be submitted or will be allowed after the contract has been awarded.

1.03 QUALITY ASSURANCE

A. Qualifications of manufacturers, materials and equipment:

1. Material and equipment, except as herein otherwise noted, shall be new and conform to standards specified herein defined to include conduits, cable, wiring materials and devices, panelboards, and the like.
2. Materials and equipment shall be of an approved design.

   a. Similar materials shall be of one manufacturer wherever possible.

3. Equipment offered under these Specifications shall be limited to products regularly produced and recommended for service ratings in accordance with manufacturer's catalogs, engineering data, or other comprehensive literature made available to the public and in effect at the time of opening of bids.
4. Install equipment in strict accordance with manufacturer's instruction for type, capacity and suitability of each piece of equipment used.

   a. Obtain these instructions which shall be considered a part of these Specifications.

B. Qualifications of supervisor, workmanship and installers:

1. The Contractor shall have a Master Electrician constantly supervising the work covered by these Specifications, and so far as possible shall keep the same foreman on the job from start to finish.

   a. The workmanship of the entire job shall be first class in every way and only experienced and competent workers shall be employed for the work.

1.04 CODES AND REGULATIONS

A. Work shall be installed in accordance with the regulations and requirements of the National Electrical Code NFPA No. 70; Life Safety Code NFPA No. 101, Standard Building Code as well as all rules, state and local codes regulations and requirements of the telephone and power companies.

B. Where conduits and/or cables penetrate fire rated walls, ceilings or floors, the penetrations shall be firestopped in accordance with chapter 10, section 1001 of the standard building code.

1. The above shall be ascertained and fully coordinated before the installation of any material, equipment, and the like, and any discrepancy shall be immediately brought

to the attention of the Project Architect in writing, and the Contractor shall receive a disposition of same before proceeding with the work.

2. Furnish, without additional charge, any additional materials and labor that may be required for compliance with these codes, law, rules, regulations or requirements even though the work is not mentioned in these Specifications or shown on the Drawings.

C. Material and equipment shall bear the label of approval of the National Board of Fire Underwriters Laboratory.

1.05 INSPECTIONS

A. All work and materials covered by these Specifications and shown on the Drawings shall be subject to inspection at any and all times by representatives of the Project Architect or Owner.

B. If the Project Architect or Owner's inspectors find that any material does not conform with these Specifications, the Contractor shall within three days after being notified by the Project Architect or Owner, remove the material from the premises, and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.

C. Tests:

The Owner reserves the right to inspect and test any portion of the equipment during the progress of this work.

1. The Contractor shall test the entire system in the presence of the Owner or the Owner's representative when the work is completed to insure that all portions are free from short circuits and grounds.
2. All equipment, material and labor necessary to conduct the above tests shall be furnished at the Electrical Contractor's expense.

1.06 PRODUCT HANDLING

A. Protection of Equipment, Material and Work: The Contractor shall effectively protect, at his/her own expense, much of his/her work, materials or equipment, as is liable to injury during the construction period.

1. Openings into any part of the conduit system as well as associated fixtures, equipment, and the like, both before and after being set in place, shall be securely covered or otherwise protected to prevent obstruction of the conduit, or injury due to carelessness or maliciously dropped tools or materials, grit, dirt, or any foreign matter.

a. The Contractor will be held responsible for all damage done until his/her work is fully and finally accepted.

2. Cover conduit ends with capped bushings.

B. Repair of damage: In the event of damage, repair shall be made immediately, to the Project Architect's satisfaction and at no additional cost to the Owner.

C. Special Handling: Special care, storage and handling of new and existing lighting fixtures shall be taken to minimize breakage of lenses and lamps shipped with fixtures.

1. Immediately replace any breakage with the exact lens or lamp. Used material is not an acceptable replacement.

1.07 JOB CONDITIONS

A. Accuracy of Data: The data given herein and on the Drawings are as exact as could be secured.

1. The Specifications and Drawings are for the assistance and guidance of the Contractor.
2. Exact locations, distances, levels, and the like, will be governed by the building field conditions and the Contractor shall use the data contained herein with this understanding.

B. Drawings:

1. The electrical drawings are diagrammatic, but shall be followed as closely as actual construction and work of other Contractors will permit.
2. Deviations from drawings required to make the work of the Contractor conform to the building as constructed, and to the work of other contractors, shall be made by the Contractor at his/her expense.
3. The branch circuit wiring and arrangements of home runs have been worked out for maximum economy consistent with adequate sizing for voltage drop, and the like. Maximum number of single phase branch circuits per home-run conduit shall be (3) three.
4. Install the wiring circuits arranged exactly as shown on the drawings.
5. It is not the intention of the drawings or specifications to indicate each piece of conduit, fittings, and the like, required for the satisfactory operation of the installation and whereby one is indicated, but not specified, or specified but not indicated on the drawings, it shall be considered to be both specified and indicated.

C. Measurements:

1. Review the Contract Drawings and Specifications and visit the job site to ascertain all conditions, including conduit runs, interfacing, interferences, conflicts, discrepancies, etc., and shall report the same to the Engineer for clarification ten days prior to submittal of the bid.
2. Failure to comply with this condition shall constitute an acceptance of the conditions and any necessary changes will be at Contractor's expense.
3. The Contractor shall make all measurements necessary for his/her work and shall assume responsibility for their accuracy.
4. Install necessary pull boxes, manholes and junction boxes as may be required to accomplish the distribution system indicated on the riser diagram.

D. Structural difficulties: Should any structural difficulties prevent the setting of cabinets, running conductors, and the like, at points indicated on the drawings, the necessary deviation therefrom, as determined by the Project Architect will be permitted and shall be made without additional cost.

E. Cooperation with Other Contractors

1. The Contractor shall arrange all parts of his/her work in proper relation to the work of other contractors.
2. Where interferences occur, the Contractor shall, before installing the work involved, consult with the Project Architect as to exact location and level of his/her work.

3. The Project Architect's decision will be final.
4. The Contractor shall be responsible for arrangement of his/her work and equipment and maintenance of proper headroom under this work.
5. Should work installed by him/her require any modifications to avoid interference with the other work, such changes shall be made without additional cost.
6. The Architect's decision as to determination or allocation or responsibility where conditions require changing of work, shall be final.
7. If any work of the Contractor is dependent for its proper execution on contiguous work, examine such work and report in writing any defect thereon or conditions rendering it unsuitable.
8. The beginning of work, without making such report, shall constitute an acceptance of such work, and any defects in his/her own work consequently shall be his/her responsibility.

1.08 TEMPORARY SERVICE

A. Temporary power: Provide, maintain and remove after construction is completed, a temporary lighting, receptacle and power system in accordance with the progress requirements and schedule.

1. Lighting: An average of one hundred watt bulb every 200 square feet and a duplex receptacle every 500 square feet.
2. Receptacles: Ground fault interrupter type.
3. Three Phase Power for Testing Motors: Provided at all necessary points.

B. Temporary telephone service: Each respective trade shall be responsible for providing and maintaining their telephone services.

1.09 CLEANING

A. Keep the premises free of debris and unusable materials resulting from the work, and immediately upon completion of the work remove such debris and material from the site and leave floors broom clean in areas affected by the work.

1.10 GUARANTEE

A. Leave the electrical installation in proper working order and without charge, replace any work or materials which develop defects within one year from date of final inspection and acceptance by the Owner.

1.11 DEFINITIONS

A. In this Division "provide" is used as a term contraction meaning "to furnish, install and connect up completely in the specified or in an approved manner for the item and/or material described".

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION Not Used

END OF SECTION 16010

SECTION 16060
MINOR ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner Architect/Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with Utility Company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Disable system only to make switchovers and connections. Obtain permission from Owner/Architect/Engineer at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Disable system only to make switchovers and connections. Notify Owner Architect/Engineer and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Disable system only to make switchovers and connections. Notify Owner, Architect/Engineer and Telephone Utility Company at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

G. Existing Intercom System: Disable system only to make switchovers and connections. Obtain permission from Notify the Owner and Architect/Engineer at least 24 hours before

partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

H. Existing Data System: Disable system only to make switchovers and connections. Obtain permission from Notify the Owner and Architect/Engineer at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

H. Repair adjacent construction and finishes damaged during demolition and extension work.

I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.05 INSTALLATION

A. Install relocated materials and equipment under the provisions found in other sections of the specifications.

END OF SECTION 16060

SECTION 16110
RACEWAYS

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 DESCRIPTION OF WORK

A. Extent of raceway work is indicated by drawings and schedules.

B. Types of raceway specified in this section include the following:

1. Rigid metal conduit.
2. Intermediate metal conduit.
3. PVC coated metal conduit.
4. Flexible metal conduit.
5. Liquid tight flexible metal conduit.
6. Electrical metallic tubing (EMT).
7. Rigid nonmetallic conduit (PVC).
8. Surface Metal Raceway

C. Electrical nonmetallic tubing (ENT) is not acceptable.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Installer shall have at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

1.04 CODES AND STANDARDS

A. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.

B. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL listed and labeled.

C. NEC Compliance: Comply with applicable requirements of NFPA-70 pertaining to construction and installation of raceway systems.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions for each type of raceway system required. Include data substantiating that materials comply with requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide raceways and fittings, of types, sizes, and weights (wall thickness) for each installation indicated. Where types are not indicated, provide proper selection determined by installer to fulfill installation requirements and comply with applicable portions of NFPA-70 for raceways.

B. All conduits and fittings shall bear the U.L. label or seal.

C. Minimum trade size raceway shall be 1/2".

D. Where conduit size is not indicated on plan, size conduit in accordance with NFPA-70, except no conduit smaller than 3/4" shall be embedded in concrete or masonry or installed below grade.

2.02 RIGID METAL CONDUIT

A. Provide zinc coated or hot-dipped galvanized type rigid steel conduit conforming to Federal Specification WW-C-581, ANSI C80 and U.L.6.

B. Provide threaded type zinc plated or hot-dipped galvanized malleable iron or steel fittings conforming to Federal Specification W-F-408.

1. Use Type 1 fittings for raintight connections.
2. Use Type 2 fittings for concrete tight connections.
3. Use Type 3 fittings for other miscellaneous conditions.

C. Provide insulated bushings on all rigid steel conduits terminating in panels, boxes, wire gutters, or cabinets.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.03 INTERMEDIATE METAL CONDUIT

A. Provide zinc coated or hot-dipped galvanized type intermediate steel conduit conforming to Federal Specification WW-C-581 and U.L. 1242.

B. Provide threaded type zinc plated or hot-dipped galvanized, malleable iron or steel fittings.

C. Provide insulated bushings on all intermediate steel conduits terminating in panels, boxes, wire gutters, or cabinets.

D. Provide zinc plated or hot-dipped galvanized malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.04 PVC COATED METAL CONDUIT

A. Provide hot-dipped galvanized type rigid steel conduit with external PVC coating (20 mil. thick) conforming to Federal Specification WW-C-581, ANSI C80.1, U.L. 6, and NEMA RN1.

B. Provide threaded type zinc plated or hot-dipped galvanized, malleable iron or steel fittings with external PVC coating (20 mil. thick).

C. Provide insulated bushings on all PVC coated metal conduits terminating in panels, boxes, wire gutters, or cabinets.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.05 FLEXIBLE METAL CONDUIT

A. Provide flexible steel conduit formed from continuous length of spirally wound, interlocked zinc coated strip steel and conforming to Federal Specification WW-C-56 and U.L. 1.

B. Provide threadless hinged clamp type fittings for use with flexible steel conduit.

1. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, male threaded end provided with locknut, and insulated throat connections for terminations.
2. 45 deg. Or 90 deg. Angle Terminal Connectors: Two piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, male threaded end provided with locknut, and insulated throat connections for terminations.

2.06 LIQUID TIGHT FLEXIBLE METAL CONDUIT

A. Provide liquid tight flexible metal conduit constructed from a continuous, flexible, interlocked, single strip and double wrapped steel, galvanized inside and outside, coated with liquid tight jacket of flexible polyvinyl chloride (PVC), and conforming to U.L. 360.

B. Provide compression type cadmium plated, malleable iron fittings with neoprene gasket sealing rings, and complying with ANSI/NEMA FB1 and U.L. 5148.

C. Provide insulated throat connectors for terminations.

2.07 ELECTRICAL METALLIC TUBING

A. Provide galvanized steel tubing conforming to Federal Specification WW-C-563, ANSI C80.3, and U.L. 797.

B. Provide set screw or compression type zinc plated or hot-dipped galvanized, malleable iron or steel fittings conforming to Federal Specification W-F-408.

1. Use Type 1 fittings for raintight connections.
2. Use Type 2 fittings for concrete tight connections.
3. Use Type 3 fittings for miscellaneous connections.

C. Provide insulated throat connectors for terminations.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.08 RIGID NONMETALLIC CONDUIT

A. Provide rigid nonmetallic conduit conforming to Federal Specification WC1094A, NEMA TC-2 and U.L. 651.

1. Heavy Wall Conduit: Schedule 40, 90C, U.L. rated, constructed of polyvinyl chloride, for direct burial or normal above ground use.

2. Extra Heavy Wall Conduit: Schedule 80, U.L. rated, constructed of polyvinyl chloride, for direct burial or above ground use.

B. Provide fittings which mate and match to conduit type and material and comply with NEMA TC-3 and U.L. 514.

C. Provide threaded terminal adapters on all rigid nonmetallic conduits terminating in panels, boxes, wire gutters, or cabinets. Adapters to have male threads on one end, socket end on other.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.09 EXPANSION FITTINGS

A. Expansion fittings shall be:

1. U.L. Listed, hot-dipped galvanized inside and outside, providing a 4" expansion chamber, external braided grounding and bonding jumper with approved clamps and U.L. listed for the application.
2. U.L. Listed, polyvinyl chloride, providing a 6" expansion chamber, and meet requirements for rigid nonmetallic conduit.

2.10 Available Conduit Bodies Manufacturers: Subject to compliance with requirements, manufacturers offering conduit bodies which may be incorporated in the work include the following:

A. Appleton Electric; Div. of Emerson Electric Co.
B. Arrow Hart Div.; Crouse Hinds Co.
C. Bell Electric Div.; Square D Co.
D. Killark Electric Mfg. Co.
E. O-Z/Gedney Div.; General Signal Co.
F. Spring City Electrical Mfg. Co.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NFPA-70, and NECA's "Standards of Installation".

B. Coordinate with other work including wires/cables, boxes and panel work, as necessary to interface installation of electrical raceways and components with other work.

C. Install conduits concealed in either wall, slabs, or above hung ceilings. Where conduits cannot be concealed, route conduits exposed on wall or ceiling.

D. Mechanically fasten together metal conduits, enclosures and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.

E. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

F. Install miscellaneous fittings such as reducers, chase nipples, 3 piece unions, split couplings,

and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200' linear run or wherever structural expansion joints are crossed.

G. Use roughing-in dimensions of electrically operated unit furnished by supplier. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.

H. Provide nylon pull cord in all empty conduits. Test conduits required to be installed, but left empty, test with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.

3.02 CONDUIT INSTALLATION

A. Use electrical metal tubing conduit in mechanical equipment rooms, electrical equipment rooms and for main feeder circuits.

B. Use EMT in offices, corridors and toilets for branch circuits.

C. Use flexible metal conduit in movable partitions and from outlet boxes to recessed lighting fixtures, and final 24" of connections to motors, or control items subject to movement or vibration and in cells of precast concrete panels.

D. Use liquid tight flexible metal conduit where subject to one or more of the following conditions:

1. Exterior location.
2. Moist or humid atmosphere where condensate can be expected to accumulate.
3. Corrosive atmosphere.
4. Subjected to water spray or dripping oil, water or grease.

E. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.

F. Field bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

G. Size conduits to meet NFPA-70, except no conduit smaller than 3/4" shall be embedded in concrete or masonry or install below grade.

H. Where penetrating grade or floor in an exposed location from underground or in slab, a black mastic coated or PVC coated galvanized rigid steel conduit shall be used.

I. Provide rigid 90 degree elbows when turning conduit up in slab or turning conduit up above grade.

J. Fasten conduit terminations in sheet metal enclosures by 2 metal locknuts, and terminate with bushing. Install locknuts inside and outside enclosure.

K. Conduits are not to cross pipe shafts, or ventilating duct openings.

L. Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

M Support riser conduit at each floor level with clamp hangers.

N. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3 piece union or split coupling.

O. Complete installation of electrical raceways before starting installation of cables/wires within raceway.

3.03 CONCEALED CONDUITS

A. Raceways installed in floors or outside shall be PVC Schedule 40.

B. Where penetrating a floor in a location concealed in a block wall and acceptable by applicable codes, PVC Schedule 40 rigid non-metallic raceways may be used up to the first outlet box, provided outlet height above finished floor does not exceed 48".

3.04 EXPOSED CONDUITS

A. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.

B. Install exposed conduit work as not to interfere with ceiling insets, lights, or ventilation ducts or outlets.

C. Support exposed conduits by use of hangers or clamps. Support conduits on each side of bends and on spacing not to exceed following: up to 1": 6'-0"; 1-1/4" and over: 8'-0".

D. Exposed conduits shall be painted to match the color of walls, ceilings, canopies, etc., as indicated on drawings, or as directed by the Architect.

3.05 NON-METALLIC CONDUITS

A. Make solvent cemented joints in accordance with recommendations of manufacturer.

B. Install PVC conduits in accordance with NFPA-70 and in compliance with local utility practices.

3.06 CONDUIT FITTINGS

A. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.

B. Insulated bushing for terminating conduits smaller than 1-1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.

C. Insulated bushings for terminating conduits 1-1/4" and larger are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.

D. Bushing off or insulated type to have screw type grounding terminal.

E. Miscellaneous fittings such as reducers, chase nipples, 3 piece unions, split couplings, and plugs to be specifically designed for their particular application.

END OF SECTION 16110

SECTION 16120
WIRES AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DESCRIPTION OF WORK

A. Extent of electrical wires and cable work is indicated by drawings and schedules.

B. Types of electrical wire, cable, and connectors specified in this section include the following:

1. Copper conductors.
2. Service entrance cable.
3. Split-bolt connectors.
4. Wirenut connectors.

C. Applications of electrical wire, cable, and connectors required for project are as follows:

1. For power distribution circuits.
2. For lighting circuits.
3. For appliance and equipment circuits.
4. For motor branch circuits.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects similar to that required for this project.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements as applicable to construction, installation and color-coding of electrical wires and cables.

D. UL Compliance: Comply with applicable requirements of UL Std. 83, "Thermoplastic Insulated Wires and Cables" and Std. 486A, "Wire Connectors and Soldering for Use With Copper Conductors".

E. UL Compliance: Provide wiring/cabling and connector products which are UL listed and labeled.

F. NEMA/ICEA Compliance: Comply with NEMA/ICEA Std. Pub/No's WC5, Thermoplastic Insulated Wires and Cable for the "Transmission and Distribution of Electrical Energy", and WC30, "Color Coding of Wires and Cables", pertaining to electrical power type wires and cables.

G. IEEE Compliance: Comply with applicable requirements of IEEE Stds. 82, "Test Procedures for Impulse Voltage Tests on Insulated Conductors", and Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to wiring.

H. ASTM Compliance: Comply with applicable requirements of ASTM B1, 2, 3, 8, and D-573. Provide copper conductors with conductivity of not less than 98% at 20 degrees C. (68 deg. F.).

I. FOIST Compliance: Comply with Federal Specifications J-C-30, "Electrical Cable and Wire (Power, Fixed, Installation)", and W-S-610, "Splice Conductor".

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical wires, cables, and conductors.

B. DELIVERY, STORAGE, AND HANDLING:

1. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.
2. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
3. Handle wire and cable carefully to avoid abrasion, puncturing, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Wire and Cable:

a. Apex Wire and Cable Corp.
b. American Insulated Wire Corp.
c. American Wire and Cable Co.
d. Anaconda-Ericson Inc., Wire and Cable Div.
e. Beldon Div.; Cooper Industries.
f. Brand-Rex Div.; Pyle National Co.
g. Cerro Wire and Cable Corp.
h. Cleveland Insulated Wire Co.
j. Phelps Dodge Cable and Wire Co.
k. Rome Cable Corp.
l. Southwire Corp.
m. Triangle PWC, Inc.

2. Connectors;

a. AMP, Inc.
b. Appleton Electric Co.; Emerson Electric Co.
c. Burndy Corporation.
d. Brand-Rex Div.; Pyle National Co.
e. Electrical Products Div.; Midland Ross Corp.
f. General Electric Co.
g. Ideal Industries, Inc.
h. Leviton Mfg. Company.
i. 3M Company.
j. O-Z/Gedney Co.

k. Southport Industries Inc.
l. Square D Company.
m. Thomas and Betts Corp.

2.02 WIRES, CABLES, AND CONNECTORS

A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20 degrees C (68 degrees F.).

B. Building Materials: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by installer to comply with project's installation requirements, NFPA-70 and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements.

1. Type THWN: For dry or wet locations; max. operating temperature 75 deg. C. (167 deg. F.). Insulation, flame retardant, moisture and heat resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.
2. Type THHN: For dry and damp locations; max. operating temperature 90 deg. C. (194 deg. F.). Insulation, flame retardant, heat resistant thermoplastic conductor, annealed copper.

2.03 CONNECTORS

A. General: Provide UL type factory fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NFPA-70 and NEMA standards. Select from the following, those types, classes, kinds and styles of connectors to fulfill project requirements:

1. Type: Pressure.
2. Type: Crimp.
3. Type: Threaded.
4. Class: Insulated.
5. Kind: Copper (for CU to CU connection).
6. Style: Butt connection.
7. Style: Elbow connection.
8. Style: Combined "T" and straight connection.
9. Style: "T" connection.
10. Style: Split-bolt parallel connection.
11. Style: Tap connection.
12. Style: Pigtail connection.
13. Style: Wirenut connection.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wire and wiring connectors as indicated, in compliance with applicable requirements of NFPA-70, NEMA, UL, and NECA's "Standard of Installation" and in accordance with recognized industry practices.

B. Coordinate wire/cable installation work including electrical raceway and equipment

installation work, as necessary to properly interface installation of wires/cables with other work.

C. Install UL type wiring in conduit, for feeders and branch circuits.

D. Pull conductors simultaneously where more than one is being installed in same raceway.

E. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulator.

F. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceways.

G. Keep conductor splices to a minimum.

H. Install splices and tapes which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

I. Use splice and tap connectors which are compatible with conductor material.

J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B.

3.02 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 16120

SECTION 16135
ELECTRICAL BOXES

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 DESCRIPTION OF WORK

A. Extent of electrical box work is indicated by drawings and schedules.

B. Types of electrical boxes specified in this section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. In-ground hand hole.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical boxes, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects utilizing electrical boxes similar to those required for this project.

C. NFPA-70 Compliance: Comply with NFPA-70 as applicable to construction and installation of electrical wiring boxes.

D. UL Compliance: Comply with applicable requirements of UL 50, UL 514 Series, and UL 886 pertaining to electrical boxes which are UL listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Std. Pub. No.'s OS1, OS2, and Pub.250 pertaining to outlets and device boxes, covers and box supports.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical boxes and fittings.

PART 2 - PRODUCTS

2.01 FABRICATED MATERIALS

A. Outlet Boxes: Provide galvanized coated flat rolled sheet steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

1. Outlet Box Accessories: Provide outlet box accessories as required for each

installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code compliance option.

B. Device Boxes: Provide galvanized coated flat rolled sheet steel gangable or non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cable clamps, and for equipment type grounding.

1. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is installer's code compliance option.
2. Manufacturers: Subject to compliance with requirements, provide interior outlet boxes of one of the following:

    a. Adalet-PLM Div., Scott Fetzer Co.
    b. Appleton Electric; Emerson Electric Co.
    c. Bell Electric; Square D Company.
    d. Midland-Ross Corp.
    e. OZ/Gedney; General Signal Co.
    f. Pass and Seymor, Inc.
    g. RACO Div; Harvey Hubbell Inc.
    h. Thomas and Betts Co.

C. Raintight Outlet Boxes: Provide corrosion resistant cast metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast metal face plates with spring-hinged watertight caps suitably configurated for each application, including face plate gaskets and corrosion resistant plugs and fasteners.

1. Manufacturers: Subject to compliance with requirements, provide raintight outlet boxes of one of the following:

    a. Appleton Electric; Emerson Electric Co.
    b. Arrow Hart Div.; Crouse-Hinds Co.
    c. Bell Electric; Square D Co.
    d. Harvey Hubbell, Inc.
    e. OZ/Gedney; General Signal Co.
    f. Pass and Seymor, Inc.

D. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes, and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

1. Manufacturers: Subject to compliance with requirements, provide junction and pull boxes of one of the following:

    a. Adalet-PLM Div.; Scott Fetzer Co.

b. Appleton Electric; Emerson Electric Co.
c. Arrow Hart Div.; Crouse Hinds-Co.
d. Bell Electric; Square D Company.
e. OZ/Gedney Co.; General Signal Co.
f. Spring City Electrical Mfg. Co.

E. Knockout Closures: Provide corrosion resistant box knockout closures of types and sizes, to suit respective installation requirements and applications.

1. Manufacturers: Subject to compliance with requirements, provide knockout closures of one of the following:

a. Adalet-PLM Div.; Scott Fetzer Co.
b. AMP, Inc.
c. Arrow Hart Div.; Crouse-Hinds Co.
d. Appleton Electric Co.; Emerson Electric Co.
e. Bell Electric; Square D Co.
f. Midland Ross Corp.
g. Midwest Electric; Cooper Industries, Inc.
h. OZ/Gedney Co.; General Signal Co.
i. RACO Div.; Harvey Hubbell, Inc.
j. Thomas and Betts Co. Inc.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA-70 and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

F. Avoid installing boxes back-to-back in walls. Provide not less than 6" (150mm) separation.

G. Avoid installing aluminum products in concrete.

H. Position recessed outlet boxes accurately to allow for surface finish thickness.

I. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

J. Provide electrical connections for installed boxes.

K. Subsequent to installation of boxes, protect boxes from construction debris and damage.

3.02 GROUNDING

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION 16135

SECTION 16142
ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DESCRIPTION OF WORK

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following, but not limited:

1. From electrical source to motor starters.
2. From motor starters to motors.
3. To lighting fixtures.

C. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division 15 and other Division 16 sections, and are work of this section.

D. Refer to Division 15 sections for motor starters and controller furnished integrally with equipment; not work of this section.

E. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division 16 sections, and are work of this section.

F. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 16 sections, and are work of this section.

G. Refer to Division 15 sections for control system wiring; not work of this section.

H. Refer to sections of other Divisions for specific individual equipment power requirements, not work of this section.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and rating required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Installer shall have at least 3 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

C. NFPA-70 Compliance: Comply with applicable requirements of NFPA-70 as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters and disconnect switches.

D. IEEE Compliance: Comply with Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

E. ANSI Compliance: Comply with applicable requirement of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

F. UL Compliance: Comply with UL Std.486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL listed and labeled.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of product):

1. Adalet-PLM Div., Scott and Fetzer Co.
2. Allen-Stevens Conduit Fittings Corp.
3. AMP Incorporated.
4. Appleton Electric Co.
5. Arrow Hart Div., Crouse Hinds Co.
6. Burndy Corp.
7. General Electric Co.
8. Harvey Hubbell Inc.
9. Ideal Industries, Inc.
10. Pyle National Co.
11. Reliable Electric Co.
12. Square D Company.
13. Thomas and Betts Corp.

2.02 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cables ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

2.03 METAL CONDUIT, TUBING AND FITTINGS

A. General: Provide metal conduit, tubing, and fittings of types, grades, sizes, and weights (wall thickness) indicated for each type service. Where types and grades are not indicated, provide proper selection to fulfill wiring requirements, and comply with NFPA-70 requirements for raceways. Provide products complying with Division 16 basic electrical materials and methods section "Raceways" and in accordance with the following listing of metal conduit, tubing and fittings.

1. Rigid metal conduit.
2. Rigid metal conduit fittings.

3. Electrical metallic tubing (EMT).
4. EMT fittings.
5. Flexible metal conduit.
6. Flexible metal conduit fittings.
7. Liquid tight flexible metal conduit.
8. Liquid tight flexible metal conduit fittings.
9. PVC coated metal conduit.
10. PVC coated metal conduit fittings.

2.04 WIRES, CABLES AND CONNECTORS

A. General: Provide wires, cables, and connectors complying with Division 16 basic electrical materials and methods section "Wires and Cables".

B. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20 deg. C. (68 deg. F.)

C. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

D. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NFPA-70, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceways and equipment installation, as necessary to properly interface installment of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity ratings, than electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation

properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, bean-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

H. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

I. Provide liquid tight flexible conduit for connections of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:

1. Exterior location.
2. Moist or humid atmosphere where condensate can be expected to accumulate.
3. Corrosive atmosphere.
4. Subject to water spray or dripping oil, grease, or water.

J. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 16 section "Electrical Identification". Affix markers on each terminal conductor, as close as possible to the point of connection.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 16142

SECTION 16143
WIRING DEVICES

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 DESCRIPTION OF WORK

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electrical energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles.
2. Ground fault circuit interrupters.
3. Switches.
4. Wall plates.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Installer with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.

C. NFPA-70 Compliance: Comply with NFPA-70 as applicable to installation and wiring of electrical wiring devices.

D. UL Compliance: Comply with applicable requirements of UL 20, 486A, 498, and 943 pertaining to installation of wiring devices. Provide wiring devices which are UL listed and labeled.

E. IEEE Compliance: Comply with applicable requirements of IEEE Std. 241, "Recommended Practice for Electric Power Systems in Commercial Buildings", pertaining to electrical wiring systems.

F. NEMA Compliance: Comply with applicable portions of NEMA Stds. Pub/No. WD 1, "General Purpose Wiring Devices", and WD 5 "Specific Purpose Wiring Devices".

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical wiring devices.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide wiring devices of one of the following (for each type and rating of wiring device):

1. Leviton Mfg. Co.
2. Arrow Hart Div., Crouse Hinds Co.
3. Harvey Hubbell Inc.
4. Pass and Seymour Inc.

2.02 FABRICATED WIRING DEVICES

A. General: Provide factory fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and which comply with NEMA Stds. Pub/No. WD 1. Provide ivory color devices and wall plates except as otherwise indicated; color selection to be verified by Contractor with Architect/Engineer.

2.03 RECEPTACLES

A. General Duty Duplex: Provide duplex general duty type receptacles, 2 pole, 3 wire, grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20 amperes, 125 volts, with metal plaster ears; design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated.

B. Provide black colored receptacles with surge suppressors for computer equipment use where indicated.

2.04 GROUND FAULT INTERRUPTERS

A. Provide ground fault circuit interrupters, with heavy duty duplex receptacles, capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type UL rated Class A, Group 1, rated 20 amperes, 120 volts, 60 Hz; with solid state ground fault sensing and signaling; with 5 milliamperes ground fault trip level; equip with NEMA configuration 5-20R.

2.05 SWITCHES

A. Snap: Provide general duty flush single pole toggle switches, 20 amperes, 120-277 volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, switch handle, and side-wired screw terminals.

B. Double Snap: Provide general duty flush double pole AC quiet switches, 20 amperes, 120-277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, side-wired screw terminals, with break-off tab features, which allow wiring with separate or common feed.

C. Three Way: Provide general duty flush 3 way AC switches, 20 amperes, 120-277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, lock type switch handles, side wired screw terminals, with break-off tab features, which allows wiring with separate or common feed.

D. Four-Way: Provide general duty flush 4-way AC quiet switches, 20 amperes, 120-277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, side wired screw terminals, with break-off tab features, which allows wiring with separate or common feed.

2.06 WIRING DEVICE ACCESSORIES

A. Wall plates: Provide wall plates for single and combination wiring devices, of types, sizes

and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; wall plates colored to match wiring devices. Provide plates possessing the following additional construction features:

1. Material and Finish: Stainless steel #302, smooth.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES

A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA-70 and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean, free from excess building materials, dirt and debris.

D. Install wiring devices after wiring work is completed.

E. Install wall plates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A and B. Use properly scaled torque indicating hand tool.

3.02 PROTECTION OF WALLPLATES AND RECEPTACLES

A. Upon installation of wall plates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.03 GROUNDING:

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.04 TESTING:

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 16143

SECTION 16170
CIRCUIT AND MOTOR DISCONNECTS

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 DESCRIPTION OF WORK

A. Extent of circuit and motor disconnect switch work is indicated on drawings and schedules.

B. Types of circuit and motor disconnect switches in this section include the following:

1. Equipment disconnects.
2. Motor circuit disconnects.

C. Refer to other Division 16 sections for wires/cables, raceways, and electrical boxes and fittings work required in connection with circuit and motor disconnect work; not work of this section.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of circuit and motor disconnect switches of types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Installer with at least 3 years of successful installation experience with projects utilizing circuit and motor disconnect work similar to that required for this project.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.

D. UL Compliance: Comply with requirements of UL 98, "Enclosed and Dead Front Switches". Provide circuit and motor disconnect switches which have been UL listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Stds. Pub. No. KS 1, "Enclosed Switches" and 250 "Enclosures for Electrical Equipment" (1000 volts maximum).

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on circuit and motor disconnect switches.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects of one of the following (for each type of switch):

1. Square D.
2. General Electric Co.
3. Siemens (ITE).

2.02 FABRICATED SWITCHES

A. Heavy Duty Safety Switches: Provide surface mounted, heavy duty type, sheet steel enclosed safety switches, of types, sizes and electrical characteristics indicated; fusible and non-fusible type, and incorporating quick-make, quick-break type switches; construct so that switch vacu-break mechanism is visible in the OFF position. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable, and is pad lockable in OFF position; construct current carrying parts of high conductivity copper, with silver tungsten type switch contacts, and positive pressure type reinforced fuse clips. Provide NEMA type enclosures as required and rejection clips.

B. Coordinate the required size of all safety switches feeding equipment, (i.e. motors, HVAC, kitchen equipment, special purpose outlets, elevators, owner furnished equipment, etc.) with approved equipment shop drawings and owner representatives prior to ordering disconnects. Safety switches shall be sized per the NEC, the equipment name plate and manufacturers recommendations.

2.03 FUSES

A. Provide fuses for safety switches, as recommended by switch manufacturer, of classes, types, and ratings needed to fulfill electrical requirements for service indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Install circuit and motor disconnect switches as indicated complying with manufacturer's written instructions, applicable requirements of NFPA-70, NEMA and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches for use with motor driven appliances, and motors and controllers within 6'-0" of controller position unless otherwise indicated.

3.02 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for electrical disconnect switches.

3.03 FIELD QUALITY CONTROL

A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunction units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

END OF SECTION 16170

SECTION 16180
OVERCURRENT PROTECTIVE DEVICES

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 DESCRIPTION OF WORK

A. Extent of overcurrent protective device work is indicated by drawings and schedules.

B. Types of overcurrent protective devices in this section include the following:

1. Circuit Breakers:

a. Molded case.

C. Refer to other Division 16 sections for cable/wire and connector work required in conjunction with overcurrent protective devices; not work of this section.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar services for not less than 5 years.

B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for projects.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements as applicable to construction and installation of overcurrent protective devices.

D. UL Compliance: Comply with applicable requirements of UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures. Provide overcurrent protective devices, which are UL, listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Std. Pub. Nos. AB 1, AB 2, and SG 3 pertaining to molded case and low voltage power type circuit breakers.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on overcurrent protective devices, including: amperes, voltages, and current ratings, interrupting ratings, current limitations, internal inductive and non-inductive loads, time current trip characteristic curves, and mounting requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type and rating of overcurrent protective device).

1. Circuit Breakers:

   a. Square D Co.
   b. General Electric Co.
   c. Siemens (ITE).

2.02 CIRCUIT BREAKERS

A. General: Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information and as required for a complete installation.

B. Molded Case Circuit Breakers: Provide factory assembled, molded case circuit breakers of frame size indicated. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole, and with fault current limiting protection, ampere rating as indicated. Construct with overcenter, trip free, toggle type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Provide push-to-trip button on cover for mechanical tripping circuit breakers. Construct breakers for mounting and operating in any physical position and operating in an ambient temperature of 40 deg. C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

C. Coordinate the required size of all circuit breakers feeding equipment, (i.e. motors, HVAC, kitchen equipment, special purpose outlets, elevators, owner furnished equipment, etc.) with approved equipment shop drawings and owner representatives prior to ordering circuit breakers. Breakers shall be sized per NFPA-70, the equipment nameplate, and per manufacturer’s recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. The arrangements of overcurrent protective devices have been worked out for phase balancing and the like and shall be followed as closely as actual construction will permit. Comply with NFPA-70 and NEMA standards for installation of overcurrent protective devices.

B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

C. Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

D. Set field adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.

3.02 ADJUST AND CLEAN

A. Inspect circuit breakers operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

3.03 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry

and for short circuits. Correct malfunction units, and then demonstrate compliance with requirements.

END OF SECTION 16180

SECTION 16190
SUPPORTING DEVICES

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 DESCRIPTION OF WORK

A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other Division 16 sections.

B. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. C-clamps.
2. I-Beam clamps.
3. One-hole conduit straps.
4. Two-hole conduit straps.
5. Round steel rods.
6. Lead expansion anchors.
7. Toggle bolts.
8. Wall and floor seals.
9. Bridle Rings.

C. Conduit supporting devices of the spring or tension type, such as conduit clips manufactured by Caddy Corporation, are not acceptable.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings required whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installers Qualifications: Installer with at least 3 years of successful installation experience with projects utilizing electrical supporting device work similar to that required for this project.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements as applicable to construction and installation of electrical supporting devices.

D. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.

E. UL Compliance: Provide electrical components which are UL listed and labeled.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve and seal.

PART 2 - PRODUCTS

2.01 MANUFACTURED SUPPORTING DEVICES

A. General: Provide supporting devices which comply with manufacturer's standard materials, design, and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirement, selection is Installer's option.

B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 pounds per 100 units.
2. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
3. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
4. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
5. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.
6. Round Steel Rod: Black steel; 1/2" dia.; approximately 67 pounds per 100 feet.
7. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

C. Anchors: Provide anchors of types, sizes, and materials indicated, with the following construction features:

1. Lead Expansion Anchors: 1/2"; approximately 38 pounds per 100 units.
2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.
3. Manufacturers: Subject to compliance with requirements, provide anchors of one of the following:

    a. Ideal Industries, Inc.
    b. Joslyn Mfg. and Supply Co.
    c. McGraw Edison Co.
    d. Star Expansion Co.
    e. U.S. Expansion Bolt Co.

D. Sleeves and Seals: Provide sleeves and seals of types, sizes and materials indicated, with the following construction features:

1. Wall and Floor Seals: Provide factory assembled watertight wall and floor seals, of types, and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and wall. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
2. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 12 gage hot dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel.

    a. Fixture hangers.
    b. Channel hangers.
    c. End caps.
    d. Beam clamps.
    e. Wiring studs.
    f. Thinwall conduit clamps.
    g. Rigid conduit clamps.

h. Conduit hangers.
i. U-bolts.

3. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:

a. Allied Tube and Conduit Corp.
b. B-Line Systems, Inc.
c. Greenfield Mfg. Co., Inc.
d. Midland Ross Corp.
e. OZ/Gedney Div.; General Signal Corp.
f. Power Strut Div.; Van Huffel Tube Corp.
g. Unistrut Div.; GTE Products Corp.

2.02 FABRICATED SUPPORTING DEVICES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seam, or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20 gage; 4" to 6", 16 gage; over 6", 14 gage.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
3. Iron Pipe: Fabricate from cast-iron or ductile iron pipe; remove burrs.

PART 3 - EXECUTION

3.01 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NFPA-70 for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacing indicated and in compliance with NFPA-70 requirements.

D Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

END OF SECTION 16190

SECTION 16195
ELECTRICAL IDENTIFICATION

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 DESCRIPTION OF WORK

A. Extent of electrical identification work is indicated by drawings and schedules.

B. Types of electrical identification work specified in this section include the following:

1. Electrical power, control and communication conductors.
2. Operational instructions and warnings.
3. Danger signs.
4. Equipment/system identification signs.

C. Refer to Division 1 general requirements section "Identification Systems", for equipment and system nameplates, and performance data, not work of this section.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. NFPA-70 Compliance: Comply with NFPA-70 as applicable to installation of identifying labels and markers for wiring and equipment.

C. UL Compliance: Comply with applicable requirements of UL Std.969, "Marking and Labeling Systems" pertaining to electrical identification systems.

D. NEMA Compliance: Comply with applicable requirements of NEMA Std. No's. WC-1 and WC-2 pertaining to identification of power and control conductors.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical identification materials and products.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):

1. Alarm Supply Co., Inc.
2. Brady, W.H. Co.

3. Calpico Inc.
4. Cole Flex Corp.
5. Direct Safety Co.
6. George Ingraham Corp.
7. Griffolyn Co.
8. Ideal Industries, Inc.
9. LEM Products, Inc.
10. Markal Co.
11. National Band and Tag Co.
12. Panduit Corp.
13. Seton Name Plate Co.
14. Tesa Corp.

2.02 ELECTRICAL IDENTIFICATION MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard product of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Color Coded Plastic Tape:

1. General: Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.

C. Cable/Conductor Identification Bands:

1. General: Provide manufacturer's standard vinyl cloth self adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

D. Baked Enamel Danger Signs:

1. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20 gage steel, of standard red, black, and white graphics; 14" x 10" size except where 10" x 7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

E. Engraved Plastic Laminate Signs:

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thickness indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16" except as otherwise indicated.
3. Thickness: 1/8" except as otherwise indicated.
4. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.
5. Fasteners: Self tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.03 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical system and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NFPA-70.
2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:

1. General: Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply color coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

C. Cable/Conductor Identification:

1. General: Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

D. Operational Identification and Warnings:

1. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets, and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

E. Danger Signs:

1. General: In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.
2. High Voltage: Install danger signs wherever it is possible under any circumstances, for persons to come into contact with electrical power of voltages higher than

110-120 volts.

F. Equipment/Systems Identification:

1. General: Install engraved plastic-laminate signs on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/ control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:

a. Panelboards, electrical cabinets and enclosures.
b. Access panel/doors to electrical facilities.
c. Major electrical switchboard.
d. Fire alarm control panel.
e. Disconnect switches

G. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

END OF SECTION 16195

SECTION 16450
GROUNDING

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 DESCRIPTION OF WORK

A. Extent of grounding work is indicated by drawings and schedules.

B. Types of grounding specified in this section include the following:

1. Solid Grounding.

C. Applications of grounding work in this section include the following:

1. Underground metal water piping.
2. Grounding electrodes.
3. Grounding rods.
4. Service equipment.
5. Enclosures.
6. Equipment.
7. Ground Test Well.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cables, copper brain and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with electrical grounding work similar to that required for project.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL listed and labeled.

D. UL Compliance: Comply with applicable requirements of UL Standards Nos.467 and 869 pertaining to electrical grounding and bonding.

E. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

1.04 SUBMITTAL

A. Product Data: Submit manufacturer's data on grounding systems and accessories.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide grounding products of one

of the following:

1. B-Line Systems, Inc.
2. Burndy Corp.
3. Crouse-Hinds Co.
4. Electrical Components Div.; Grould, Inc.
5. General Electric Supply Co.
6. Ideal Industries, Inc.
7. Thomas and Betts Corp.
8. Western Electric Co.

2.02 GROUNDING SYSTEMS

A. Materials and Components:

1. General: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes, and plate electrodes, bonding jumper braid, surge arrestors, and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products complying with NFPA-70, UL, IEEE, and established industry standards for applications indicated.
2. Provide raceways, and electrical boxes and fittings complying with Division 16 Basic Materials and Methods sections "Raceways" and "Electrical Boxes and Fittings", in accordance with the following listing:
   a. Rigid steel conduit.
   b. Electrical metallic tubing.
   c. Flexible metal conduit, Type 2.
   d. Liquid-tight flexible metal conduit.
   e. Rigid metal conduit fittings.
   f. EMT Fittings, Type 1.
   g. Flexible metal conduit fittings.
   h. Liquid-tight flexible metal conduit fittings.

B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NFPA-70.

C. Bonding Jumper Braid: Copper braided tape, constructed of 30-gage bare copper wires and properly sized for indicated applications.

D. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gage bare copper wire; 3/4" wide, 9-1/2" long; 48,250 cm. Protect braid with copper bolthole ends with holes sized for 3/8" dia. bolts.

E. Ground Rods: Steel with copper welded exterior. Each ground rod shall consist of a 40 ft. ground rod, 5/8” driven vertically. Top of ground rod shall be at least one (1) foot deep below grade.

F. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.

G. Ground Test Well: Plastic 10" diameter x 10" high body with two pipe slots; plastic snap-lock cover with lifting holes and shall read “Ground”. Provide test well at each ground rod location. Cover shall be flush with grade.

H. Grounding Bars: Ground bars shall be copper of the size and description as shown on the drawings, or shall be 1/4" x 2" bus grade copper, spaced from wall on insulating 1" high supports, of 6" or greater O.A. length, allowing 2" length per lug connected thereto.

PART 3 - EXECUTION

3.01 GENERAL

A. Grounding conductors shall be provided with every circuit.

B. Grounding conductors shall; be so installed as to permit shortest and most direct path from equipment to ground; be installed in metal conduit with both conductor and conduit bonded at each end; have connections accessible for inspection and made with approved solderless connectors brazed (or bolted) to the equipment or structure to be grounded. The main grounding electrode conductor shall be exothermically welded to ground rods and water pipe.

C. All contact surfaces shall be thoroughly cleaned before connections are made to insure good metal-to-metal contact.

D. All exterior grade mounted equipment shall have their enclosures grounded directly to a separate driven ground at the equipment in addition to the building ground connection.

3.02 BONDING

A. Where available on the premises, bond the following items together:

1. Metal water pipe.
2. Building metal frame.

B. A main ground, bare copper conductor, NEC sized but in no case less than #2/0, shall be run in conduit from the Main Switchgear of each building to the building steel in respective building. This ground conductor shall also be run individually and be bonded to the main water service ahead of any union in pipe and must be metal pipe of length as acceptable by authorities having jurisdiction. Provide properly sized bonding shunt around water meter and/or dielectric unions in the water pipe. Also required is the same size ground wire to minimum 5/8" x 20 ft. copperweld driven ground rod.

C. Install ground bushings on all conduits entering enclosures where the continuity of grounding is broken between the conduit and enclosure (i.e. conduit stub-up into a motor control center enclosure). Provide an appropriately sized bond jumper from the ground bushing to the equipment ground bus.

3.03 INSTALLATION AND METHODS - 120 THROUGH 480 VOLT SYSTEMS

A. Except as otherwise indicated, each feeder raceway on the load side of the service entrance shall contain a ground conductor sized as indicated and where not shown shall be sized in accordance with Table 250-95 of the NEC. Conductor shall be connected to the equipment grounding bus in switchboards and panelboards, to lighting fixtures, motors and other types of equipment and outlets. The ground shall be in addition to the metallic raceway and shall be properly connected thereto, using a lug device located within each item enclosure at the point of electric power connections to permit convenient inspection.

B. Each feeder metallic conduit shall be bonded at all discontinuities, including at switchboards and all sub-distribution and branch circuit panels with conductors in accordance with Table 250-95 of NEC for parallel return with respective interior grounding conductor.

C. Provide green insulated ground wire for all grounding type receptacles and for equipment of all voltages. In addition to grounding strap connection to metallic outlet boxes, a supplemental grounding wire and screw equal to Raco No. 983 shall be provided to connect receptacle ground terminal to the box.

D. All plug strips and metallic surface raceway shall contain a green insulation ground conductor from supply panel ground bus connected to grounding screw on each receptacle in strip and to strip channel. Conductor shall be continuous.

3.04 GROUNDING FOR LIGHTING FIXTURES SHALL BE AS FOLLOWS

A. All fixtures in building interior, and exterior fixtures shall be provided with green grounding conductor, solidly connected to unit. Individual fixture grounds shall be with lug to fixture body, generally located at point of electrical connection to the fixture unit.

B. All suspended fixtures and those supplied through flexible metallic conduit shall have green ground conductor from outlet box to fixture. Cord connected fixtures shall contain a separate green ground conductor.

C. Except as otherwise indicated, freestanding, pole mounted, lighting fixtures shall each have a Copperweld, or equal, rod located within or adjacent to the concrete base and projecting a minimum of 4 feet below base bottom. An NEC sized grounding conductor shall be used to connect rod to pole base and an NEC sized conductor also shall be provided from pole to supply panel ground bus. Conductor shall be thermowelded to rod.

3.05 MOTORS AND EQUIPMENT

A. All motors, all heating coil assemblies, and all building equipment requiring flexible connections shall have a green grounding conductor properly connected to the frames and extending continuously inside conduit with circuit conductors to the supply source grounding bus with approved connectors regardless of conduit size or type. This shall include Food Service equipment, Laundry equipment, and all other "Equipment By Owner" to which an electric conduit is provided under this Division.

3.06 TRANSFORMER GROUNDING

A. Grounding of transformers and enclosures of 120/208V and 277/480V "separately derived systems" shall be to the nearest grounding electrode, grounded structural steel (when accessible), effectively grounded metal water pipe, or other approved electrodes when the former are not available as required by the N.E.C. (Where ground electrode per N.E.C. is the grounded structural steel, all additional ground wire (sized per N.E.C.) shall be connected to effectively grounded metal water pipe.

B. In addition, work shall include a conduit with an N.E.C. sized grounded conductor to main building ground system except where specifically rejected by Local Inspection Authority. Verify during construction procedures.

3.07 MISCELLANEOUS GROUNDING CONNECTIONS

A. Required connections to building steel shall be with approved terminals and bolted in accessible locations.

B. Where reinforced concrete is utilized for building grounding system (UFER ground), proper reinforced bonding shall be provided to secure low resistance to earth with "thermite" type devices, and #10AWG wire ties shall be provided to not less than ten (10) full length rebars which contact the connected rebar (by Division 16 contractor).

C. All surfaces to which grounding connections are made shall be thoroughly cleaned to maximum conductive condition immediately before connections are made thereto. Exposed bare metal at the termination point shall be painted.

D. Welded or Brazed Connections: Joints in ground conductors shall be welded or brazed. The welding or brazing processes shall be an exothermic type.

3.08 TESTING AND REPORTS

A. Raceway Continuity: Metallic raceway system as a component of the facilities ground system shall be tested for electrical continuity. Resistance to ground throughout the system shall not exceed NEC specified limits.

B. Ground resistance measurements shall be made on each grounding system utilized in the project. The ground resistance measurements shall include building structural steel, driven grounding system, and other approved systems as may be applicable. Ground resistance measurements shall be made in normally dry weather, not less than 24 hours after rainfall, and with the ground under test isolated from other grounds. Resistances measured shall not exceed specified limits.

C. Upon completion of testing, the testing conditions and results shall be certified by the Contractor and submitted in writing on Contractor's letterhead to the Architect/Engineer.

3.09 GROUND RESISTANCE

A. Grounding resistance measure at main service shall not exceed 10 ohms.

B. Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms, measured at motors, panels, grounding busses, cabinets, etc.

END OF SECTION 16450

SECTION 16470
PANELBOARDS

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 this Section.

B Division 16 Basic Electrical Materials and Methods sections apply to this Section.

1.02 DESCRIPTI0N OF WORK

A. Extent of panelboard and enclosure work, including cabinets and cutout boxes is indicated by drawings and schedules.

B. Types of panel boards and enclosures in this section include the following:

1. Distribution panelboards.
2. Lighting and appliance panelboards.

C. Refer to other Division 16 sections for cable/wire connectors, and electrical raceway work required in conjunction with panelboards and enclosures; not work of this section.

D. Panelboards shall not be series rated.

E. Where equipment selected is from an acceptable manufacturer other than the design basis indicated in the documents, provide a 1/4" = 1'-0" scale plan view of room where equipment is being installed. Plan view shall show all equipment to be located in room and all working clearances required about equipment accurately scaled. Provide additional elevations and sections of room where plan view is not sufficient to show all conditions encountered.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Installer shall have at least 3 years of successful installation experience on projects utilizing panelboards similar to those required for this project.

C. NFPA-70 Compliance: Comply with NFPA-70 as applicable to installation of panelboards, cabinets, and cutout boxes.

D. UL Compliance: Comply with applicable requirements of Std. No. 67, "Electric Panelboards" and Std. No.'s 50, 869, 486A, 486B and 1053 pertaining to panelboards, accessories, and enclosures. Provide units which are UL listed and labeled.

E. NEMA Compliance: Comply with NEMA Std. Pub. No. 250 "Enclosures for Electrical Equipment (1000 Volts Maximum", Pub. No. PB 1, "Panelboards" and Pub. o. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

F. Federal Specification Compliance: Comply with FS W-P115, "Power Distribution Panel",

pertaining to panelboards and accessories.

1.04 SUBMITTALS

A. Submit product data on each basic panelboard construction type, showing manufacturer's standard construction data including:

1. Cabinet construction/dimensions.
2. Bus constructions.
3. UL labeling.
4. Each overcurrent device.

B. Shop drawings shall be submitted for each panel and clearly indicate the following information:

1. UL Label.
2. Each circuit breaker amperage rating, circuit number and position/location in panel.
3. Electrical characteristics of panel.
4. Mains rating.
5. Main device rating.
6. Mounting.
7. Dimension, width, depth, height.
8. Bus material.
9. Interrupting capacity of minimum rated breaker.
10. Panel type.

1.05 PROJECT AS-BUILT DOCUMENTS

A. Record actual locations of Panelboards on red lined as-built documents and indicate actual branch circuit arrangement.

1.06 OPERATION AND MAINTENANCE DATA

A. Provide spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

B. Provide two of each panelboard key.

PART 2 -PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide panelboard products of one of the following (for each type and rating of panelboard and enclosure): Basis of design: Square D.

B. Acceptable manufacturers:
1. General Electric Co.
2. Siemens (ITE).
3. Approved substitution

C. Where basis of design panelboard can accept a certain type, frame, and/or A.I.C. rated breaker, then the accepted substitution manufacturer must also be able to accept all equal breaker type, frame and/or A.I.C. rating.

2.02 PANELBOARDS

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components of types, sizes, and ratings indicated which comply with manufacturer's standard materials, design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes or ratings are not indicated, comply with NFPA-70, UL and established industry standards for those applications indicated.

B. Distribution Panelboards: Provide dead front safety type distribution panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti -burn solderless pressure type lug connectors approved for copper conductors; construct unit for connecting feeders at the bottom of panel; equip with copper bus bars full sized neutral bar, with bolt-in type heavy duty, quick-make, quick-break, single two, or three pole circuit breakers, with toggle handles that indicate when stripped. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare un-insulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.

C. Lighting and Appliance Panelboards: Provide dead front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for copper conductors; construct unit for connecting feeders at the bottom of panel; equip with copper bus bars, full sized neutral bar, with bolt-in type heavy duty, quick-make, quick-break, single, two or three pole circuit breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare un-insulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.

D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sized and NEMA types as indicated, code-gage, minimum 16 gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed trim clamps and piano door hinges and door swings as indicated. Equip with interior circuit directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for mounting as indicated. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.
   1. Cabinet box: 6 inches deep; width: 20 inches. Constructed of code gauge steel, galvanized or bonderized to prevent rust.

E. Panelboard Accessories: Provide panelboard accessories and device including, but no necessarily limited to circuit breakers, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

F. Coordinate the required size of all circuit breakers feeding equipment, (i.e. motors, HVAC, kitchen equipment, special purpose outlets, elevators, owner furnished equipment, etc.) with approved equipment shop drawings and owner representatives prior to ordering panelboards. Breakers shall be sized per the NEC, the equipment name plate and manufacturer’s recommendations.

G. The power company shall be contacted within 10 days of the award of the contract by the contractor to verify the actual available short circuit fault current (SCC) at the transformer secondary bushings. The contractor shall provide panelboards which have AIC/withstand ratings greater than the available SSC.

2.03 MAINS

A. Provide main lug only (MLO) or main circuit breaker (MCB) as noted on drawings either by riser diagram or by schedule. Where conflict exists, provide MCB.

B. Regardless of what is shown on drawings provide the following minimum requirements.

1. Main circuit breaker on each panel serving building main if required by applicable codes.
2. Main circuit breaker on each panel fed directly from a transformer (unless disconnect with overcurrent devices is installed in feeder between transformer and panel).

PART 3 - EXECUTION

3.01 INSPECTION

A. Installer must examine areas and conditions under which panelboards and enclosures are to be installed and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until satisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF PANELBOARDS

A. General: Install panelboards and enclosures as indicated in accordance with manufacturer's written instructions, applicable requirements of NFPA-70 standards and NECA's "Standard of Installation: and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacture's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A and B.

D. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.

E. Panelboard directories shall be type written, indicating type of load (i.e., lighting, receptacles, etc.), room name and number.

F. Proper working clearances shall be maintained at every panelboard location. The working space in front of a panelboard shall be a minimum 30 inches wide extending 3 feet, 3.5 feet, or 4 feet (per NEC Article 110-26) out perpendicular to the panelboard.

G. Provide equipment grounding connections for panelboards as indicated. Tighten connections to comply with tightening torques specified in UL Stds. 486A and B to assure permanent and effective grounds.

3.03 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization check panelboards for electrical continuity of circuits, and for short circuits.

D. All panel directory circuit numbers shall be checked to verify accuracy of the number.

E. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

3.04 ADJUSTMENT AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Tighten bus connections and mechanical fasteners.

C. Touch up scratched and marred surfaces to match original finish.

END OF SECTION 16470