
IFB NO. Y16-710-CC

**INVITATION FOR BIDS
FOR
ORANGE COUNTY FIRE RESCUE LOGISTICS WAREHOUSE HVAC
REPLACEMENT**

**PART H
TECHNICAL SPECIFICATIONS**

VOLUME II



**ORANGE COUNTY
FIRE LOGISTICS WAREHOUSE
HVAC RENOVATION
BID DOCUMENTS**

**FOR
ORANGE COUNTY
CAPITAL PROJECTS
IOC II, 400 EAST SOUTH STREET
ORLANDO, FLORIDA 32801**

**BY
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OCTOBER 1, 2015

**ORANGE COUNTY
FIRE LOGISTICS WAREHOUSE
HVAC RENOVATION
BID DOCUMENTS**

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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 Engineering work shall include the following:
 - 1. Replace existing four (4) DX split systems serving the currently-conditioned spaces of the warehouse as shown on drawings.
 - 2. Add two (2) new DX split systems to condition warehouse bays not previously conditioned.
 - 3. Replace all toilet ceiling cabinet exhaust fans.
 - 4. For newly-conditioned spaces, abandon and seal existing louvers and fans in the walls and roof.
- B. The Architectural work shall include the following:
 - 1. Install spray foam insulation on exterior walls of newly conditioned areas.
 - 2. Install framing and plywood to 8'-0" to protect foam insulation from damage.
 - 3. Correct existing penetrations in the exterior wall if located in newly conditioned areas.
 - 4. Box out existing ridge vents on exterior with a galvanized sheet metal closure panel mechanically fastened to framing and set in continuous bed of sealant.
 - 5. Insulate interior side of ridge vents with faced rigid insulation.
 - 6. Box out interior side of existing exhaust fans with sheet metal enclosure mechanically fastened to fan frame; set perimeter in sealant.
 - 7. Install weather stripping at overhead door track and door bottoms.
 - 8. Install a rated enclosure with rated doors around gas-fired laundry equipment.
 - 9. Install a metal frame gypsum wallboard partition with an accessible door to separate conditioned laundry space from adjacent non-conditioned warehouse area.
- C. Bid Additive: Additive No. 1: All work required for the removal of existing suspended ceiling grid and ceiling tiles in the Captain's Office 111, Men's Toilet R100C, Women's Toilet R100D, and Lounge 115. Provide new suspended ceiling grid, wall angles, and acoustical tiles as specified in Section 09510 Acoustical Panel Ceiling.

1.04 CONTRACTOR RESPONSIBILITIES

- A. General:
 - 1. The contractor shall have all submittals approved by the Engineer and accepted by

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- 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 videotape or take pictures of pre-existing conditions of the interior and exterior of the building prior to the start of active construction. Failure to provide photographs or videotape 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 set of photographs (in a three-ring binder) or videotape of the site existing 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 occupied and operational while work is in progress. All work shall be performed during normal business hours. Normal business hours are defined as 7:00 a.m. to 4:00 p.m. Monday through Friday. Material and equipment deliveries shall be made during normal business hours.

1.07 CONTRACTOR USE OF PREMISES

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

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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 am to 4:00 pm Monday through Friday. Prior to beginning of each business day, each area where work is done after normal business hours shall be fully

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operational and back in original condition. 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

2.01 ASBESTOS FREE MATERIAL

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

PART 3 EXECUTION (Not applicable).

END OF SECTION 01010

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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:

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- 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.

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- 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 s Construction Schedule. Use updated schedules if revisions have been made.
 2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.
- E. Transmittal: Submit four (4) original executed copies of each Application for Payment to the Project Manager 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.

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- 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.
 - 10. Contractor shall not submit final payment until all close-out documents are assembled and delivered to the Orange County Project Manager.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01027

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SECTION 01030
BID ADDITIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Conditions/Provisions of the Contract, including Contractual Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Refer to Specification Section 09510 – Acoustical Panel Ceiling.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing Additive.

1.3 DEFINITIONS

- A. Definition: An Additive is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. The cost for each additive is the net addition to/from the Contract Price to incorporate the Additive into the Work. No other adjustments are made to the Contract Price.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely and fully integrate that work into the Project.
 - 1. Include as part of each additive, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Additive.
- B. Notification: The Owner will notify each party involved, in writing, if additives have been accepted, rejected, or deferred for later consideration.
- C. Schedule: A schedule of additives is included in the Bid Form. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each additive.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 SCHEDULE OF ADDITIVES

- A. Additive No. 1: All work required for the removal of existing suspended ceiling grid and ceiling tiles in the Captain's Office 111, Men's Toilet R100C, Women's Toilet R100D, and Lounge 115. Provide new suspended ceiling grid, wall angles, and acoustical tiles as specified in Section 09510 Acoustical Panel Ceiling.

END OF SECTION 01030

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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

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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

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SECTION 01040
PROJECT COORDINATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 COORDINATION

- A. Coordination: Coordinate construction activities included under various Sections of these Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specification that are dependent upon each other for proper installation, connection, and operation.
 - 1. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
 - 2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required: notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Schedules
 - 2. Installation and removal of temporary facilities
 - 3. Delivery and processing of submittals

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4. Progress meetings
 5. Project close-out activities
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment (if any) involved in performance of, but not actually incorporated in, the Work.
- E. Lack of coordination as specified in this and other sections of the contract documents are in grounds for assessment of back charges and/or termination in order to remediate the situation.

1.04 SUBMITTALS

- A. Coordination Drawings: Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
1. Show the interrelationship of components shown on separate Shop Drawings.
 2. Indicate required installation sequences.
 3. Comply with requirements contained in Section "Submittals".
 4. Refer to Division-15 Section "Basic Mechanical Requirements," and Division-16 Section "Basic Electrical Requirements" for specific coordination Drawing requirements for mechanical and electrical installations.
- B. Staff Names: At the Preconstruction Conference submit a list of the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.
1. Post copies of the list in the project meeting room, the temporary field office, and each temporary telephone.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 GENERAL INSTALLATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- D. Provide attachment and connection devices and methods necessary for securing work.

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Secure work true to line and level. Allow for expansion and building movement.

- E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to Project Manager for final decision.
- F. Recheck measurements and dimensions, before starting each installation.
- G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- H. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Project Manager for final decision.

3.02 CLEANING AND PROTECTION

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

END OF SECTION 01040

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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 Engineer to proceed with cutting and patching does not waive the 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.

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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 Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.
 1. If possible retain the original installer or fabricator to cut and patch the following categories of exposed work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:
 - a. Processed concrete finishes
 - b. Preformed metal panels
 - c. Window wall system
 - d. Stucco and ornamental plaster
 - e. Acoustical ceilings
 - f. Carpeting
 - g. Wall covering
 - h. HVAC enclosures, cabinets or covers
 - i. Roofing systems

PART 2 PRODUCTS

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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 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.
- 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

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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

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SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 PRE-CONSTRUCTION CONFERENCE

- A. Schedule a pre-construction conference and organizational meeting at the project site or other convenient location no later than 20 days after execution of the agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attendees: The County's Representative, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work.
- C. Agenda: Discuss items of significance that could affect progress including such topics as:
 - 1. Tentative construction schedule
 - 2. Critical Work sequencing and/coordinating
 - 3. Designation of responsible personnel
 - 4. Procedures for processing field decisions and Change Orders
 - 5. Procedures for processing Applications for Payment
 - 6. Distribution of Contract Documents
 - 7. Submittal of Shop Drawings, Product Data and Samples
 - 8. Preparation of record documents
 - 9. Use of the Premises
 - 10. Office, Work and storage areas
 - 11. Equipment deliveries and priorities
 - 12. Safety procedures
 - 13. First aid
 - 14. Security
 - 15. Housekeeping
 - 16. Working hours
- D. Contractor must submit at the time of the meeting at least the following items:

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

1.04 PRE-INSTALLATION CONFERENCE

- A. Conduct a Pre-installation conference at the site before each construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise at least 48 hours in advance the Project Manager of scheduled meeting dates.
1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
 - a. Contract Documents
 - b. Options
 - c. Related Change Orders
 - d. Purchases
 - e. Deliveries
 - f. Shop Drawings, Product Data and Quality Control Samples
 - g. Possible conflicts
 - h. Compatibility problems
 - i. Time schedules
 - j. Weather limitations
 - k. Manufacturer's recommendations
 - l. Comparability of materials
 - m. Acceptability of substrates
 - n. Temporary facilities
 - o. Space and access limitations
 - p. Governing regulations
 - q. Safety
 - r. Inspection and testing requirements
 - s. Required performance results
 - t. Recording requirements
 - u. Protection
 2. Record significant discussions and agreements and disagreements of each conference along with and approved schedule. Distribute the record of the meeting to everyone concerned promptly including the Owner and Engineer.
 3. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.05 COORDINATION MEETINGS

- A. Conduct project coordination meeting at weekly intervals on day and time as established by the Project Manager or more frequently, if necessary convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

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- B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved, to include subcontractors and representatives.
- C. Contractor shall record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.06 PROGRESS MEETINGS

- A. Conduct progress meetings at the Project site at bimonthly intervals or more frequently if necessary as directed by the Project Manager. Notify the Owner at least 48 hours in advance of scheduled meeting time and dates. Coordinate dates of meetings with preparation of the payment request.
- B. Attendees: In addition to representatives of the Owner and Engineer, each subcontractor, supplier or other entity concerned with current progress of involved in planning, coordination or performance of future activities with the project and authorized to conclude matters relating to progress.
- C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.
 - 1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time, ahead, or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 2. Review the present and future needs of each entity present, including such items as:
 - a. Interface requirements
 - b. Time
 - c. Sequences
 - d. Deliveries
 - e. Off-site fabrication problems
 - f. Access
 - g. Site utilization
 - h. Temporary facilities and services
 - i. Hours of work
 - j. Hazards and risks
 - k. Housekeeping
 - l. Quality and work standards
 - m. Change Orders
 - n. Documentation of information for payment requests.
- D. Reporting: No later than 3 days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, or progress since the previous meeting and report.

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

END OF SECTION 01200

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SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including:

1. Contractor's Construction Schedule
2. Submittal Schedule
3. Daily Construction Reports
4. Shop Drawings
5. Product Data
6. Samples

- B. Administrative Submittals: Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

1. Permits
2. Applications for Payment
3. Performance and Payment Bonds
4. Insurance Certificates
5. List of Subcontractors with start and finish dates (update as necessary)
6. Schedule of Values
7. Construction Schedule

- C. The Schedule of Values submittal is included in Section 01027 "Applications for Payment".

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.

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- 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 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.

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- 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.

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- 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.
- H. Delays: Contractor is responsible for delays in job project accruing directly or indirectly from late submissions or resubmissions of shop drawings, or product data.

1.05 SUBMITTAL LOG

- A. After development and acceptance of the Contractor's construction schedule, prepare a complete log of submittals.
 - 1. Coordinate submittals log with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
 - 2. Prepare the log in chronological order; include all submittals required. Provide the following information:
 - a. Scheduled date for the first submittal
 - b. Related Section number
 - c. Submittal category
 - d. Name of subcontractor
 - e. Description of the part of the work covered
 - f. Scheduled date for resubmittal
 - g. Scheduled date 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.

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- 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.

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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.

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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

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- 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 Applicable)

PART 3 Execution (Not Applicable)

END OF SECTION 01300

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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".

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:

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- 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

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- 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

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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 is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the work is not complete.
 - 2. Advise Owner of pending insurance change-over requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
 - 4. Obtain and submit releases enabling the Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
 - 5. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
- B. Inspection Procedures: On receipt of a request for inspection, the Project Manager will either proceed with inspection or advise the Contractor of unfilled requirements. The Project Manager will prepare the Certificate of Substantial Completion following

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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 purposes; 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

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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

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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 Applicable)

PART 3 EXECUTION

3.01 CLOSE-OUT PROCEDURES

- A. Operating and Maintenance Instructions: Arrange for each installer of equipment that required regular maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. All items to be provided or completed prior to Certificate of Substantial Completion being issued by the Owner. Include a detailed review of the following items:
1. Maintenance manuals
 2. Record documents
 3. Spare parts and materials
 4. Tools
 5. Lubricants
 6. Fuels
 7. Identification systems
 8. Control sequences
 9. Hazards
 10. Cleaning
 11. Warranties and bonds
 12. Maintenance agreements and similar continuing commitments
 13. On site instructions to County maintenance personnel on major systems operations such as HVAC as per technical specifications.
- B. As part of instruction for operating equipment, demonstrate the following procedures, prior to the Owner issuing Certificate of Substantial Completion:
1. Start-up
 2. Shutdown
 3. Emergency operations
 4. Noise and vibration adjustments
 5. Safety procedures
 6. Economy and efficiency adjustments

3.02 PROJECT CLOSE-OUT MANUALS AT SUBSTANTIAL COMPLETION

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- 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-built drawings will be landscape. All fonts will be Arial. All items will be in PDF with OCR (Optical Character Recognition). This will enable a search engine to identify words on the scanned documents.
 - 1. Contacts: Set up a separate PDF for the contacts. No bookmarks are needed for this section.
 - 2. As-Built: All as-built drawings will be landscape.
 - 3. Submittals: All technical submittal items (approved and approved as noted) will be provided and sorted by the 16 standard divisions. Bookmarks will be needed for the appropriate divisions.
 - 4. Operations and Maintenance Manual: Specify the division name only in the bookmarks (1-16). Please note that all items will be in PDF with OCR (Optical Character Recognition). This will enable a search engine to identify works on the scanned documents.
 - 5. Permitting: This should include the Certificate of Occupancy and any other document that the Project Manager may include pertaining to the permitting for the project.

3.03 FINAL CLEANING

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- A. General: General cleaning during construction is required by the General Conditions.
- 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

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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

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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.

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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

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SECTION 02070
DEMOLITION AND ALTERATIONS

PART 1 - GENERAL

1.1 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.

1.2 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.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- 2. NFPA 241 Safeguarding Construction, Alteration and Demolition Operations

- B. 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.

- C. Structural Members: Do not cut any building structure without written authorization of the Engineer. 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 concrete pre cast slabs. Use existing chases and openings at floor slabs.

1.3 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 has 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).

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- D. Portable Coverings: For minor interior alterations, where acceptable to Engineer, 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.
- F. Wet mop concrete floors slab to control dust.
- G. Vacuum space every day at the completion of the work.

1.4 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.

1.5 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.

1.6 OCCUPIED SPACES

- A. Since the building will maintain operations, coordination will be required with building staff and owners representative to coordinate time of demolition to minimize disturbance 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

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- 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 Engineer. 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 Engineer, flame-proofed drop cloths may be used. Flammable plastic sheet or film shall not be used within the building.

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 or stored for reinstallation.
- 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.

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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, concrete slabs, columns, joist and beams.
- C. Patch all existing slab penetrations caused by demolition of mechanical and plumbing with rated and UL listed seal assembly.

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 Engineer. If electrical, communications, fire protection and systems lines are encountered and not shown on drawings, contact the Engineer prior to the start of the work.

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 other wise 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 tile work remove drywall ceiling and ceiling suspension system and supports, fasteners complete.

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

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- A. Fire stop existing holes at all 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.

3.14. ACOUSTICAL LAY-IN CEILING

- A. Remove and re-install existing acoustical ceiling and suspension system as required by the work U.O.N. on the drawings. If any portion of the existing ceiling is damaged by the G.C. it shall be replaced to match existing.

END OF SECTION 02070

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SECTION 02361
TERMITE CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following for termite control: Provide if Owner accepts masonry partition about new Laundry Room.
 - 1. Soil treatment.
 - 2. Bait station system.

1.03 DEFINITIONS

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

1.04 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.
- E. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

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

1.06 PROJECT CONDITIONS

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

1.07 COORDINATION

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

1.08 WARRANTY

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

PART 2 - PRODUCTS

2.01 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.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AgrEvo Environmental Health, Inc.; a Company of Hoechst and Schering, Berlin.
 - 2. American Cyanamid Co.; Agricultural Products Group; Specialty Products Department.
 - 3. Bayer Corp.; Garden & Professional Care.

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4. DowElanco.
5. FMC Corp.; Pest Control Specialties.
6. Zeneca Professional Products.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 APPLICATION, GENERAL

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

3.04 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.
 1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 2. Foundations: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric

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conduit penetrating slab, and around interior column footers, piers; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.

4. Masonry: Treat voids.
 5. 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

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SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

Applicable provisions of "General Conditions", "Supplementary General Conditions" and "General Requirements", Division One, govern work under this section.

1.01 DESCRIPTION

- A. Work Included: Labor, materials and equipment to complete concrete reinforcement shown on the drawing, or herein specified, and as required for a complete installation.
- B. Related Work Specified Elsewhere.
 - 1. Cast-in-Place Concrete: Section 03300
 - 2. Misc. Metal Fabrications: Section 05500

1.02 QUALITY ASSURANCE

- A. Reference Standards (Current Editions):
 - 1. ACI 301: Specifications for Structural Concrete for Buildings.
 - 2. ACI 318: Building Code Requirements for Reinforced Concrete.
 - 3. Southern Building Code Congress International, Inc.: Standard Building Code.
 - 4. CRSI: Reinforcing Bar Detailing.
 - 5. ASTM Standards referenced herein.
- B. Accessibility of Standards: Maintain one copy of ACI 301, ACI 318 and Standard Building Code at the construction office, readily accessible for reference.

1.03 SUBMITTALS

- A. Placing drawings: Show all fabrication dimensions, and locations and instructions for placing of reinforcing steel and bar supports.
 - 1. Drawings shall not contain reproductions of the contract drawings.
 - 2. Each submitted drawing shall be complete. No changes or additions shall be made to drawings after submittal except those needed to comply with Contractor's checking or Engineer's review.
- B. Manufacturer's Data:
 - 1. Manufacturer's specifications and installation instructions for proprietary bar splicing systems.
 - 2. Manufacturer's printed data for proposed fibrous concrete reinforcement materials, and batching and mixing instructions.

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1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery: Deliver materials to the site in a timely manner, so that work on the project is uninterrupted.
- B. Storage: Store materials for ease of inspection and identification. Keep items off the ground, using blocking or other supports. Protect materials from deterioration.
- C. Handling: Handle steel items so as to prevent bending or distortion of material.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with ACI 301.
- B. Deformed Bars: Comply with ASTM A615, Grade 60 with Supplement (SI), marked "S". Where bars are to be spliced or connected by welding, insure that bars are weldable type.
 - 1. Provide zinc-coated bars where shown. Coating weight Class I.
 - 2. Provide epoxy-coated bars where shown.
- C. Welded Wire Fabric: Comply with ASTM A185. Furnish in flat sheets.
- D. Butt Splice Devices: Comply with Section 12.14.3.3 or Section 12.14.3.4 of ACI 318.
- E. Bar Supports: Wire, with plastic tips in contact with forming surfaces, where reinforcement is supported from formwork. Reinforcement supported from ground shall rest on precast concrete blocks at least 4 inches square and having a compressive strength not less than that of the concrete being placed.
- F. Tie Wire: Black, soft-annealed wire, not smaller than 16-gauge.

2.02 FABRICATION

- A. General: Comply with ACI 301.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Site Inspection: Inspect site prior to placement. Verify that conditions affecting placement are satisfactory. Do not start placement until unsatisfactory conditions are corrected.
- B. Compliance with Standards: Comply with ACI 301. Install bar supports in conformance with CRSI – Reinforcing Bar Detailing.
- C. Butt Splices: Butt splices for reinforcing bars shall be full welded or full mechanical type, complying with Section 12.14.3.3 or Section 12.14.3.4 of ACI 318.
- D. Damaged Zinc Bar Coating: Repair in conformance with ACI 301.

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E. Damaged Epoxy Bar Coating: Repair in conformance with ACI 301.

END OF SECTION 03200

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SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

Applicable provisions of "General Conditions", "Supplementary General Conditions" and "General Requirements", Division One, govern work under this section.

1.01 DESCRIPTION

A. Work Included:

1. Labor, materials and equipment to complete cast-in-place concrete shown, compaction of clean fill to 95% proctor, and vapor barrier, except that specified as work of other sections.

B. Related Work Specified Elsewhere:

1. Concrete Reinforcement: Section 03200
2. Misc. Metal Fabrications: Section 05500

1.02 QUALITY ASSURANCE

A. Reference Standards (Current Editions):

1. ACI 301: Specifications for Structural Concrete for Buildings.
2. ACI Publications referenced herein.
3. ASTM Standards referenced herein.

B. Accessibility of Standards: Maintain one copy of ACI 301 at the construction office, readily accessible for reference.

C. Fibrous Concrete Reinforcement: Manufacturer shall provide the services of a qualified technical representative to instruct the concrete supplier in proper batching and mixing of fiber reinforced concrete.

1.03 SUBMITTALS

A. Concrete Mix Designs: Submit the tabulated proportioning for each concrete mix proposed for use.

B. Certification: Submit written certification by the manufacturer and testing laboratory as to compliance of admixtures with listed requirements, including chloride ion content. Highlight all evidence of compliance.

C. Manufacturer's Data: Submit manufacturer's published technical data for specified curing compounds, bonding compounds, epoxy compounds and non-shrink grout. Highlight all evidence of compliance.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with ACI 301.
- B. Cement:
 - 1. Domestic Portland Cement, Type I or Type II.
 - 2. Blended Hydraulic Cement, conforming to ASTM C595, except that Types S and SA are not permitted.
- C. Fine Aggregate: Clean sand conforming to Florida Department of Transportation Standard Specifications, Section 902.
- D. Coarse Aggregate:
 - 1. Normal weight concrete: Clean limestone, Size 57, except Size 8 for cell-fills and trim items.
- E. Lightweight concrete: Conform to ASTM C 330.
- F. Admixtures:
 - 1. No calcium chloride, thiocyanates, nor admixture containing more than 0.05% chloride ions shall be used.
 - 2. Water Reducing Admixture: Conform to ASTM C494, Type A.
 - 3. Water Reducing, Retarding Admixture: Conform to ASTM C494, Type D.
 - 4. High-Range Water Reducing Admixture (Superplasticizer): Conform to ASTM C494, Type F or G. Shall be a second or third generation type.
 - 5. Non-Corrosive, Non-Chloride Accelerator: Conform to ASTM C494, Type C or E. Admixture manufacturer must have long term non-corrosive test data from an independent testing laboratory.
 - 6. Air Entraining Admixture: Conform to ASTM C260.
 - 7. Fly Ash: Type F or C. Conform to ASTM C618.
- G. Curing Compounds:
 - 1. Curing and Sealing Compound Shall be Ashford Formula manufactured by Curecrete Chemical Company, Inc. or approved equivalent.
- H. Bonding Compound: Polyvinyl acetate, rewettable type. "Euco-Weld" by Euclid Chemical Co., "Hibond" by Lambert Corp., "Weldcrete" by Larsen Co., or accepted substitute.

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- I. Epoxy Adhesive: 100% solids, 100% reactive compound suitable for use on dry or damp surfaces. "Euco Epoxy #620" by Euclid Chemical Co., "Epiweld 580 Hi-Mod Epoxy" by Lambert Corp., "Sikadur" by Sika Corp., "Allied Gold A-1000" by Rawl or accepted substitute.
- J. Epoxy Mortar: 100% solids, solvent free. "#456 Epoxy Mortar System" by Euclid Chemical Co., "Epiweld 9-N-7" by Lambert Corp., "SikaTop 122" by Sika Corp. or accepted substitute.

2.02 MIXES

A. General: Comply with ACI 301.

B. Slump:

- 1. Concrete containing high range water reducing admixture (superplasticizer) shall have a maximum slump of 8 to 10 inches. Water content shall be such as to produce a slump of 2 to 3 inches without the admixture. Treated concrete shall be capable of maintaining its extended slump for at least 90 minutes.
- 2. Concrete in slabs which will be consolidated by vibrating screed shall have a maximum slump of 3 inches.
- 3. Pump-mix concrete not containing high range water reducing admixture shall have a maximum slump of 6 inches at the mixer.
- 4. All other concrete shall have a maximum slump of 4 inches.

C. Admixtures:

- 1. Concrete slabs placed at air temperatures below 50°F shall contain non-corrosive, non-chloride accelerator.
- 2. Where required to be air entrained, concrete shall contain air entraining admixture.
 - a. Where concrete is to contain both air entraining and high range water reducing admixtures, the air entraining admixture shall be added only after the high range water reducing admixture is thoroughly blended into the concrete.
- 3. Fly ash may be used to replace pound for pound a maximum of 25% of the Portland Cement in a mix.

D. Water-Cement Ratio:

- 1. Conform with Section 3.4 of ACI 301.
- 2. Reinforced concrete requiring corrosion protection and in contact with brackish water or salt spray shall have a maximum water-cement ratio of 0.40.
- 3. All concrete required to be watertight shall have a maximum water-cement ratio of 0.45.

E. Mixing: All concrete shall be ready-mixed.

F. Lightweight Concrete: Dry weight shall not exceed 112 pcf. Proportion in accordance with manufacturers instructions.

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- G. Concrete Strengths: Required strengths are shown on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with ACI 301.
- B. Site Inspection: Inspect site prior to placement. Verify that conditions affecting placement are satisfactory. Do not start placement until unsatisfactory conditions are corrected.
- C. Age: No concrete in the project shall be placed for which more than 90 minutes have elapsed at time of placement since introduction of mixing water to the cement and aggregate or introduction of cement to the aggregate.
- D. Hot or Cold Weather Placement: For concrete placed during hot or cold weather, observe procedures and precautionary measures in conformance with ACI 301.
- E. Free-fall Placement: Maximum allowable free fall of concrete is 4 feet. Use a drop chute or elephant trunk in walls and columns directing the discharge so that concrete does not contact forms or reinforcement during its fall.
- F. Consolidate Concrete As Follows:
1. Use internal mechanical vibrators unless otherwise noted. Insert vibrator vertically to a depth of at least 4 inches into the previous layer. Allow vibrator to remain in one location for not longer than 10 seconds. Repeat procedure at intervals not to exceed 2 feet on centers. Use and type of vibrators shall be in strict conformance with ACI 309. Use lower frequency vibrators with "flowing" concrete.
 2. For slabs on grade with thickness of 6" or less, use vibrating screed of low frequency (3000-6000 vibrations per minute), high amplitude type.
- G. Finishing of Formed Surfaces:
1. Use rough form finish for all surfaces not exposed to public view.
 2. Use smooth form finish for all surfaces exposed to public view.
- H. Finishing of Slabs:
1. Slab surfaces shall be finished to a Class B tolerance. Depressions between high spots shall not exceed 1/4" under a 10-foot straightedge placed anywhere on the slab.
 2. General information (slab on grade and elevated slabs): the requirements indicated are based on the latest FF/FL method per ASTM E1155. Ride for this work shall reflect these requirements and enforcement thereof can be expected.
 3. Slab on grade:
 - a. Specified overall value: FF30/FL23
 - b. Minimum local value: FF25/FL20

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- c. Apply trowel finish to surfaces that are to receive resilient flooring, paint, or other thin film finish coating system.
 4. Elevated slabs shall have a specified overall value of FF22 to FF27 and a minimum value of FF20 with no FL number defined. Slab finishes shall be finished to a Class B tolerance.
 5. Finish slabs for surfaces as follows:
 - a. Exposed concrete: Broom finish.
 6. Ramps, stair steps and landings: Nonslip finish.
- I. Curing:
 1. Apply two applications of Ashford Formula immediately after final finishing in conformance with directions of manufacturer.
- J. Concrete Strength: Where specified concrete strength of columns exceeds that of supported floor system, provide for adequate load transmission through the floor system in conformance with ACI 318, Section 10.13.

3.02 REPAIR OF DEFECTIVE AREAS

- A. General: With prior approval of the Architect as to method and procedure, repairs of defective areas of concrete shall be as follows:
 1. Structural repairs: Use epoxy adhesive and/or epoxy mortar in conformance with the manufacturer's directions.
 2. Repair of other defective areas: Use bonding compound in conformance with ACI 301 and the manufacturer's directions.

3.03 GROUTING

- A. General: Grout under bases and bearing plates of steel columns, beams and other structural members bearing on concrete, using an approved non-metallic, non-shrink grout in strict conformance with the manufacturer's directions.

3.04 FIELD QUALITY CONTROL

- A. Testing:
 1. Engage and pay for the services of a recognized engineering testing laboratory to conduct compressive strength tests of the concrete in accordance with ACI 301. Results of such tests shall be reported to the Architect on the same day that tests are made.
 2. For the purpose of early form removal, if the Contractor desires strength tests to be made at an earlier age than the standard 28-days, he shall arrange, at his own expense, for the laboratory to perform additional testing. Two additional cylinders shall be prepared for each age report desired. The strength at that age shall be determined as the average of the two cylinder strengths.
 3. When there is question as to quality of concrete in the structure, the Architect may order non-destructive testing or testing of specimens secured from the hardened concrete. Cost of such testing shall be borne by the Contractor.

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4. If there remains a question as to adequacy of strength of structure, the Architect may direct load testing of the structure to determine its acceptability. Cost of such testing shall be borne by the Contractor.
- B. Notification: Notify the Architect and the testing agency at least 24 hours before concrete is scheduled for placement. Place no structural or exposed concrete without approval of the Architect.
- C. Supplier's Representative: During placement of concrete containing high range water reducing admixture (superplasticizer), a representative of the concrete admixture supplier shall be present at the jobsite.

END OF SECTION 03300

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SECTION 04150
MASONRY ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DESCRIPTION

- A. Provide masonry accessories shown on the drawings, specified and required for wall type[s] indicated.

1.03 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.

ASTM INTERNATIONAL (ASTM)

- | | | |
|----|-------------------|---|
| 1. | ASTM A 82 | Steel Wire, Plain, for Concrete Reinforcement |
| 2. | ASTM A 153/A 153M | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| 3. | ASTM A 641/A 641M | Zinc-Coated (Galvanized) Carbon Steel Wire |

1.04 SUBMITTALS

- A. Product Data: Submit product data and installation instructions for each masonry accessory required. Data shall show thickness, gage and galvanized coating for each type accessory.
- B. Samples:
 - 1. Submit one sample of each accessory required. Horizontal joint reinforcing sample length shall include two cross rods and one box tie when box type is required.
 - 2. Identify each sample with Architect's Commission Number and Project Title.

1.05 PRODUCT HANDLING

- A. Store accessories indoors and protect from damage.

PART 2 - PRODUCTS

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2.01 GENERAL

- A. Fabricate wire accessories from cold drawn steel wire conforming to ASTM A 82, zinc coated in accordance with ASTM A 641/A 641M, Class 2.

2.02 MANUFACTURERS

- A. The following manufacturers are acceptable provided the products furnished are equal in gage, thickness, strength and performance to the products specified:
 - 1. Dur-O-Wal Inc.
 - 2. Heckman Building Products Co.
 - 3. Hohmann & Barnard, Inc.
 - 4. Masonry Reinforcing Corp. of America.
- B. Products of Dur-O-Wall, Inc. are specified to establish the basic type, design, minimum thickness, gage and size required. Products of other acceptable manufacturers may be furnished provided products are equal in type and design and meet requirements specified.

2.03 FINISH

- A. All accessories shall be hot dip galvanized in accordance with ASTM A 153/A 153M, Class B-2, 1.5 ounce/sf.

2.04 HORIZONTAL JOINT REINFORCING (HJR)

- A. Provide HJR fabricated of $\frac{3}{16}$ -inch deformed wire side rods and 9-gage plain cross rods flush welded to side rods. HJR may be ladder type with perpendicular cross rods welded at 15-inches on center, or truss type with diagonal cross rods welded at 16 inches on center. Provide in 10-foot straight lengths with matching L-shaped corner pieces and T-shaped intersection pieces. Width shall be 1½-inches less than actual width of wall or partition or 2-inches less than nominal width of wall or partition. Single side rods and ladder or truss cross rods. Dur-O-Wal D/A320 Ladder or Dur-O-Wall D/A310 Truss.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All anchors, ties and reinforcing shall be solidly embedded in mortar. Where anchors and ties extend over, into and across cells of hollow units, the cells shall be filled solid with mortar including the cells above and below the anchors and ties. Anchors, ties and reinforcing shall be carefully positioned in the outer wythe so that the metal is covered with no less than ½-inch thickness of mortar.

3.02 HORIZONTAL JOINT REINFORCING (HJR)

- A. Install the type indicated or specified in all masonry walls and partitions continuous at 16-inches on centers vertically starting 16-inches above footing or slab and ending with

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the last mortar joint. In addition, install reinforcing in the first two mortar joints above and below all openings, extending at least 24-inches beyond each side of the opening. Install so that a cross rod or box tie occurs within 4-inches of all openings. Lap all joints not less than 6-inches.

END OF SECTION 04150

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SECTION 04810
CONCRETE MASONRY UNITS

PART 1 - GENERAL

Applicable provisions of "General Conditions", "Supplementary General Conditions" and "General Requirements", Division One, govern work under this section.

1.01 DESCRIPTION

- A. Work Included: Labor, materials and equipment to construct concrete unit masonry work as shown on the drawings or specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Cast-In-Place Concrete: Section 03300
 - 2. Concrete Reinforcing: Section 03200
 - 3. Caulking, Joint Fillers and Sealants: Section 07921
 - 4. Misc. Metal Fabrications: Section 05500

1.02 QUALITY ASSURANCE

- A. Reference Standards: (Current Editions)
 - 1. ACI 530.1: Specifications for Masonry Structures.
 - 2. ACI Publications referenced herein.
 - 3. ASTM Standards referenced herein.
- B. Accessibility of Standards: Maintain one copy of ACI 530.1 at the construction office, readily accessible for reference.
- C. Masonry Strength: Net area compressive strength of masonry (f'm) shall be as shown on Structural Drawings.

1.03 SUBMITTALS

- A. General: Conform to ACI 530.1.
 - 1. One Specimen of each type of masonry unit proposed for use (stretcher units, control joint units, etc.).
 - 2. Results of tests of masonry units showing compliance with Specifications.
 - 3. Results of mortar tests showing compliance with Specifications.
 - 4. Producer's certificate showing that grout for the project conforms to Specifications.
 - 5. Cold weather construction procedures.
 - 6. Hot weather construction procedures.
 - 7. Manufacturer's literature for submittal items.

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8. Shop drawings showing details of steel reinforcement and masonry lintels.
 - a. Drawings shall not contain reproductions of contract drawings.
 - b. Each submitted drawing shall be complete. No changes or additions shall be made to drawings after submittal except those needed to comply with Contractor's checking, or Engineer's review.
 9. One sample at least 6 inches long of each type of non-masonry joint material proposed for use.
 10. Compressive strength of masonry determined by the unit strength method from tests on proposed masonry units and mortar, showing compliance with the Specifications.
 11. One sample of masonry wall panels representative of quality, materials and color proposed for construction. Lay up sample at jobsite in location approved by Architect. Maintain sample in as-built condition until project is accepted by Owner. Minimum sample size 4'-0" long X 4'-0" high.
- B. Copies: Except as noted, forward submittals in sufficient copies that the Architect may retain two copies of each submittal.

1.04 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with ACI 530.1.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with ACI 530.1.

B. Concrete Masonry Units:

1. Units for exterior walls and bearing partitions shall conform to ASTM C90, Type II, two cell, hollow, load bearing units of 8-inch by 16-inch nominal face size and bed dimension as shown on the drawings. Units shall be normal weight unless otherwise noted, and shall have no end flanges. Average compressive strength for the net area shall be as shown on Structural Drawings.
2. Units for non-bearing partitions shall conform to ASTM C129, Type II, two cell, hollow, non-load bearing units of 8-inch by 16-inch nominal face size and bed dimension as shown on the drawings. Units shall be normal weight unless otherwise noted.
3. Solid units shall conform to ASTM C90, Type II, and shall be normal weight unless otherwise noted. Nominal size shall be 2-2/3" X 4" X 8", except as noted.
4. Units shall be free from substances that would cause staining or pop-outs and shall be of fine, even texture with straight, true edges.
5. Obtain units from one manufacturer to insure even color and texture.
6. Provide special units required by the drawings, including corner, pilaster, sash and jamb units.

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C. Mortar:

1. Mortar shall conform to ASTM C270, and shall contain no admixtures.
2. Mortar shall conform to Type M or S, except Type N may be used for non-bearing partitions. Color of mortar shall match color of masonry units.

D. Lintels: Masonry lintels shall be precast concrete, U-type, of thickness to match supported wall. End bearings shall contain openings for installation of vertical bars and grout. As manufactured by Power Concrete Products, Co., Orlando, FL, or accepted substitute. Length shall provide for at least 8-inches of bearing on masonry at each end.

E. Grout:

1. Grout shall conform to ASTM C476, and shall contain no admixtures.
2. Grout shall be fine or coarse, as best suits the application.
3. At placement, grout slump shall be between 8 inches and 11 inches.

F. Reinforcement:

1. Reinforcing bars shall conform to ASTM A615, Grade 60.
2. Joint reinforcement shall be galvanized, single width truss type, fabricated with a single pair of deformed 9-gage side rods and continuous 9-gage cross rods spaced not more than 16 inches on center. Furnish complete with prefabricated corners and tees. Width shall be 2-inches narrower than wall. Where wall is used to back-up face brick, furnish with 3/16-inch diameter adjustable wall tie eye sections spaced at 24-inches on center, complete with rectangular pintles. Length as required to span insulation air space plus 3-inches into face brick. Dur-O-Wal, or accepted substitute.

G. Accessories:

1. Galvanized 24-gage dove-tailed anchor slots with anchors at 16-inches o.c. Heckmann Building Products, or accepted substitute.
2. Galvanized 16-gage metal ties for use with the anchor slots provided. Type and size as required. Heckmann Building Products, or accepted substitute.
3. Miscellaneous anchors and attachment members required for anchorage of this work and work of other trades requiring attachment to masonry, which are not specifically provided under separate sections.
4. Control joint gaskets shall be factory extruded preformed polyvinyl chloride shear keys. Dur-O-Wal "Regular Rapid Poly-Joint", or accepted substitute.
5. Cleaning agent shall be a mild, non-caustic detergent solution. 801 Super Real Clean by Superior Mfg., Co., or accepted substitute.

PART 3 - EXECUTION

3.01 MASONRY, REINFORCEMENT, METAL ACCESSORIES AND GROUT

- A. General: Conform to ACI 530.1.

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- B. Wetting Units: Do not wet masonry units before placing in wall.
- C. Bond: Construct masonry in running bond pattern with head joints in successive courses horizontally offset one-half unit length.
- D. Lintels: Install precast concrete lintels so that length of bearing at each end is at least 8-inches. Fill with pea-gravel concrete ($f'c=3000$ psi) if recommended by manufacturer. Before installing lintels, fill wall cells under bearings with grout.
- E. Reinforcing Bars: Lap bars 48 diameters at splices. Center vertical reinforcement in cells, unless otherwise noted.
- F. Joint Reinforcement: Place reinforcement in horizontal joints at 16 inches o.c. measured vertically. Lap reinforcement at least 8 inches at splices. Install prefabricated corners and tees at wall intersections.
- G. Bed and Head Joints: Joints shall be 3/8" thick. Cut off mortar flush with block face, and tool joints slightly concave. Rake out mortar in preparation for application of caulking or sealants where shown.
- H. Grout Vibration: Mechanical vibration shall be performed using a low velocity vibrator with a 3/4-inch head. Activate vibrator for one to two seconds in each grouted cell of hollow masonry. Do not over-vibrate.
- I. Wall Control Joints: Install where shown, but not to exceed horizontal spacing of 24'-0" o.c.
- J. Filled Cells: At vertical cells to be filled with grout, lay masonry units with full bed joints around cells.
- K. Build-in items furnished by Others for anchorage or support of their work.

3.02 REPAIR, POINTING AND CLEANING

- A. Repair: 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 matching units and install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.
- C. Cleaning: Clean exposed masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings.

3.03 FIELD QUALITY CONTROL

- A. Inspections and Testing:
 - 1. The Owner will engage an independent engineering testing laboratory to conduct tests of masonry prisms and grout for compliance with Specification requirements.
 - 2. Engage an independent engineering testing laboratory to conduct tests of masonry prisms and grout for compliance with Specification requirements.
 - 3. Coordinate and cooperate with testing laboratory to expedite this work.

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4. Results of inspections and tests will be reported to the Architect on the same day as completed.
5. Results of inspections and tests shall be reported to the Architect on the same day as completed.
6. Prism Testing:
 - a. Conform to ACI 530.1.
 - b. Prior to construction, perform two tests on samples of materials to be used in construction to determine masonry strengths at 7 days and at 28 days, and to verify adequacy of strength for the project.
 - c. During construction, perform tests on materials at site to verify that specified strengths are being provided. Tests may be made at 7 days and strengths determined by comparison with tests made prior to construction. Make two separate unscheduled tests during construction of each story of masonry.
7. Grout Testing:
 - a. Test grout in conformance with ACI 530.1.

END OF SECTION 04810

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SECTION 05500
MISCELLANEOUS METAL FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide miscellaneous metal work shown on the drawings, specified herein and required to complete the work.
- B. Hot-Dip galvanize items as specified, scheduled or indicated.

1.02 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.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

- 1. AISI Cold- Specification & Commentary Formed for the Design of Cold- Specification Formed Steel Structural Members (Part V of the Cold-Formed Steel Design Manual)

ASTM INTERNATIONAL (ASTM)

- 1. ASTM A 27/A 27M Steel Castings, Carbon, for General Application
- 2. ASTM A 36/A 36M Carbon Structural Steel
- 3. ASTM A 48 Gray Iron Castings
- 4. ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- 5. ASTM A 123/A 123M Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
- 6. ASTM A 153/A 153M Zinc-Coated (Hot Dip) on Iron and Steel Hardware
- 7. ASTM A 283/A 283M Low and Intermediate Tensile Strength Carbon Steel Plates
- 8. ASTM A 307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- 9. ASTM A 366/A 366M Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
- 10. ASTM A 449 Quenched and Tempered Steel Bolts and

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Studs

- | | | |
|-----|-------------------|--|
| 11. | ASTM A 500 | Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| 12. | ASTM A 574 | Alloy Steel Socket-Head Cap Screws |
| 13. | ASTM A 653/A 653M | Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process) |
| 14. | ASTM A 663 | Carbon Steel Bars Subject to Mechanical Property Requirements |
| 15. | ASTM A 666 | Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar |
| 16. | ASTM A 924/A 924M | Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| 17. | ASTM F 436 | Hardened Steel Washers |
| 18. | ASTM F 835 | Alloy Steel Socket Button and Flat Countersunk Head Cap Screws |

AMERICAN WELDING SOCIETY (AWS)

- | | | |
|----|----------------|-------------------------------------|
| 1. | AWS D1.1/D1.1M | Structural Welding Code—Steel |
| 2. | AWS D1.2 | Structural Welding Code—Aluminum |
| 3. | AWS D1.3 | Structural Welding Code—Sheet Steel |

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

- | | | |
|----|----------------------|--------------------------|
| 1. | SSPC-SP 1 | Solvent Cleaning |
| 2. | SSPC-SP 2 | Hand Tool Cleaning |
| 3. | SSPC-SP 3 | Power Tool Cleaning |
| 4. | SSPC-SP 7/NACE No. 4 | Brush-Off Blast Cleaning |

1.03 QUALITY ASSURANCE

- A. Field Measurements: Verify shop drawing dimensions by field measurements prior to fabrication.
- B. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly.
- C. Certification of Welders: Welding shall be done by welders who are currently qualified

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by test procedures in AWS D1.1/D1.1M, AWS D1.2, and AWS D1.3.

1.04 SUBMITTALS

- A. Manufacturer's Product Data: Submit for products to be used in fabrication of miscellaneous steel work, including shop primer and galvanized repair compound.
- B. Shop Drawings: Submit for each miscellaneous steel item. Include plans, elevations, details, sections and connections. Show anchorage and accessory items.

PART 2 - PRODUCTS

2.01 MATERIALS AND COMPONENTS

- A. Metal Surfaces: For miscellaneous steel work which will be exposed to view, materials shall be smooth and free of surface blemishes including pitting, seam marks, rolled trade names and roughness.
- B. Steel Plates, Shapes and Bars: ASTM A 36/A 36M.
- C. Steel Plates to be Bent or Cold Formed: ASTM A 283/A 283M, Grade C.
- D. Steel Tubing: Cold-formed, ASTM A 500 Grade B.
- E. Steel Bars and Bar-Sized Shapes: ASTM A 663, Grade 65 or ASTM A 36/A 36M.
- F. Carbon Steel Sheets:
 - 1. Cold-Rolled: ASTM A 366/A 366M.
 - 2. Galvanized: ASTM A 653/A 653M, with ASTM A 924/A 924M, G90 Zinc Coating.

2.02 FASTENERS

- A. General: Provide zinc-coated fasteners for all interior and exterior use. Select fasteners for the type, grade and class required.
- B. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A and ASTM A 449.
- C. Lag Bolts: Hex head type, ASTM A 307, Grade A.
- D. Machine Screws: Alloy steel, galvanized ASTM A 574 and ASTM F 835.
- E. Plain Washers: Round, carbon steel, ASTM F 436.
- F. Expansion Anchorage Devices: Type and size as required and approved for intended use.
- G. Toggle Bolts: Tumble-wing type, class and style as required and approved for intended use.
- H. Lock Washers: Helical spring type carbon steel.

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2.03 ROUGH HARDWARE

- A. Furnish standard and custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel shapes as required for framing and supporting wood and steel work, and for anchoring or securing steel and wood to concrete or other structures.
- B. Manufacture or fabricate rough hardware items of sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

2.04 SHOP PRIMER

- A. Provide a universal primer as recommended by the manufacturer for the type metal being primed. Coordinate selection of metal primer with finish paint requirements specified in Section 09900 - PAINTING. Primer selected must be compatible with finish coats of paints. Acceptable primers: Glidden Glid-Guard No. 5205; Sherwin-Williams Galvite B50 W3; Tnemec Galv-Guard Series 22; Southern Coatings Enviro-Guard 1-6227; or approved equivalent.

2.05 SHOP FABRICATION

- A. Workmanship: Use materials of size and thickness shown, or, if not shown, of requirement size and thickness to produce strength and durability in finished product. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately $\frac{1}{32}$ -inch unless otherwise shown. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- C. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flat-head screws or bolts.
 - 1. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
 - 2. Cut, reinforce, drill and tap miscellaneous steel work as indicated to receive finish hardware and similar items.

2.06 SHOP PRIMING

- A. Shop prime miscellaneous steel work including galvanized items, except members or portions of members to be embedded in concrete and masonry and surfaces and edges to be field welded.

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- B. Remove scale, rust and other deleterious materials before applying shop coat.
 - 1. Remove oil, grease and similar contaminants in accordance with SSPC-SP 1 Solvent Cleaning.
 - 2. Clean off rust and loose mill scale in accordance with SSPC-SP 2 Hand Tool Cleaning, or SSPC-SP 3 Power Tool Cleaning or SSPC-SP 7/NACE No. 4 Brush-Off Blast Cleaning.
- C. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's instructions, and at a rate to provide uniform dry film thickness of 1.5 mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges and exposed surfaces.
- D. Apply one shop coat of primer to all fabricated metal items. Apply second coat or primer to surfaces inaccessible after assembly and erection. Change of second coat to distinguish it from the first.

2.07 GALVANIZING

- A. Provide a zinc coating for items shown and for items specified to be galvanized. Hot-dip galvanize after fabrication unless otherwise specified or indicated.
 - 1. ASTM A 153/A 153M for galvanizing iron and steel hardware.
 - 2. ASTM A 123/A 123M for galvanizing rolled, pressed and forged steel shapes, plates, bars and strips 1/8-inch thick and heavier.
 - 3. ASTM A 123/A 123M for galvanizing assembled steel products.
- B. Galvanizing Repair Compound: High zinc dust content for regalvanizing welds and damaged galvanized surfaces. Provide ZRC by ZRC Chemical Products Co. or Galvicon by Kenco Division of Southern Coatings.

2.08 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required to complete work.
- B. Fabricate miscellaneous steel framing and support units to size, shapes and profiles shown, or, if not shown, of required dimensions to receive adjacent work and other work to be supported by framing. Except as otherwise shown, furnish units fabricated from structural steel shapes, plates and steel bars, and of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- C. Fabricate units with integrally welded anchors for casting into concrete and for building into masonry. Furnish drilled-in type expansion anchors for items that are required to be installed after concrete is placed.
 - 1. Except as otherwise shown, space anchors 24 inches o.c. and provide minimum anchors of 1 1/4 x 1/4 x 8 inch steel straps.

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2. Galvanize miscellaneous frames and supports specified and indicated. All items exposed to weather shall be galvanized.

2.09 MISCELLANEOUS STEEL TRIM

- A. Provide shapes and sizes for profiles shown. Except as otherwise noted, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work. Galvanize miscellaneous steel trim exposed to weather and other trim where indicated.

2.10 MISCELLANEOUS STEEL ITEMS

- A. Provide the following items as detailed on drawings.
 1. Galvanized steel sheet 20 gage cover panels.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install manufactured items according to printed directions of the manufacturer except as specified otherwise or modified by details.
- B. Install, anchor and make field connections in accordance with approved shop drawings.
- C. To prevent electrolysis, separate contacting surfaces of dissimilar metals with one ply of 15-pound asphalt-saturated felt or a bituminous coating.
- D. Repair damaged areas of galvanized surfaces with galvanizing repair paint before and after installation.
- E. Use setting drawings, diagrams, templates, manufacturer's instructions and directions for installation of anchorages such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete and embedded in masonry.
- F. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop primer. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted field connections.

END OF SECTION 05500

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SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes the following:
1. Framing with dimension lumber.
 2. Wood grounds, nailers, blocking, and panels.
 3. Wood furring.
 4. Interior plywood wall sheathing.

1.02 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.

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

1. APA F405 Product Guide Performance Rated Panels

AMERICAN FOREST AND PAPER ASSOCIATION (AFPA)

1. Manual for Wood Frame Construction

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI B18.2.1 Square and Hex Bolts and Screws Inch Series
2. ANSI B18.6.1 Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

1. ASTM A 153/A 153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2. ASTM A 307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
3. ASTM A 563 Carbon and Alloy Steel Nuts
4. ASTM C 79/C 79M Treated Core and Nontreated Gypsum Sheathing Board
5. ASTM D 226 Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

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6. ASTM E 84 Surface Burning Characteristics of Building Materials
7. ASTM E 96 Water Vapor Transmission of Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

1. AWPA C2 Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processing
2. AWPA C9 Plywood - Preservative Treatment by Pressure Processes
3. AWPA C20 Structural Lumber - Fire-Retardant Pressure Treatment
4. AWPA C27 Plywood - Fire-Retardant Pressure Treatment
5. AWPA M4 Standard for the Care of Preservative-Treated Wood Products

FEDERAL SPECIFICATIONS (FS)

1. FS FF-N-105 Nails, Brads, Staples and Spikes: Wire, Cut and Wrought

FLORIDA BUILDING CODE

1. Latest Issue with modifications and updates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1. Manual for House Framing

SOUTHERN PINE INSPECTION BUREAU (SPIB)

1. Standard Grading Rules for Southern Pine Lumber

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

1. PS-1.. Construction and Industrial Plywood
2. PS-20 American Softwood Lumber Standard

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

1.03 QUALITY ASSURANCE

- A. Lumber Standard: Comply with NBS Voluntary Product Standard PS 20, American Softwood

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Lumber Standard.

- B. Plywood Standard: Comply with U.S. Product Standard PS 1, Construction and Industrial Plywood.
- C. Wood Treatment: American Wood Preservers Association (AWPA).

1.04 SUBMITTALS

- A. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.
- B. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material.
 - 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 water-borne treated products include statement that moisture content of treated materials was reduced to levels indicate prior to shipment to project site.
 - 3. For fire-retardant-treated wood products include certification by treating plant that treated material compiles with specified standard and other requirements.
 - 4. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
 - 5. Warranty of chemical treatment manufacturer for each type of treatment.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
- B. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.01 LUMBER, GENERAL

- A. Furnish lumber manufactured to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:

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1. SPIB - Southern Pine Inspection Bureau.
 2. WCLIB - West Coast Lumber Inspection Bureau.
 3. 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.
- D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
1. Provide dressed lumber, S4S, unless otherwise indicated.
 2. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.02 DIMENSION LUMBER

- A. For light framing (2 to 4 inches thick, 2 to 4 inches wide) provide the following grade and species:
1. "Construction" Grade.1
 2. Southern Pine graded under SPIB rules or approved equivalent.
- B. For structural light framing (2 to 4 inches thick, 2 to 4 inches wide), provide the following grade and species:
1. SPIB "No. 2" Grade
 2. Same species as indicated for structural framing grade below.
- C. For structural framing (2 to 4 inches thick, 5 inches and wider), provide the following grade and species:
1. SPIB "No. 2" Grade.
 2. Southern Pine graded under SPIB rules.
- D. For exposed framing lumber provide material complying with the following requirements:
1. Definition: Exposed framing refers to dimension lumber that is not concealed by other construction and is indicated to receive a stained or natural finish.
 2. Grading: Material hand-selected at factory from lumber of species and grade indicated below that complies with "Appearance" grade requirements of ALSC National Grading Rule; issue inspection certificate of inspection agency for selected material.
 3. Same species and grade as indicated for structural framing.

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2.03 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: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 3 Common" or "Standard" grade boards per WCLIB or WWPA rules or "No. 2 Boards" per SPIB rules.

2.04 PERFORMANCE-RATED CONSTRUCTION PLYWOOD PANELS

- A. General: Where construction panels are indicated for the following concealed types of applications, provide APA F405 Performance-Rated Panels complying with requirements designated under each application for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.
- B. Wall Sheathing: APA F405 Rated Sheathing.
 - 1. Exposure Durability Classification: EXPOSURE 1.
 - 2. Span Rating: As required to suit stud spacing indicated, minimum 5/8-inch thick, or 3/4-inch thick as detailed.

2.05 CONSTRUCTION PANELS FOR BACKING

- A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade designation, APA F405 C-D PLUGGED EXPOSURE 1, in thickness indicated, or, if not otherwise indicated, not less than 15/32 inch.

2.06 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153/A 153M or of AISI Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Wood Screws: ANSI B18.6.1
- D. Lag Bolts: ANSI B18.2.1.
- E. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

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2.07 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

- A. General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood). Lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX). Mark each treated item with the AWPA or SPIB Quality Mark Requirements.
- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. 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 the ground or fresh water with water-borne preservatives to a minimum retention of 0.40 pcf.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.08 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

- A. General: Where fire-retardant-treated wood is indicated pressure impregnate lumber and plywood with fire-retardant chemicals to comply to AWPA C20 and C27, respectively, for treatment type indicated; identify "fire-retardant-treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Current Evaluation/Research Reports: Provide fire-retardant-treated wood for which a current model code evaluation/research report exists that is acceptable to authorities having jurisdiction and that evidences compliance of fire-retardant-treated wood for application indicated.
- B. Interior Type A: For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
 - 1. No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this project under elevated temperature and humidity conditions simulating installed conditions.

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2. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
 3. No corrosion of metal fasteners result from their contact with treated wood.
- 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.
- E. Available Products: Subject to compliance with requirements, fire-retardant-treated wood products that may be incorporated in the work include, but are not limited to, the following:
1. Interior Type A Fire-Retardant-Treated Wood:
 - a. "Dricon," Hickson Corporation.
 - b. "Pyro-Guard," Hoover Treated Wood Products.
 - c. "Flameproof LHC-HTT," Osmose Wood Preserving Co., Inc.
 2. Exterior Type Fire-Retardant-Treated Wood:
 - a. "Exterior Fire-X," Hoover Treated Wood Products.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required to accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size 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 of wood; predrill as required.

3.02 WOOD FURRING

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

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1. Firestop furred spaces on walls at ceiling line, with wood blocking or noncombustible materials, accurately fitted to close furred spaces.
- B. Furring to Receive Gypsum Drywall: Install 1-inch by 2-inch furring at 16 inches o.c., vertically.
- C. Suspended Furring: Install suspended furring members of size and spacing indicated, including hangers and attachment devices. Level to a tolerance of 1/8-inch in 10 feet, except 1/4-inch in 10 feet for thick-coat plaster work.

3.03 WOOD FRAMING, GENERAL

- A. Framing Standard: Comply with AFPA Manual for Wood Frame Construction, unless otherwise indicated.
- B. Install framing members of size and spacing indicated.
- C. Anchor and nail as shown, and to comply with the following:
 1. National Evaluation Report No. NER-272 for pneumatic or mechanical driven staples, P-Nails, and allied fasteners.
 2. Published requirements of manufacturer of metal framing anchors.
 3. "Recommended Nailing Schedule" of referenced framing standard and with NFPA "National Design Specifications for Wood Construction".
 4. Florida Building Code.
- D. Do not splice structural members between supports.
- E. Firestop concealed spaces of wood framed walls and partitions at the ceiling line. Where firestops are not automatically provided by the framing system used, use closely fitted wood blocks of nominal 2-inch-thick lumber of the same width as framing members.

3.04 STUD FRAMING

- A. General: Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Install single bottom plate and double top plates using 2-inch-thick members whose widths equal that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction.
 1. For walls and partitions install 2-inch by 4-inch wood studs spaced 16 inches o.c.
 2. Construct corners and intersections with not less than three studs. Install miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items, and trim.
 3. Install continuous horizontal blocking row at mid-height of single-story partitions over 8 feet high and at midpoint of multi-story partitions, using 2-inch thick members of same width as wall or partitions.
- B. Frame openings with multiple studs and headers. Install nailed header members of

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thickness equal to width of studs. Set headers on edge and support on jamb studs.

1. For nonbearing partitions, install double-jamb studs and headers not less than 4-inches deep for openings 3-feet and less in width, and not less than 6-inches deep for wider openings.
2. For load-bearing partitions, install double-jamb studs for openings 6-feet and less in width, and triple-jamb studs for wider openings. Install headers of depth shown, or if not show, as recommended by AFPA Manual for Wood Frame Construction.

END OF SECTION 06100

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SECTION 07213
CLOSED CELL WALLFOAM INSULATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, tools and equipment necessary for the application of sprayed in place polyurethane foam for application in interior perimeter stud wall cavities as detailed.

1.02 RELATED WORK

- A. Section 06100 – Rough Carpentry
- B. Section 09260 – Gypsum Drywall
- C. Division 15 – Mechanical
- D. Division 16 – Electrical

1.03 QUALITY ASSURANCE

- A. All work shall be performed by applicators skilled in the application of polyurethane foam systems. Applicators shall have completed 5 similar projects over the last 5 years and shall provide a list of these projects to the Owner or Owner's representative upon request.
- B. Health and safety concerns
 - 1. Consult with manufacturer for specific health and safety procedures for handling and application of this product.

1.04 SUBMITTALS

- A. Current data sheets on all materials intended for use on the project.
- B. Manufacturer's application and installation instructions.
- C. Safety and handling instructions for storage, handling and use of the materials including Material Safety Data Sheets (MSDS) on each product intended for use.
- D. Field Quality control Procedures to be utilized by the contractor/applicator to insure proper installation of the specified sprayed in place insulation.

1.05 MATERIALS, DELIVERY AND STORAGE

- A. Materials shall be delivered in the manufacturers original, tightly sealed containers or unopened packages clearly labeled with the manufacturer's name, product identification, safety information, UL approvals, and batch or lot numbers where applicable.
- B. Containers shall be stored out of the weather and away from direct sunlight at temperatures within the limits specified by the materials manufacturer.
- C. All materials shall be stored in compliance with local fire and safety codes.

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1.06 ENVIRONMENTAL CONDITIONS

- A. Do not apply the sprayed in place insulation below the temperature specified in the product manufacturer data sheets (or within 5 degrees of the dew point) or as approved by the manufacturer technical personnel.
- B. Apply thermal barriers and vapor retarder (if required) in accordance with local building code requirements.

1.07 SEQUENCE OF SCHEDULING

- A. Install the insulation system when the preparation of the interior perimeter walls to in place and in coordination with other building trades.

1.08 SAFETY REQUIREMENTS

- A. All non-essential personnel are restricted from access to the areas where sprayed in place insulation is applied.
 - 1. Review MSDS and be familiar with chemicals and their hazards.
 - 2. Post warning signs at all work area entrances to restrict entry by unauthorized personnel.
 - 3. No welding or open flame.
 - 4. Ground equipment to prevent sparking.
 - 5. Seal off work area from adjacent rooms and ventilation ducts.
 - 6. Restrict access of non-application personnel including other trades.
 - 7. Do not eat, drink, or smoke in work area.
 - 8. Use engineering controls to ventilate the area if possible.
 - 9. Wear breathing, body, glove, and eye protection during application and for the 24 hours following application for the sprayer and any necessary spectators.
 - 10. Provide ventilation as needed. Contact your supplier as necessary for guidance on ventilation time and re-occupancy for the formulation you are using.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Gaco Western Wall Foam (Two Pound), or approved equivalent.
- B. Type:
 - 1. The sprayed in place insulation shall be a two component system made by combining an isocyanate (A) component with a polyol (B) component and shall possess the following typical physical properties:
- C. Physical Properties:

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1. Nominal Density: Sprayed-In-Place (D-1622-03): 1.8 – 2.0 lbs/ft³
 2. Compressive Strength: Parallel to Rise (D-1621-04a): 37.0 psi
 3. Closed Cell Content (D-2856C-94): 90.8%
 4. Aged R Value (C-518), tested at 75°F (23.9°C): R at 1 inch: 6.22; R at R at 4 inches: 27.17
 5. Flame Spread/Smoke Developed: 25 Flame/400 Smoke (ASTM E84-05, Also known as ANSI 2.5, NFPA 255, UBC 8-1 (42-1) and UL 723).
- D. Primer: As recommended by the product manufacturer for the specific substrate.
- E. Fire Safety Requirements: See API Bulletin AX-119, “MDI – Based Polyurethane Foam Systems: Guidelines for Safe Handling and Disposal.”

PART 3 - EXECUTION

3.01 APPLICATION

- A. The products intended for use in the building envelope insulation system shall be within the manufacturer’s guidelines for temperature, humidity and other atmospheric conditions. In addition, they must be sequenced so as to take into consideration substrate preparation, proper cure times and inter-pass adhesion.

3.02 SURFACE PREPARATION

- A. All surfaces not to receive foam shall be carefully masked to avoid overspray. This includes (but is not limited to) beams, columns, floors, windows, doors, equipment, and any other surface which could be damaged by overspray.

3.03 EQUIPMENT

- A. Equipment shall be capable of maintaining 1000 psi of pressure or higher and maintaining a minimum of 130 degrees.
1. Equipment shall be capable of maintaining 1:1 ratio of A and B components on a continuous basis.
 2. Equipment shall be Graco/Gusmer, Glascraft or other type approved by the foam manufacturer.

3.04 STORAGE OF MATERIALS

- A. Materials shall be maintained at a temperature of 65°F-77°F
- B. A and B chemical temperature shall be 70°F-75°F or higher before spraying. Material temperatures below 70°F may result in proportioning errors and/or insufficient heat at the spray gun.

3.05 SUBSTRATE CONSIDERATION AND PREPARATION

- A. Wood
1. Plywood shall contain no more than 18% water.

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2. Most untreated and unpainted wood surfaces need not be primed. Spray polyurethane foam can be applied directly to dry wood.
 3. Priming may be required in certain cases. Contact manufacturer representative for further information.
- B. Steel
1. Primed: If the primed metal surface is free of scale, rust or oils it normally does not require priming. Remove loose dirt or contaminants by power washing prior to application of the polyurethane foam.
 2. Stainless steel requires primer. Contact the manufacturer for recommendations.
 3. Previously painted: Clean the painted metal surface using hand or power tools to remove loose scale and rust. Grease, oil and other surface contaminants can be cleaned using a power washer.
 4. Galvanized: Primers shall be as recommended by the product manufacturer. Galvanized studs adhered to backer usually do not require primer.

3.06 PRIMER APPLICATION

- A. When required, the primer shall be applied to the properly prepared substrate in accordance with the product manufacturer recommendations to achieve the design coverage rate.

3.07 SPRAY APPLIED FOAM INSULATION

- A. Polyurethane foam shall be processed at design temperatures and at a 1:1 ratio. See manufacturer recommendations for specific instructions.
- B. Atmospheric Conditions: the product shall not be applied when the temperature is within 5 degrees F of the dew point.
- C. Sprayed polyurethane foam shall be applied in multiple passes, minimum $\frac{3}{4}$ " thick, maximum 2" per pass. For winter application consult manufacturers technical personnel for specific instructions. The full thickness of sprayed polyurethane foam shall be applied in the same day.
- D. When applying polyurethane foam over gypsum board, the first pass shall be no more than one inch in thickness.

3.08 VAPOR RETARDER APPLICATION

- A. When required, a vapor barrier shall be applied to the warm side of the foam insulation. In low temperature applications or in high humidity conditions, consult the product manufacturer for specific instructions.

3.09 THERMAL BARRIER APPLICATION

- A. In interior applications the polyurethane foam shall be covered with an approved 15 minute thermal barrier.
 1. The thermal barrier shall be applied in accordance with the manufacturer's instructions.

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3.10 CLEAN UP

- A. After the installation is complete, the installer shall remove all masking from protected surfaces. Collect all trash and debris and remove from the site, leaving the site in a clean and orderly condition.

END OF SECTION 07213

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SECTION 07921
JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Application of sealants at control and expansion joints on exterior vertical and horizontal intersections to provide a water and air tight barrier, as specified below and as noted on drawings.
- B. Application of specialty sealants and caulking as noted on drawings.
- C. Associated materials and preparatory work to insure a successful sealant application.

1.02 REFERENCES

- A. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants.
- B. ASTM D 2240 – Standard Test Method for Rubber Property-Durometer Hardness.
- C. ASTM C 1248 – Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- D. ASTM C 719 – Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
- E. ASTM D 412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers–Tension.
- F. ASTM C 834 – Standard Specification for Latex Sealants.
- G. ASTM C 881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- H. ASTM C 510 – Standard Test Method for Staining and Color Change of Single or Multi Component Joint Sealant.
- I. Sealant, Waterproofing and Restoration Institute (SWRI) Sealant & Caulking Specification.

1.03 SUBMITTALS

- A. Product Literature: Product data sheets, color charts, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Compatibility with Substrate and Coatings:
 - 1. Applicator shall be responsible for verifying with sealant manufacturer that

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sealants used are compatible with joint substrates and coatings to which sealants will come in contact.

2. Submit written certification from sealant manufacturer of acceptability for adhesion, staining, and compatibility with adjacent materials and finishes.
 3. Schedule sufficient time for the conducting of testing, certification of results and submission which will not cause a project delay.
- B. Applicator shall be responsible for providing a completely sealed joints as detailed and ensure that all joints between surfaces are properly sealed.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years experience.
- B. Use personnel specifically trained in proper application procedures that are thoroughly familiar with joint details shown on drawings and installation requirements as specified in this Section.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver in manufacturer's original, unopened containers identifying each product specified, relating to product literature submitted.
- B. Store in accordance with manufacturer's recommendation; take precautions to ensure material fitness when installed for design performance.

1.07 WARRANTY

- A. Upon completion of the work, furnish a written and signed manufacturer's warranty against adhesive and cohesive failure of sealant and watertightness of sealed silicone joints for a period of twenty (20) years, and five (5) years for polyurethane sealant. This warranty shall certify the properties of the products affecting their performance and that the products are used in accordance with the recommendations of the manufacturer.
- B. Provide a manufacturers 20-year non-staining warranty for silicone sealant.
- C. The Contractor shall be responsible for damages to the building resulting from failure to prevent penetration of water during construction.

PART 2 - PRODUCTS

2.01 SILICONE SEALANTS (See schedule for each sealant type.)

- A. Type 1: ASTM C 920; low modulus, one component, non-sag, neutral cure silicone.
1. Movement Capability: ASTM C 719; plus 100 percent to minus 50 percent; elongation, 1600% per ASTM D 412.
 2. Service Temperature Range: Minus 20 to 160 degrees F.

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3. Shore A Hardness Range: 15 – 20; ASTM D 2240.
 4. Staining: None; ASTM C 1248.
 5. Manufacturers: Dow Corning Corp. 790, or Approved Equivalent
- B. Type 2: ASTM C 920; intermediate modulus, one component, non-sag, neutral cure silicone.
1. Movement Capability: Plus or minus 50 percent.
 2. Service Temperature Range: Minus 40 to 300 degrees F.
 3. Shore A Hardness Range: 30; ASTM D 2240.
 4. Staining: None; ASTM C 510.
 5. Manufacturers: Dow Corning Corp. 795, 995, or Approved Equivalent
- C. Type 3: ASTM C 920; high modulus, one component, non-sag, acetoxy cure silicone.
1. Movement Capability: Plus or minus 25 percent.
 2. Service Temperature Range: Minus 35 to 140 degrees F.
 3. Shore A Hardness Range: 23; ASTM D 2240.
 4. Manufacturers: Dow Corning Corp. 999A; Pecora 863; GE 1200.
- D. Type 4: ASTM C 920; medium modulus, one component, non-sag, neutral cure silicone.
1. Movement Capability: Plus or minus 50 percent.
 2. Service Temperature Range: Minus 20 to 120 degrees F.
 3. Shore A Hardness Range: 25 – 30; ASTM D 2240.
 4. Staining: None; ASTM C 1248.
 5. Manufacturers: Dow Corning Corp. 791; GE Silprof.
- E. Type 5: ASTM C 920; one component, self-leveling, fuel resistant, low modulus silicone.
1. Movement Capability: Plus 100, minus 50 percent.
 2. Service Temperature Range: Minus 20 to 160 degrees F.

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3. Shore A Hardness Range: 15 – 20; ASTM D 2240.
4. Manufacturers: Dow Corning Parking Structure Self Leveling.

F. Type 6: ASTM C 920; one component, non-sag, sanitary silicone sealant.

1. Movement Capability: Plus or minus 25 percent.
2. Shore A Hardness Range: 20 – 20; ASTM D 2240.
3. Manufacturers: Dow Corning Corp. 786, GE 1700, Percora 898.

2.02 POLYURETHANE SEALANTS

A. Type 7: ASTM C 920; medium modulus, two component, non-sag, polyurethane.

1. Movement Capability: Plus or minus 50 percent.
2. Service Temperature Range: Minus 20 to 120 degrees F.
3. Shore A Hardness Range: 20 – 40; ASTM D 2240.
4. Manufacturers: Sika Corporation, Sikaflex 2c; Tremco, Dymeric 241, Pecora, Dynatrol II.

B. Type 8: ASTM C 920; low modulus, one component, non-sag, polyurethane.

1. Movement Capability: Plus or minus 50 percent.
2. Service Temperature Range: Minus 20 to 120 degrees F.
3. Shore A Hardness Range: 25 – 25; ASTM D 2240.
4. Manufacturers: Tremco, Vulkem 921, Sika Corporation, Sikaflex 15LM.

2.03 SPECIALTY SEALANTS

A. Type 9: Semi rigid, two component, epoxy joint filler.

1. Movement Capability: N/A, designed for non-moving floor joints.
2. Service Temperature Range: 40 to 120 degrees F.
3. Shore A Hardness Range: 50 - 75; ASTM D 2240.
4. Manufacturers: Euclid Chemical, Euco 700, Sika Corporation, Sikadur CJR LPL.

B. Type 10: ASTM C 881; two component (security area) pick proof epoxy sealant.

1. Service Temperature Range: 40 to 120 degrees F.
2. Manufacturers: Sika, Sikadur 23 Lo-Mod Gel.

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- C. Type 11: ASTM C 920; Polyurethane security sealant.
 - 1. Movement Capability: Plus or minus 12.5 percent.
 - 2. Service Temperature Range: Minus 20 to 120 degrees F.
 - 3. Shore A Hardness Range: 49 – 60; ASTM D 2240.
 - 4. Manufacturers: Pecora Corporation, Dynaflex; Sika Corporation, Sikaflex TR.

2.04 CAULKING

- A. Type 13: ASTM C 834; Acrylic latex caulking compound with silicone.
 - 1. Movement Capability: Plus or minus 7.5 percent.
 - 2. Manufacturers: Pecora, AC-20+Silicone; Tremco, Tremflex 834.

2.05 PRIMERS

- A. Comply with manufacturer's instructions. Manufacturer shall be consulted for all surfaces not specifically covered in submitted application instructions.

2.06 BACKER ROD - TAPE

- A. Closed-cell polyethylene; open-cell polyurethane; or non gassing, open-cell polyethylene soft-type backer rod as recommended by sealant manufacturer. Bond breaker tape shall be used to prevent three-sided adhesion in locations where backer rod cannot be used.
- B. Acceptable Manufacturers:
 - 1. Closed-Cell: ITP, Standard Backer Rod; Nomaco Standard Backer Rod.
 - 2. Open-Cell: Denver Foam; ITP Tundra Foam; Nomaco.
 - 3. Soft-Type: ITP Soft-type; Nomaco Soft-rod.
 - 4. Bond Breaker Tape: Pecora Corp.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrate surfaces to ensure no bond breaker materials contaminate surface to which sealant is to adhere, and that unsound substrates are repaired.
- B. Verify joint dimensions are within manufacturer's acceptable tolerances, per manufacturer's submittal literature.

3.02 PREPARATION

- A. Protect adjacent exposed surfaces.

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- B. Prepare joints in accordance with manufacturer's recommended instructions for maximum adhesion; prime as required by manufacturer.
- C. Consult manufacturer for surfaces not specifically covered in application instructions.
- D. Installation of sealant shall be evidence of acceptance of substrate.

3.03 INSTALLATION: GENERAL.

- A. Both temperature and dampness conditions may restrict application of these sealants. Comply with manufacturer's instructions.
- B. Sealant shall be mixed (if multi-component) and installed in accordance with manufacturers' recommendations and instructions to ensure complete mixing and an installed proper width/depth ratio with maximum adhesion contact. Prevent three-sided adhesion.

3.04 BACKER ROD INSTALLATION

- A. Backer rod shall be installed using only blunt or rounded tools which will ensure a uniform (+ or – 1/8") depth without puncturing the material. Backer rod shall be a minimum of 33% oversized for closed cell or soft rod and a minimum of 50% oversized for open cell backer rod, unless otherwise required by the manufacturer.
- B. Set backer rod at proper depth in the joint. Do not leave voids or gaps between the ends of joint filler.

3.05 SEALANT INSTALLATION

- A. Deposit sealants in uniform, continuous ribbons without gaps with complete "wetting" of the joint bond surfaces equally on opposite sides. Fill sealant joint to a slightly concave surface, slightly below adjoining surfaces.
- B. Joint Size and Shape: Install sealants to depths recommended by sealant manufacturer. Fill joints to a depth equal to 50% of joint width, but no more than 50% of joint width, but nor more than ½-inch deep nor less than ¼-inch deep.
- C. Finished bead shall be smooth, free from wrinkles, air pockets, and foreign matter.

3.06 CLEANING

- A. Remove excess material adjacent to joint.
- B. Remove unused materials from jobsite.

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3.07 SCHEDULE

JOINT TYPE	SEALANT TYPE												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Structural Glazing		X											
Glass to Glass (Non Structural)			X	X									
Perimeter Window Sealant		X		X									
Aluminum to Brick	X			X									
Brick to Brick	X						X						
Wood to Wood				X				X					
Metal to Metal		X		X									
Metal to Stucco				X									
Aluminum to Concrete	X			X									
Concrete to Concrete	X												
Aluminum to Plaster	X												
Stone to Stone	X												
Aluminum to EIFS(note)				X									
EIFS to EIFS (note)	X			X									
Paving on Grade					X								
Interior Caulking													X
Sanitary Sealant						X							
Warehouse Floor Control Joints									X				
Pick Proof Security Joints										X			
Tamper Proof Security Joints											X		
Interior Acoustical Joints												X	

Note: Consult Sealant and EIFS manufacturers for suitability of sealant to specific EIFS system.

END OF SECTION 07921

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SECTION 08100
STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide steel doors and frames, galvanized at exterior locations, as specified and indicated on drawings.

1.02 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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | | |
|----|--------------|--|
| 1. | ANSI 250.6 | Hardware on Standard Steel Doors (Reinforcement Application) |
| 2. | ANSI/SDI-100 | Specifications for Standard Steel Doors and Frames |

ASTM INTERNATIONAL (ASTM)

- | | | |
|----|---------------------|---|
| 1. | ASTM A 153/A 153M | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| 2. | ASTM A 568/A 568M | Steel, Sheet, Carbon and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for |
| 3. | ASTM A 653/A 653M | Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| 4. | ASTM A 924/A 924M | General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| 5. | ASTM C 236 | Steady-State Thermal Performance of Building Assemblies by Means of Guarded Hot Box |
| 6. | ASTM A 1008/A 1008M | Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low-Alloy and High-Strength Low-Alloy with Improved Formability |
| 7. | ASTM A 1011/A 1011M | Steel, Sheet and Strip, Hot-Rolled, Carbon, High-Strength, Low-Alloy and High-Strength |

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Low-Alloy with Improved Formability

- 8. ASTM E 90 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- 9. ASTM E 413 Classification for Rating Sound Insulation

FLORIDA BUILDING CODE

- 1. Latest Issue with modifications and updates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- 1. NFPA 80 Fire Doors and Fire Windows

STEEL DOOR INSTITUTE (SDI)

- 1. SDI-100 Specifications for Standard Steel Doors and Frames
- 2. SDI-105 Erection Instructions for Steel Frames

1.03 QUALITY CONTROL STANDARDS

- A. Steel doors and frames shall conform to one of the following standards except as specified herein.
 - 1. ANSI/SDI -100.
- B. Provide fire-rated door and frame assemblies where indicated and where required by Code and local authority having jurisdiction. Fire-rated doors and frames shall comply with NFPA 80 Standard for Fire Doors and Windows, and have been tested, approved, listed and labeled in accordance with standard methods of fire tests of door assemblies acceptable to NFPA.
 - 1. Where louvers are indicated in fire-rated doors, provide steel louvers that have been tested, approved, listed and labeled by UL or FM Provide replaceable fusible links.
- C. Hardware preparations and locations shall conform to the following.
 - 1. ANSI A250.6

1.04 SUBMITTALS

- A. Manufacturer's Product Data: Submit for each type door and frame and each accessory required.
- B. Shop Drawings: Submit details for installation and anchorage of each frame type, elevations of each door type. Include finish hardware location and reinforcements.
 - 1. Provide schedule of doors and frames using same reference numbers for details and openings as the drawings.

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2. Provide schedule of glazing frames and stops with glazing requirements.
3. Submit manufacturer's certification for each fire door and frame assembly with name of testing agency.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Protect doors and frames from damage and exposure. Store in dry location indoors stacked on wood runners.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide steel doors and frames manufactured by one of the following members of the Steel Door Institute:
 1. Amweld Building Products, Inc.
 2. Ceco Door Products; a United Dominion Company.
 3. Curries Company.
 4. Mesker Door, Inc.
 5. Pioneer Industries, Inc.
 6. Republic Builders Products.
 7. Steelcraft; a division of Ingersoll-Rand.

2.02 MATERIALS

- A. Hot-Rolled Steel Sheets: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 568/A 568M and ASTM A 1011/A 1011M and.
- B. Cold-rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 568/A 568M and ASTM A 1008/A 1008M.
- C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets, commercial quality, complying with ASTM A 653/A 653M or ASTM A 924/A 924M, G60 zinc coating, mill phosphatized.
- D. Supports and Anchors: Fabricate of not less than 18-gage galvanized sheet steel.
- E. Inserts, Bolts and Fasteners: Manufacturer's standard units hot-dip galvanized complying with ASTM A 153/A 153M, Class C or D as applicable.

2.03 DOORS AND PANELS

- A. Provide steel doors of type indicated on drawings.

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1. Exterior Doors: Minimum 16-gage, ASTM A 653/A 653M, galvanized steel sheet face panels.
2. Interior Doors: Minimum 18-gage, ASTM A 366/A 366M, cold-rolled steel face panels.

2.04 STEEL FRAMES, WELDED

- A. Provide metal frames for doors, transoms, sidelights, view windows and other openings indicated on drawings.
- B. Fabricate frames with mitered corners, welded and ground smooth. Each jamb shall have 14 gage steel floor anchor welded to inside of jamb. All frames over 4-feet wide shall have 12 gage channel stiffener welded in head member.
- C. Door Silencers: Except on fire-rated frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.
- D. Plaster-Mortar Guards: Provide 26-gage steel guards welded to frame, at back of finish hardware cutouts to close off interior of openings and to prevent mortar from entering cutouts.
- E. Jamb Anchors: Fabricate of 16 gage steel minimum. Anchors in masonry and concrete shall be galvanized, T-shaped and corrugated or punched for embedding in mortar. Anchors for steel studs shall be T-shaped with integral stirrup straps for attaching to studs.
- F. Spreaders: Each welded frame shall be provided with a factory installed spreader bar at bottom of jambs.
- G. Provide UL labeled fire doors and frames where indicated.

2.05 FABRICATION

- A. Fabricate door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Weld all seams and grind smooth.
- B. Doors:
 1. Full flush or seamless, seams and joints welded and ground smooth. All doors shall be sound deadened by filling core with non-combustible mineral fiber.
 2. Close top and bottom edges of exterior doors and panels as integral part of construction or with 14-gage steel channel flush welded into place and ground smooth.
 3. Glass Lites: Where glass lites are indicated, prepare openings in the factory and provide 20 gage steel moldings and stops attached with countersunk Phillips head screws. Galvanize frames and stops for all exterior doors.
 4. Door Louvers: Provide sightproof stationary louvers in doors where indicated, fabricate of inverted Y-shaped blades formed of 16-gage steel set into 18-gage steel frame. Galvanize louvers and frames for all exterior doors.

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- C. Frames: Form frames to profiles indicated. If not indicated provide 2-inch face by 5 $\frac{3}{4}$ -inch jamb depth, double equal rabbet, integral buck and stop frame with $\frac{1}{2}$ -inch returns.
 - 1. Fabricate all exterior frames, all frames in masonry and all frames over 4-feet wide of 16 gage steel.
 - 2. Fabricate interior frames (except frames in masonry) up to 4-feet wide of 18-gage steel; frames over 4-feet wide of 16-gage steel.
 - 3. Fabricate interior frames (except frames in masonry) up to 4-feet wide of 16-gage steel; frames over 4-feet wide of 14-gage steel.
- D. Exposed Fasteners: Provide countersunk flat Phillips heads.
- E. Shop Primer: Manufacturer's standard rust-inhibitive coating.

2.06 FINISH HARDWARE PREPARATION

- A. Prepare doors and frames to receive finish hardware with templates provided by hardware supplier. Comply with ANSI/DHI A115 series. Reinforce doors and frames to receive surface-applied hardware. Locate finish hardware in accordance with referenced DHI Standard.

2.07 SHOP PRIME

- A. Clean and treat all exposed steel surfaces including galvanized surfaces of mill scale, rust, oil and other foreign materials. Apply shop prime not less than 1.5 mils dry to provide uniformly finished surface ready to receive finish paint.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install steel doors, frames and accessories in accordance with approved shop drawings, referenced standards and manufacturer's data.

3.02 FRAME INSTALLATION

- A. Comply with SDI-105, unless otherwise specified or indicated.
- B. Set frames accurately in position, plumbed, aligned and braced securely until permanent anchors are set. Anchor floor anchors to floor with $\frac{3}{8}$ -inch bolts and drilled-in steel expansion sleeves. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 1. Jamb Anchors: Provide 3 jamb anchors per jamb for frames up to 7'-6". Install at hinge and strike levels. Frames to 8-feet shall have 4 anchors per jamb; frames over 8-feet shall have 5 anchors per jamb.
 - 2. In-Place Steel, Concrete and Masonry Construction: Set frames and secure to adjacent construction with machine screws and in-place type anchorage devices furnished by frame manufacturer.

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3. Metal Stud Partitions: Attach jamb anchors to studs with self-tapping screws.
4. Masonry: Install anchors in masonry joints as masonry is laid up, fill frames with mortar.

C. Fire Rated Frames: Install in accordance with NFPA 80.

3.03 DOOR INSTALLATION

- A. Fit hollow metal doors accurately in frames, within clearances specified in ANSI A250.8.
- B. Fit fire-rated doors with clearances as specified in NFPA 80.

3.04 ADJUST AND TOUCH-UP

- A. After erection, sand rusted and damaged areas smooth and touch-up all damaged primer.
- B. Adjustments: Check and readjust hardware so that doors operate as intended.

END OF SECTION 08100

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SECTION 09260
GYPSUM DRYWALL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide gypsum drywall work shown on drawings and specified.

1.02 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.

ASTM INTERNATIONAL (ASTM)

- | | | |
|-----|-------------------|--|
| 1. | ASTM A 653/A 653M | Design of Cold-Formed Steel Structural Members |
| 2. | ASTM C 36/C 36M | Gypsum Wallboard |
| 3. | ASTM C 79/C 79M | Treated Core and Non-treated Gypsum Sheathing Board |
| 5. | ASTM C 475 | Joint Compound and Joint Tape for Finishing Gypsum Board |
| 6. | ASTM C 514 | Nails for the Application of Gypsum Board |
| 7. | ASTM C 557 | Adhesives for Fastening Gypsum Wallboard to Wood Framing |
| 8. | ASTM C 630/C 630M | Water-Resistant Gypsum Backing Board |
| 9. | ASTM C 645 | Nonstructural, Steel Framing Members |
| 10. | ASTM C 665 | Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing |
| 11. | ASTM C 754 | Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products |
| 12. | ASTM C 840 | Application and Finishing of Gypsum Board |
| 13. | ASTM C 954 | Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 Inch (0.84 mm) to 0.112 Inch (2.84 mm) In Thickness |

UNITED STATES GYPSUM CO. (USG)

1. Gypsum Construction Handbook

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1.03 QUALITY ASSURANCE

- A. ASTM Standards: Comply with applicable requirements.
- B. Fire Resistance Ratings: Provide assemblies that have been tested, approved and listed by Underwriter's Laboratories, Inc., FM Global or other testing agency acceptable to local authorities and code.

1.04 SUBMITTALS

- A. Submit manufacturer's product data, specifications and installation instructions for each product, system and component.
- B. Submit shop drawings for details not in manufacturer's data. Include drawings locating wall control joints as required by ASTM C 840 and drywall manufacturer. Control joint location is subject to approval by the Architect.
- C. Submit a copy of the test(s) reports for each proposed Fire-Resistance Rated assembly.

1.05 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 and off the ground.

PART 2 - PRODUCTS

2.01 STEEL STUD FRAMING AND FURRING

- A. Steel Studs: Conform to ASTM C 645; 25-gage minimum at interior locations; ASTM A 653/A 653M galvanized steel; profile, size and spacing shown on drawings. Gage of metal shall be increased in accordance with ASTM C 754 Table 3 or manufacturer's limiting height tables so that deflection shall not exceed L/240 at 10 psf.
- B. Stud Accessories: Provide galvanized steel.
 - 1. Runners: Provide type recommended by stud manufacturer to match studs, for floor and ceiling support of studs, and for abutment to other work.
 - 2. Stud System Accessories: Provide stud manufacturer's standard reinforcements, fasteners and other accessories.
 - 3. Deflection Clips: Provide attachment system or clips for attachment of studs to head track designed to permit deflection of structure without transferring vertical loading to the studs where studs extend from floor to underside of floor above.
- C. Steel Furring: ASTM C 645; 25-gage, hat-shaped, galvanized.
- D. Fasteners for Steel: ASTM C 954; size recommended by gypsum board manufacturer.

2.02 GYPSUM WALLBOARD

- A. Regular Gypsum Wallboard: ASTM C 36/C 36M, regular type with tapered long edges.
 - 1. Sheet Size: Maximum length available by 4'-0" wide.

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2. Thickness: Shall be $\frac{5}{8}$ -inch unless otherwise indicated.
 3. Use sag-resistant type for ceiling surfaces.
- B. Fire Retardant Gypsum Wallboard: ASTM C 36/C 36M, Type X, provide where fire rated construction is indicated.
1. Size: 4-foot wide sheets by maximum length available.
 2. Thickness: Shall be $\frac{5}{8}$ -inch.

2.03 TRIM ACCESSORIES

- A. Provide galvanized steel trim accessories manufactured by U.S. Gypsum Company, or approved equivalent.
1. Casing Trim: USG No. 200 series, type as detailed.
 2. Corner Beads: USG NO. 103 Durabead reinforcement, 1¼" x 1¼".
 3. Control Joints: USG No. 093.

2.04 JOINT TREATMENT MATERIALS

- A. Comply with ASTM C 475.
- B. Joint Tape: U.S. Gypsum Perf-A-Tape or approved equivalent by Georgia Pacific or National Gypsum Co.
- C. Joint Compound: U.S. Gypsum All-Purpose Ready-Mixed Joint Compound, vinyl tape or approved equivalent by Georgia Pacific or National Gypsum Co.

2.05 MISCELLANEOUS MATERIALS

- A. Fastening to Wood: Nails, ASTM C 514 or screws, ASTM C 954.
- B. Fastening to Metal: Screws, ASTM C 954.
- C. Adhesive Fastening to Wood: ASTM C 557.
- D. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.

PART 3 - EXECUTION

3.01 INSTALLING STEEL FRAMING AND FURRING, GENERAL

- A. Comply with ASTM C 754 for installation of steel framing members; ASTM C 1007 for load bearing partitions, and manufacturer's instructions for screw attachment of gypsum board.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, trim, grab bars, toilet accessories, furnishings or other similar items supported from ceiling or partition framing. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with

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"Gypsum Construction Handbook" published by U. S. Gypsum Company.

- C. Installation Tolerances:
1. Install framing to an alignment tolerance not to exceed $\frac{1}{8}$ -inch in 10-feet vertically and horizontally. Square corners to a tolerance not to exceed $\frac{1}{8}$ -inch in 4-feet each side of corner.
 2. Install steel framing components for suspended ceilings so that cross-furring members or grid suspension members are level to within $\frac{1}{8}$ -inch in 12-feet as measured both lengthwise on each member and transversely between parallel members.
- D. Do not bridge building expansion joints with support system, frame both side of joints with furring and other support as indicated.

3.02 INSTALLING STEEL FRAMING FOR PARTITIONS AND WALLS

- A. Install steel studs and furring in sizes and at spacings indicated but not less than that required by the referenced steel framing installation standard to comply with maximum loading requirements specified.
- B. Space studs at 16-inches o.c. unless otherwise shown on drawings.
- C. Terminate partition stud system at ceilings, except where shown to be extended to structural support or substrate above.
- D. Door Frames: Install a minimum of two jamb studs at door frames. Space jack studs over door frames at same spacing as partition studs.
- E. Space wall furring members 16-inches o.c. except as otherwise indicated on drawings.

3.03 FIRE RATED ASSEMBLIES

- A. Installation, spacing of framing members and spacing of fasteners shall conform to the test report of each fire rated assembly.
- B. Fire rated walls and partitions shall extend to floor or roof construction above.

3.04 GYPSUM WALLBOARD INSTALLATION

- A. Comply with ASTM C 840 systems as listed below, manufacturer's instructions and the requirements specified and indicated for fire-resistance ratings.
1. System I; Application of Single-Ply Gypsum Board to Wood Framing Members.
 2. System II; Application of Two-Ply Gypsum Board to Wood Framing.
 3. System VIII; Application of Gypsum Board to Steel Framing and Furring.
 4. System XIII; Control (Expansion) Joints.
- B. Space Fasteners in wallboard in accordance with ASTM C 840.

3.05 INSTALLATION TRIM ACCESSORIES

- A. Use the same screw fasteners to anchor trim necessary flanges as required to fasten

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gypsum board to the supports. Stapling flanges is not permitted.

- B. Install corner beads at external corners of gypsum board work.
- C. Install edge trim whenever edge of wallboard would otherwise be exposed or semi-exposed. Install L-type trim where work is tightly abutted to other work, and install U-type trim where indicated and where edge is exposed.

3.06 WALLBOARD FINISHING

- A. Comply with ASTM C 840. Apply treatment at wallboard joints, flanges of trim accessories, penetrations, fasteners heads, surface defects and elsewhere as required to prepare work for painting or other decoration. Prefill open joints and beveled edges, using type of compound recommended by manufacturer.
 - 1. Apply joint tape at joints between wallboards, except where a trim accessory is to be provided.
 - 2. Apply joint compound in three coats, not including prefill of openings in base, and sand after second coat and after last coat.

3.07 CLEANING AND PROTECTION

- A. Promptly remove all residual joint compound from adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner that ensures that gypsum board assemblies remain free from damage or deterioration at time of substantial completion.

END OF SECTION 09260

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SECTION 09510
ACOUSTICAL PANEL CEILINGS (ADDITIVE BID)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems. See Section 01030 Bid Additives No. 1 for replacing the existing suspended ceiling tiles and grid in rooms Captain's Office 111, Men's Toilet - R100C, Women's Toilet - R100D, and Lounge 115.

1.03 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. 12 inch- square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch- long samples of exposed suspension system members, including moldings, for each color and system type required.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

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- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
 - 2. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.07 COORDINATION

Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following manufacturers:
- B. Suspension Grid System:
 - 1. Armstrong World Industries Inc.
 - 2. Chicago Metallic Corporation.
 - 3. USG Interiors Inc.
 - 4. Substitutions submitted in compliance with Section 01600.

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- C. Acoustical Panels:
 - 1. Armstrong World Industries Inc.
 - 2. USG Interiors Inc.
 - 3. Celotex Corporation.
 - 4. Substitutions submitted in compliance with Section 01600.
- D. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated as Design Basis, or those producing acceptable equivalent products..

2.02 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.03 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Metal Suspension System Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3.
- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- D. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- G. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.03 INSTALLATION

- A. Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
 - 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
 - 5. Do not attach hangers to steel deck tabs.
 - 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

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- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 - 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, for fire-resistance ratings, and to retain panels tight to grid system within 15 feet of an exterior door. Space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.
 - 5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.04 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Conduct an above-ceiling observation prior to installation of acoustical panel ceilings and report any deficiencies in the Work observed. Do not proceed with installation of acoustical panels to ceiling suspension system until deficiencies have been corrected.
 - 1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
 - 2. Prior to notifying Architect, complete the following in areas to receive acoustical panel ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - c. Installation of air duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control air tubing.
 - f. Installation of ceiling suspension system.
 - g. Firestopping of penetrations and joints in fire rated assemblies.
 - h. Smoke sealing of penetrations and joints in smoke resistant assemblies.

3.05 CLEANING

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- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.06 ACOUSTICAL PANEL CEILING AND SUSPENSION SYSTEM SCHEDULE

- A. Suspension System for Acoustical Panel Ceiling: Where scheduled or indicated, provide non-fire rated and fire-resistance-rated acoustical panel ceiling suspension system complying with the following:

- 1. Products: Design Basis.
 - a. "DX 24" as manufactured by USG Interiors Inc. , with characteristics and requirements as follow:
- 2. Standard, Single-Web, Extruded-Aluminum Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with 7/8-inch-wide faces; other characteristics as follows:
 - a. Structural Classification: Intermediate-duty system, components die cut and interlocking.
 - b. Face Finish: Unless indicated or directed otherwise, painted white.

- B. Acoustical Panels: Where scheduled or indicated, provide acoustical panels complying with the following:

- 1. Ceiling Designation CA1 Product: Design Basis.
 - a. "Radar" as manufactured by USG Interiors Inc. with characteristics and requirements as follows:
 - b. Classification: Panels fitting ASTM E 1264, Class A, fiber base with factory applied finish.
 - c. Light reflectance: 75 percent minimum.
 - d. NRC Rating: .70.
 - e. Color: White.
 - f. Edge Detail: Square.
 - g. Size: 24 by 24 inches.
 - h. Thickness: 5/8 inch.

END OF SECTION 09510

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SECTION 09900
PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide interior painting work specified herein and when shown on the drawings. The word paint means to apply paint materials and refers to the paint materials specified including primers, undercoats, sealers, fillers, stains and the finish coats of paint material.
- B. Shop priming and primer touch-up miscellaneous steel items is specified in other sections.
- C. The work includes painting of interior unfinished and primed items and surfaces throughout the project, unless otherwise specified or shown on drawings. Where items and surfaces are not specifically identified but are not specifically excluded from the painting work, paint the same as specified for adjacent similar surfaces and items.
- D. Colors will be selected by Architect.
- E. Coordinate painting with all other sections for surfaces and items specified to be shop primed and for items to be factory and shop finished.

1.02 SURFACES NOT TO BE PAINTED

- A. Surface preparation and priming of items and surfaces specified in other sections to be factory or shop primed.
- B. Surfaces and items specified in other sections to be factory or shop finished.
- C. Concealed wall and ceiling surfaces and inaccessible surfaces such as in pipe and duct chases and shafts, elevator shafts and similar areas.
- D. Galvanized steel surfaces that will be concealed in completed work.
- E. Fire rating labels, equipment labels and name plates.

1.03 SUBMITTALS

- A. Manufacturer's Product Data: Submit for each product. Include block fillers and primers.
 - 1. General: Include manufacturer's identification numbers, major pigment and vehicle constituents by volume, surface preparation, mixing, thinning, application and curing instructions.
 - 2. Material List: Submit an inclusive list required coating materials. Submit list of manufacturer's brand name and number of each material proposed for use. Identify surface(s) to receive material.

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3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples: Submit for each material and color to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
- C. Qualifications: Applicators shall submit data to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information that may substantiate experience.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Applicator shall have 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.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver all 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 or material name.
 2. Product description (generic classification or binder type).
 3. Contents by volume, for pigment and vehicle constituents.
 4. Thinning and application instructions.
 5. Volatile organic compound (VOC) content.

1.06 JOB CONDITIONS

- A. Paint Application:
 1. Apply water-based paints only when temperature of surfaces to be painted are between 50°F and 90°F.
 2. Apply solvent thinned paints only when the temperature of surfaces to be painted are between 45°F and 95°F.
- B. Do not apply paint when the relative humidity exceeds 85 percent; or at temperatures less than 5°F above the dew point; or to damp or wet surfaces.
- C. Paint Coordination: Review other sections in which primer paints are specified to ensure chemical compatibility with finish coating system. Furnish finish products which are compatible with primer products, or apply barrier coats over incompatible primers or remove and reprime.
- D. Protection: Remove or otherwise protect hardware, lighting fixtures, sprinkler heads,

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electric device plates, HVAC grilles and registers and similar items in place prior to painting and re-position upon completion of operations. Protect floors and other adjacent work by use of clean drop cloths or similar coverings. Protect the work of other trades from damage. Post signs on freshly painted surfaces immediately following their completion.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Paint systems, primers, sealer, fillers and finish paint shall be by one manufacturer for each type surface. Products shall be factory ready mixed for immediate application without thinning or other modification.

2.02 ACCEPTABLE MANUFACTURERS

- A. First grade products of the following manufacturers are acceptable, subject to submittal and approval of a schedule of products listing the surfaces for which they are intended.
 - 1. Benjamin Moore & Company.
 - 2. ICI Paints. (Formerly Devoe & Reynolds Company and Glidden Paint)
 - 3. PPG Industries, Inc.
 - 4. Pratt & Lambert Company.
 - 5. Sherwin-Williams Company.
- B. Products of Sherwin-Williams Company are listed in the Product Schedule to illustrate paint material quality and type. Equivalent products of the listed acceptable manufacturers are also acceptable.

2.03 PRODUCT SCHEDULE

- A. Block Filler: A24W200, high-performance acrylic resin latex emulsion block filler for interior use in filling bare CMU and concrete before application of finish coats.
- B. Primers for Metals:
 - 1. Universal Metal Primer: B50Z Series Kem Kromik acrylic/alkyd base metal primer for all interior ferrous metal.
 - 2. Galvanized and Non-ferrous Metal Primer: Promar 200, solvent based acrylic primer for all galvanized and non-ferrous metal.
- C. Primers for Wood:
 - 1. PrepRite classic latex primer for interior wood to receive paint finish.
- D. Primer-Sealer: B28W200 PrepRite 200 premium quality latex primer-sealer for drywall.
- E. Flat Masonry Paint: A-100 (A6), acrylic latex base masonry paint for exterior concrete

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and stucco.

- F. Interior Flat: B30 ProMar 200, vinyl-acrylic latex type low sheen finish coat.
- G. Interior Satin: B20 ProMar 200, vinyl acrylic latex type eggshell sheen enamel finish coat.

PART 3 - EXECUTION

3.01 PREPARATION OF SURFACES

- A. Cleaning: Remove accumulated dirt and loose dust by brushing or wiping.
- B. Concrete Masonry: Clean all excess mortar, loose and foreign material using metal scraper and wire brush. Remove all grease and oil spots by suitable cleaning compound and rinse (to remove alkali). If necessary, neutralize by washing with zinc sulphate solution.
- C. Gypsum Board: Inspect joint and nail-head treatment; correct all imperfections before proceeding. Remove all dust and dirt by use of a soft cloth or brush.
- D. Metal: Surfaces shall be free of rust and loose scale. Clean with mineral spirits before painting. Surfaces which will be inaccessible after installation shall be completely painted before installation. Prime field welds, bolts and rivets.
 - 1. Aluminum: Clean and remove all lacquer or other protective coating.
 - 2. Steel: Wipe shop primed metal clean of foreign matter, retouch where scratched, marred or rusted using similar primer. As soon as practical after erection (to minimize rusting) wire brush structural and miscellaneous steel and touch-up welds, scratches and abrasions of shop applied primer.
- E. Wood: Sandpaper smooth. Before installation apply wood-sealer. Back-prime trim and prime cut ends to match finished surface. Ease sharp knife-edge corners by rubbing with fine sandpaper. Remove soil by wiping using clean cloth moistened with alcohol.

3.02 APPLICATION

- A. Workmanship: Read and conform to instructions in label on containers. Materials uniformly spread and smoothly finished. Do not thin in excess of the printed directions. Mix and apply in accordance with manufacturer's directions. Field applied priming coats shall be applied as soon as possible after the work is received or in place. Apply coats by brush or roller. Coverage of products shall not be less than that recommended by manufacturer. When finishing operating parts, the parts shall be painted in the "open" position and shall remain so until dry. Metal surfaces required to be bare for proper operations shall be kept free of paint. Cut sharp lines at different colors, glass and other unpainted materials. In painted work each coat shall differ in color from the preceding and succeeding coats.

3.03 COLORS

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- A. Colors shall match colors scheduled by manufacturer's colors.
- B. Colors for surfaces not scheduled:
 - 1. Access Panels: Match adjacent wall or ceiling.
 - 2. Electric and Telephone Panels: Match adjacent walls.
 - 3. Closets: Match spaces into which they open.
 - 4. Steel Door Frames: Match door.
 - 5. Hardware (prime coated hinges and closers): Match door and frames to which attached.
 - 6. Interior of Ducts Visible Through Grilles: Matte black.

3.04 INTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Universal metal primer and two coats interior semi-gloss enamel.
- B. Non-Ferrous and Galvanized Metal: Galvanized and non-ferrous metal primer and two coats interior semi-gloss enamel.
- C. Gypsum Drywall:
 - 1. Walls: Primer-Sealer and two coats interior satin latex finish coat.
- D. CMU: Block Filler and two coats interior satin latex finish coat.
- E. Metal Doors and Frames: Primer and two coats interior latex semi-gloss enamel.
- F. Metal Panels: Primer and two coats of satin latex finish paint.

3.05 TOUCH-UP

- A. Retouch finished surfaces, including factory finished items, necessary so work is neat, clean and unblemished at time of substantial completion.

3.06 CLEANING

- A. Keep freshly coated surfaces, brushed and cans clean and dust free. Remove paint splatters and daubs from hardware, glass, floors and any other surfaces not indicated to be painted.

END OF SECTION 09900

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SECTION 11166
ACCORDION STRIP DOORS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes manually operated, folding accordion strip doors.
- B. Provide at interior of existing overhead garage door locations as detailed.

1.2 SUBMITTALS

- A. Product data on physical characteristics, durability, characteristics for the accordion strip doors specified.
- B. Shop drawings showing location and extent of the accordion strip doors.
- C. Template drawings prepared by manufacturer showing location of items supported or anchored by permanent construction.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain accordion strip doors and mounting hardware from one source and a single manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer and brand name.
- B. Store accordion strip doors, blocked off ground , in original undamaged packages and containers, inside well ventilated area protected from weather, moisture, soiling, extreme temperatures and humidity.
- C. Comply with instructions and recommendations of manufacturer for special delivery, storage and handling requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The design is based on product manufactured by AKON-Curtain and Dividers Company.
- B. Approved equivalent.

2.2 MATERIALS

- A. Door Strips: Heavy Duty Black PVC

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1. Strip Width: 12-inches.
 2. Strip Thickness: .120-inches.
 3. Strip Overlap: 67%.
- B. Hardware: Manufacturer's standard, galvanized.
- 2.3 STRIP OPERATION
- A. Manually operated by pull cord located on left or right side of door opening.
1. Bi-parting operation.
- 2.4 MOUNTING
- A. Mount to a support beam with face mounting as detailed.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. Examine existing door opening for compliance with requirements for installation tolerances and other conditions affecting performance of the accordion strip door operation. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION
- A. Install accordion strip doors in conformance with drawings, approved shop drawings and in strict compliance with manufacturer's written installation instructions.
- 3.3 ADJUSTING
- A. Lubricate hardware and sliding parts, adjust pulleys to insure smooth, easy operation.
- 3.4 CLEANING
- A. Clean all accordion strip door surfaces and clean adjacent surfaces soiled by work of this section. Avoid use of abrasive cleaners or solutions containing corrosive solvents. Use cleaning materials recommended by manufacturer.

END OF SECTION 11166

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SECTION 15010
MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Each Section within Division 15, Mechanical, shall conform to the requirements of the General Conditions of the Contract, including Supplementary General Conditions, Special Conditions, and all requirements of Division 1.
- C. Each Section within Division 15, Mechanical, shall conform to the additional requirements of this Section, Mechanical General Provisions.

1.2 ARTICLES INCLUDED

- A. Definitions.
- B. Permits, Fees and Notices.
- C. Applicable Publications.
- D. Code Compliance.
- E. Scope of Work.
- F. Record Drawings.
- G. Intent of Drawings and Specifications.
- H. Quality Assurance
- I. Submittals.
- J. Product Requirements, Equals and Substitutions.
- K. Manufacturers Instructions.
- L. Transportation and Handling.
- M. Storage and Protection.
- N. Cutting, Patching and Demolition.
- O. Cleaning Up/Removal of Debris.
- P. Starting of Mechanical Systems.
- Q. Operating and Maintenance Manuals.
- R. Training of Owners Operators.

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- S. Guarantee of Work.
- T. System Testing.

1.3 ARTICLES

A. Definitions:

1. The term "As indicated" means as shown on drawings by notes, graphics or schedules, or written into other portions of contract documents. Terms such as "shown", "noted", "scheduled" and "specified" have same meaning as "indicated", and are used to assist the reader in locating particular information.
2. The term "Provide", means furnish and install as part of the work covered in Division 15.
3. The term "Furnish" means furnish only, for installation, as part of this contract, by other Divisions.
4. The term "Install only" means to install under the work of Division 15 equipment furnished by other Divisions, or by the Owner.
5. The term "Owner's Representative" when referenced herein shall be the Architect or the Engineer acting as his designated representative unless otherwise noted.
6. The term "design" as it pertains to the work of this division shall describe the basic intent, component sizing, component relationships and overall architecture of the HVAC, plumbing and fire protection system. The design is generally schematic in nature and will require specific detailing after the accepted products are determined.
7. The term "detail" as it pertains to the work of this division shall describe the work required by the contractor to assure a fully coordinated installation of the material and equipment supplied. When requested, the contractor shall produce detailed shop drawings or sketches indicating the actual placement of the equipment or material supplied; also including how the equipment or material interfaces with work of other sections or divisions within the contract documents.
8. The term "workman-like manner" as it pertains to the work of this division shall describe a neat well organized high quality installation system (duct, pipe, control wire or tube, conduit, etc.). Routing shall be well thought out providing adequate service clearance and maximum use of space. Equipment placement shall exhibit proper clearances for service. All lines (duct, pipe, control wire or tube, conduit, etc.) shall be run straight and true, parallel or perpendicular to building structure neatly supported.
9. For additional definitions refer to the General Conditions.

B. Permits, Fees and Notices: Comply with the General Conditions.

C. Applicable Publications:

1. Publications listed in each Section form a part of that Section to the extent referenced.
2. When a standard is specified by reference, comply with requirements of that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
3. The Publication or Standard is the publication in effect as of the bid date, except when a specific date is listed.

D. Code Compliance:

1. 2006 Life Safety Code - NFPA 101
2. 2010 The Florida Building Code

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3. 2010 The Florida Accessibility Code for Building Construction
 4. 2008 National Electric Code (NEC)
 5. 2010 The Florida Building Code – Mechanical
 6. 2009 NFPA Standards
- E. Scope of Work: The work to be performed under this Division consists of the satisfactory completion of all HEATING, VENTILATING, AIR CONDITIONING, as indicated in the Contract Documents.
- F. Record Drawings: Comply with the General Conditions.
- G. Intent of Drawings and Specifications:
1. The intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment and workmanship, and to provide operable mechanical systems complete in every respect.
 2. Existing conditions, dimensions, etcetera, depicted on the drawings are taken from the "as-built" drawings of the original construction supplemented by field observation. The contractor is cautioned to field verify all existing conditions, dimensions, etcetera, notifying the Owner's Representative of any discrepancies other than those minor in nature, for direction, prior to ordering or fabricating equipment or materials. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawing and specifications, the more stringent shall govern, unless the discrepancy conflicts with applicable codes, wherein the code shall govern.
 3. The drawings are diagrammatic, intending to show general arrangement, capacity and location of system components, and are not intended to be rigid in detail. Final placement of equipment, other system components, and coordination of all related trades shall be the contractor's responsibility.
 4. Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets and fittings may not be shown but shall be provided at no additional change in contract cost.
 5. In the event of a conflict, the Owner's Representative will render an interpretation in accordance with the General Conditions.
- H. Quality Assurance:
1. All equipment furnished under this Division shall be listed and labeled by U.L., ETL or a nationally recognized testing laboratory (NRTL).
 2. Material furnished under this Division shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such material and shall be the latest design.
 3. Materials shall be the best of their respective kinds. Materials shall be new except where the specifications permit reuse of certain existing materials.
 4. Work provided for in these specifications shall be constructed and finished in every part in a workmanlike manner.
 5. All items necessary for the completion of the work and the successful operation of a product shall be provided even though not fully specified or indicated on the drawings.
 6. All work to be performed by qualified and experienced personnel specifically trained in their respective field.
 7. All work of this division shall be carefully interfaced with the work of other divisions to assure a complete, functioning system or systems.

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- I. Submittals: Comply with the General Conditions.
- J. Product Requirements, Equals and Substitutions: Comply with the General Conditions.
- K. Manufacturer's Instructions:
 - 1. Installation of work shall comply with manufacturer's printed instructions.
 - 2. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Owner's Representative for clarification. Do not proceed with work without clear instructions.
- L. Transportation and Handling: Comply with General Conditions.
- M. Storage and Protection:
 - 1. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.
 - 2. Store products to prevent damage by the elements. Space temperature shall be controlled as required to prevent condensation and metal corrosion or damage to electrical or electronic parts are the result of condensation.
 - 3. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.
 - 4. Provide protection as necessary to prevent damage after installation.
 - 5. Products which suffer damage due to improper storage shall not be installed and if found in place, shall be removed and replaced at the contractors expense.
- N. Cutting and Patching: Comply with the General Conditions.
- O. Cleaning Up/Removal of Debris:
 - 1. Comply with the General Conditions.
 - 2. Maintain a clean work area. Construction debris shall be immediately removed from all newly erected work.
- P. Starting of Mechanical Systems:
 - 1. Provide material and labor to perform start-up of each respective item of equipment and system prior to beginning of test, adjust and balance procedures.
 - 2. Provide labor to assist the Owner's Representative in acceptance review.
 - 3. Provide point by point system check-out. Submit results in tabulated form by system. Include this data as part of Operation and Maintenance Manuals.
 - 4. Provide information and assistance and cooperate with test, adjust and balance services.
 - 5. Comply strictly with manufacturer's recommended procedures in starting up mechanical systems.
 - 6. Provide such periodic continuing adjustment services as necessary to ensure proper functioning of mechanical systems until acceptance and up to 1 full year after date of Owner acceptance.
- Q. Operating and Maintenance Manuals: Comply with the General Conditions.
- R. Training of Owners Operators:
 - 1. The owners shall be given comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of equipment.

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2. The contractor shall be responsible for scheduling the training which shall start with classroom sessions followed by hands on training on each piece of equipment. Hands on training shall include start-up, operation in all modes possible, shut-down and any emergency procedures.
3. Training shall be conducted in a minimum of three sectors. The first, or orientation portion, shall be scheduled prior to system start-up. The second, or equipment portion, shall be scheduled as soon as possible after start-up of the equipment and the third portion, or the TAB and commissioning portion, shall be conducted after completion of this work.
4. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.
5. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual.
6. The manufacturer's representative shall provide the instructions on each major piece of equipment. These sessions shall use the printed installation, operation and maintenance instruction material included in the O&M manuals and shall emphasize safe and proper operating requirements and preventative maintenance.
7. The contractor shall attend all sessions and shall add to each session any special information relating to the details of installation of the equipment as it might impact the operation and maintenance.
8. The building controls system contractor shall attend all sessions and be prepared to conduct the controls portion of the training as it relates to each equipment section.
9. The building controls system contractor shall conduct the training session on the controls system hardware and software.
10. The piping, insulation and sheet metal sub-contractors shall conduct sessions on their respective trades with emphasis on any peculiarities of the systems, pressure limitations and maintenance requirements.
11. The TAB sub-contractor shall conduct a training session reviewing the procedures and methods used in the TAB process, shall review the TAB data and shall demonstrate use of test equipment which may have been turned over to the owner and shall point out the locations of all pitot traverse locations for the owner's future use.

S. Guarantee of Work:

1. Comply with the General Conditions.
2. Where applicable, furnish manufacturer's written warranty for materials and equipment.
3. Insert warranties in appropriate locations in operating and maintenance manuals.
4. Materials and equipment having seasonal operation limitations, shall be guaranteed for a minimum of one year from date of seasonally appropriate test, and acceptance in writing by the Owner, unless specific Division 15 specifications specify a longer period.

T. System Testing:

1. Provide all necessary labor, materials and equipment to successfully complete all system testing necessary for building occupancy and owner acceptance.
2. Provide all necessary labor, materials and equipment to assist contractors of other division to complete system testing necessary for building occupancy and owner acceptance, wherever an inter-relationship between Division 15 and the work of other divisions exists.
3. Tests shall be repeated as necessary until all occupancy and operation permits are granted and the owner accepts the project.

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PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 15010

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SECTION 15020
DEMOLITION

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.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Heating, Ventilation and Air Conditioning: Remove all existing heating, ventilating and air conditioning equipment as shown on the Contract Documents.

PART 2 – PRODUCTS (Not applicable)

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall obtain the permission of the Owners Representative and coordinate with other trades prior to commencement of demolition of the existing installations.
- B. The Contractor shall provide for safe conduct of the work, protection of property, and coordination with other work in progress. The spread of dust and flying particles shall be minimized.
- C. Existing construction to remain shall be protected from damage. Work damaged by the Contractor shall be repaired to match existing work.
- D. When indicated, the contractor shall remove specific equipment in a careful manner so as to maintain the equipment in proper operating order. This equipment will be turned over to the owner and transported to a storage area as directed by the owner and further described herein.
- E. Material demolished under this section shall become the property of the Contractor and shall be promptly removed and disposed of off the site.
- F. Debris and rubbish shall not accumulate on the site, and shall be disposed of periodically by the Contractor.
- G. All necessary precautions shall be taken by the Contractor to prevent spillage during removal activities. Pavement and areas adjacent to the demolition areas shall be kept clean and free from mud, dirt and debris at all times.
- H. Existing utilities and mechanical systems including related equipment shall be disconnected by the Contractor to the extent shown on the contract drawings or specified and as required to perform the work in accordance with Division 15 of the specifications.
- I. The Contractor shall exercise care during the progress of the work under this section so as not to damage or displace the work of the other trades performed under other sections. He shall coordinate work under this section with work under other sections, as

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necessary for the proper execution of the entire work.

- J. When the contract documents indicate the removal of existing equipment to be temporarily stored and to be re-used, the contractor shall provide adequate protection for the stored equipment including the proper capping of several pipe connections, protection of power and control wiring and devices, and draining of coils to prevent freezing damage.
- K. Equipment which contains refrigerants shall be pumped down prior to demolition. The refrigerant shall be properly contained and disposed of in accordance with the accepted local procedures.

END OF SECTION 15020

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SECTION 15050
BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.
- C. Provisions of Division 7 for Fire and Smoke Stopping requirements.

1.2 WORK INCLUDED

- A. Access doors.
- B. Piping and equipment identification.
- C. Fire and smoke stopping.
- D. Electrical requirements.
- E. Placing of equipment.

1.3 RELATED WORK

- A. DIVISION 7 - Fire and Smoke Stopping.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Section to the extent referenced.
 - 1. American Institute of Steel Construction (AISC) Publications
 - 2. American National Standards Institute (ANSI) Standards
 - 3. American Society for Testing and Materials (ASTM) Publications
 - 4. American Welding Society (AWS) Publications
 - 5. Underwriters Laboratories, Inc. (UL) Standards

1.5 SUBMITTALS

- A. Where submittals are required, comply with Section 15010 Mechanical General Provisions.
- B. Submit drawings of fabricated steel supports where proposed supports are not in accordance with details on drawings, or where drawings do not detail supports. Submittal for acceptance is required.
- C. Submittal for other than fabricated steel supports is not required. Product data for the following shall be included in the operation and maintenance manuals. Submittal for acceptance is not required.
 - 1. Access doors.
 - 2. Piping and equipment identification.
 - 3. Fire and smoke stopping material.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Access Doors:

1. Acudor
2. Elmodor Manufacturing, Co.
3. Karp Metal Associates, Inc.
4. Larsen's Manufacturing Co.
5. Milcor

B. Piping and Equipment Identification:

1. Communications Technology Corp.
2. Craftmark Identification Systems, Inc.
3. EMED Co., Inc.
4. Florida Marking Products, Inc.
5. Marking Services, Inc.
6. Seton Name Plate Corp.
7. W.H. Brady Co., Signmark Division

C. Fire and Smoke Stopping Material:

1. General Electric Company.
2. Hilti, Inc.
3. International Protective Coatings Corp. (IPC) Division of Grace Construction Prod.
4. Johns Manville
5. Rectorseal
6. Tremco, Inc. Sealant/Weatherproofing Division
7. 3M Fire Protection Products.

2.2 FABRICATION

A. Access doors:

1. Access doors: UL labeled where installed in fire rated walls, partitions, and ceilings. Door rating shall be not less than wall, partition, or ceiling rating.
2. Frames: 16 gauge steel, flush trim, with corners welded and ground smooth, masonry anchor strap for masonry walls, bolt holes for mounting in framed openings.
3. Non-fire rated doors: 13 gauge steel, concealed continuous piano hinge with dust flap, flush screwdriver operated lock with stainless steel cam and studs.
4. Fire rated doors: 20 gauge steel welded pan type, concealed continuous piano hinge with stainless steel pins, key-operated latch bolt, interior latch release, automatic door closer, automatic door latch when door closes. The door panel shall contain 2- inch thick insulation in sandwich type construction.
5. Finish of doors and frames: Prime coat of rust inhibitive baked enamel, except as specified otherwise.
6. Finish of doors and frames in wet areas, and in areas with surfaces subject to wet cleaning: No. 4 satin stainless steel.

B. Piping and Equipment Identification:

1. Pipe markers: Sub-surface printed plastic, with protective undercoating. Markers shall be permanently curled for snap-on installation for pipe sizes (including

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insulation) up to 6" diameter. For external diameters above 8". Marker shall be secured using cable ties for indoor use and stainless steel banding or ultraviolet resistant plastic for exterior use. Markers for outdoor installation shall be overlaminated with Tedlar™ on polyester ultraviolet to avoid damage and fading. Markers shall identify the pipe contents and direction of flow through 360 degree visibility range. Marker size, letter size, letter color, wording and background color shall be in accord with ANSI A13.1 – Scheme for the Identification of Piping Systems. Based on Marking Services Inc. Model MS-970 Coiled Plastic Markers for indoor use and Model MS-995 Maxilar Marker for exterior use.

2. Valve tags: Contractors Option:
 - a. Indoor:
 - 1) 19 gauge brass, 1-1/2 inch round, with 1/4 inch high black pipe service letter abbreviation above 1/2 inch high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Valve tag attachment shall be 4 ply 0.018 copper wire meter seal or #6 solid brass bead chain with locking link. Based on Marking Services Inc.
 - 2) 1/16 inch thick plastic, 1-1/2" round, with ¼ inch high black pipe service abbreviation above 1/2 inch high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Color of valve tag shall match pipe marker color. Valve tag attachment shall be 4 ply 0.018 copper wire meter seal or #6 solid brass bead chain with locking link. Based on Marking Services Inc.
 - b. Outdoor Service:
 - 1) 19 gauge brass, 1-1/2 inch round, with 1/4 inch high black pipe service letter abbreviation above 1/2 inch high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Valve tag attachment shall be 4 ply 0.018 copper wire meter seal or #6 solid brass bead chain with locking link. Based on Marking Services Inc.
 - 2) 19 gauge Type 304 stainless steel, 1-1/2" round, with ¼ inch high pipe service abbreviation above 1/2 inch high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Color of valve tag shall match pipe marker color. Valve tag attachment shall be 4 ply 0.018 stainless wire meter seal or #6 Type 304 stainless steel bead chain with locking link. Based on Marking Services, Inc.
3. Valve chart frame: Self-closing, satin-finished, extruded aluminum with glass window, 8-1/2 inch by 11 inch chart size.
4. Equipment nameplates:
 - a. Indoor: Shall be 1/16 inch thick plastic with black satin surface and white core. Lettering shall be engraved through the surface color to expose the core color. Plate size shall be a minimum of 2-1/2 inch by 4 inch, with 3/4 inch high lettering for equipment and 3/4 inch by 2-1/2 inch, with 3/16 inch high lettering for ceiling grid labeling. Equipment identifying name and number shall be in accord with schedules on the Contract Documents. Plate manufacturer shall furnish pre-drilled hole locations for pop riveting. Where pop riveting is not suitable, a suitable adhesive for permanently

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- b. attaching plate to equipment shall be provided.
 - b. Outdoor: Shall be 125 Mil rigid plastic constructed of printed legend sealed between two layers of chemically-resistant plastic to resist ultraviolet damage. Plate size shall be a minimum of 2-1/2 inch by 4 inch, with 3/4 inch high lettering for equipment. Equipment identifying name and number shall be in accord with schedules on the Contract Documents. Plate manufacturer shall furnish pre-drilled hole locations for pop riveting. Where pop riveting is not suitable, a suitable adhesive for permanently attaching plate to equipment shall be provided.
 - c. Based on Marking Services Inc. Model MS-215 Max-Tex.
- D. Fire and Smoke Stopping: Refer to Division 7 for extensive requirements. Fire and smoke stopping material: A one-part silicone elastomer, or a one-part intumescent elastomer caulk or putty, UL classified and FM approved with flame spread of 0 and smoke development not to exceed 50 in accord with ASTM E84. Material shall be suitable for penetration seals through fire-rated floors and walls when tested in accord with ASTM E814 under positive pressure. Material shall not melt or soften at high temperatures, shall be suitable for direct outdoor and ultraviolet exposures, shall cure to give a tight compression fit, and shall not produce toxic fumes. Material, when heated, shall expand to fill and hold penetration closed where burn out of cable insulation or ATC tubing occurs.
- E. Electrical Requirements: Product description not applicable to this Section.
- F. Placing of Equipment: Product description not applicable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation of materials and equipment shall be in accord with the manufacturer's written instructions, except as specified.

3.2 INSTALLATION

A. Access Doors:

1. Deliver access doors to the appropriate trade well in advance of the time they are needed so as to avoid unnecessary delay of the work.
2. Access doors shall be sized as indicated on drawings. If no size is given, provide access door of size suitable for servicing equipment or valve. Unless otherwise noted, the minimum size for a access door shall be 12" x 12".
3. Access doors shall be provided where indicated and if not indicated, where required.
4. Access doors shall be installed so as to allow full door swing.
5. Where full swing and access is not possible, removable doors shall be provided.
6. Access doors not required in lay-in-tile ceilings.

B. Piping and Equipment Identification:

1. Install pipe markers adjacent to each valve and fitting, at each branch connection, on each side of wall, floor, and ceiling penetrations, where entering and leaving underground areas, and at minimum 40 foot spacing on horizontal and vertical pipe runs. Markers shall be arranged for easy reading at eye level.
2. Provide valve tags on all valves exposed or concealed unless otherwise noted.
3. Attach valve tag to stem of each valve to be tagged. Valve numbers shall follow in sequence the Owner's existing valve numbers, where applicable.
4. Provide a marker for each valve and equipment to be tagged, located above lift-out

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tile ceilings. The marker shall be 1/16 inch thick plastic with a satin surface and white core. Color of the marker shall match color of piping identification system. Lettering shall be engraved through the surface color to expose the core color. Plate size shall be ¾ inch by 2-1/2 inch, with 3/16 inch high lettering for ceiling grid labeling. Plate manufacturer shall furnish suitable adhesive for permanently attaching plate to ceiling grid.

5. Provide a minimum of 4 valve charts. Chart information shall indicate job name, Contractor name, date of installation, valve number, valve location, valve type, valve purpose, and system in which installed. Mount framed chart in equipment room, and insert copy of chart in each operating and maintenance manual under separate tabbed section labeled "Valve Chart". Where project drawings include a piping flow schematic, request AutoCad file from Engineer and label all of the valves according to the valve chart and frame in an 18" x 24" frame in main mechanical or pump room.
6. Provide air and water flow diagrams installed in waterproof, laminated frames on the wall in each Mechanical Room. Air flow diagrams shall show locations of dampers, sensors, and exhaust fans associated with the air handling unit. Water flow diagrams shall show shut-off valves and control valve locations.
7. Permanently affix nameplate to each item of equipment using stainless steel pop rivets. Where irregular surface impede direct attachment of plates, affix plate to sheet metal bracket and attach bracket to equipment with screws, bolts or suitable adhesive from nameplate manufacturer.

C. Fire and Smoke Stopping:

1. Refer to Division 7 for further requirements.
2. Fire and smoke stopping shall be provided as required to meet all code requirements and at a minimum is required in the following locations:
 - a. Where exposed and concealed horizontal pipes, tubes, wires and ducts which are part of an active smoke control system that are not provided with fire dampers penetrate fire rated walls, shaft walls, and smoke barriers.
 - b. Where exposed and concealed vertical pipes, tubes, and wires ducts which are part of an active smoke control system that are not provided with fire dampers penetrate rated and non-rated floors.
3. Provide pipe or duct sleeve for all penetrations. Space between pipe or duct and sleeve shall not exceed the UL listing of the penetration.
4. Fill annular space between pipe and sleeve, or between duct and sleeve on non-dampened penetrations, with approved material.
5. Depth of material shall be in accord with laboratory tests for 1, 2, or 3 hour rated assemblies.
6. Damming material may be temporary non-fire approved, or permanent fire-approved. Where permanent fire-approved damming material is used depth of fire and smoke stopping material may be decreased in accord with manufacturer's recommendations. Temporary damming material shall be removed after installation of fire and smoke stopping material.
7. Seal all gaps or voids in cured foam with material to match the fire and smoke stopping material.
8. Trim excess cured foam from around all openings and leave smooth, flush surface.

D. Electrical Requirements:

1. Electrical apparatus, devices, controls, etc., required but not specified in detail in this Division shall conform to Division 16 - ELECTRICAL.
2. Except as otherwise detailed or specified, all power wiring required to operate

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electrical devices and equipment furnished in this Division will be provided under Division 16 - ELECTRICAL.

3. Control and interlock wiring required for all electrical devices and equipment furnished in this Division is specified under Section 15058 - CONTROL WIRING.
4. Motor driven equipment provided under this Division shall be provided with motors as specified in Section 15055 - MOTORS.
5. Starters shall be furnished under Division 15 for installation under Division 16 - ELECTRICAL. Starters shall be as specified in Section 15056 - Motor Starters or Section 15057 - Adjustable Frequency Drives.
6. Starters, except where specified to be furnished with the equipment or for motors having adjustable frequency drives, shall be provided in Motor Control Centers under Division 16 - ELECTRICAL.

E. Placing of Equipment:

1. Coordinate setting of equipment with the requirements of other trades so as to avoid conflicts and to insure compatibility. Equipment shall not block access for installation of other equipment.
2. Set base mounted equipment on permanent and finished supports. Temporary support, if any, shall be removed prior to making final pipe, duct, or electrical connections to equipment.
3. Adjust suspended equipment to final elevation prior to making pipe, duct or electrical connections.
4. Exercise caution during equipment placing operations to insure that structure is not overloaded.
5. Do not move heavy equipment across floor or roof of insufficient load bearing capacity to support such equipment. Provide bracing or shoring as required, or use crane to place equipment directly on permanent and finished support.
6. Secure all roof mounted equipment to the structure adequately to resist overturning, uplift and sliding forces for basic wind speeds indicated for this location in Figure 1609 of the Florida Building Code, Latest Edition.
7. Guards shall be provided where appliances, equipment, fans or other components that require service are located within 10 feet of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches above the floor, roof or grade below. The guard shall extend not less than 30 inches beyond each end of such appliance, equipment, fan or component and the top of the guard shall be located not less than 42 inches above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21-inch-diameter sphere and shall comply with the loading requirements for guards specified in the Florida Building Code.

END OF SECTION 15050

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SECTION 15051
ADJUSTING, BALANCING AND SYSTEM TESTING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this Section.

1.2 WORK INCLUDED

- A. Checking installation for conformity to design.
- B. Checking each piece of equipment for proper installation and operation.
- C. Balancing air and water distribution systems to provide design fluid quantities.
- D. Measuring and recording of fluid quantities.
- E. Electrical measurement.
- F. Verification of performance of all equipment and sequence of operation of automatic controls.
- G. Checking sound levels and vibration isolators for proper function and measurement and correction where a problem or question of acceptability exists.
- H. Recording and reporting results on sub-contractors standard report forms and on commissioning data sheets where these have been provided.

1.3 REFERENCES

- A. Air Diffusion Council (ADC) 1062R3 Equipment Test Code
- B. Associated Air Balance Council (AABC)
National Standards for Field Measurements and Instrumentation, Total Balance System Balance, Air Distribution - Hydronic Systems, Volume 1.

1.4 SUBMITTALS

- A. Submit in accordance with Section 15010 - Mechanical General Provisions.
- B. Submit complete description of procedures, instrument calibration and qualifications of personnel actually doing testing and balancing on this project prior to beginning of any balancing.
- C. Submit schedules of test data readings in organized, schematic, tabulated format. Include schematic drawing showing location of all readings.
- D. Submit as-built drawings showing locations of all readings.

1.5 QUALITY ASSURANCE

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- A. Adjusting, balancing and testing procedures and compilation of test data shall be performed by a Certified Test and Balance Engineer or by personnel trained and supervised by a Certified Test and Balance Engineer.
- B. Test and balance personnel shall be qualified to perform testing and balancing in accordance with AABC or NEBB procedures.

1.6 TOLERANCES

- A. Balance final fluid flow (air and water) to within plus or minus 5 percent of specified quantities. Caution is urged on systems where diversity has been taken and the total flow exceeds the equipment capacity. In this case, the system must be sectioned as necessary to get proper terminal flow.

1.7 GENERAL COMMENTS

- A. Water Balance: Readings from venturi flow meters, or automatic pressure independent flow control devices will be given highest priority as to accuracy. Where neither is specified pump curves and chiller or boiler pressure drops are to be correlated to establish flow. Pressure drop across coils or chillers is to be used to proportion flow. Volt and ampere readings will be used as checks. Temperature data will be used only as a performance check and not for balancing.
- B. Air Balance: Readings from a pitot tube traverse will be given highest priority as to accuracy. Terminal flow shall be as taken from the terminal DDC flow readings. Outlet flow as established by flow hood will be used to pro-rate air flow. Pressure readings as well as voltage and ampere readings will be used for check purposes only. Temperature readings will be used as a check against performance.
- C. All readings shall be cross-checked for accuracy. These cross-checks shall be tabulated within the report.

PART 2 – PRODUCTS (Not applicable)

PART 3 - EXECUTION

3.1 INTENT OF DRAWINGS AND SPECIFICATIONS

- A. Review drawings and specifications with regard to adjusting and balancing.
- B. Additional balancing devices which, in the opinion of the TAB sub-contractor, would aid in the adjusting and balancing of the systems shall be brought to the attention of the contractor prior to bid time so that the contractor may make allowances to cover the provision of these additional devices in the original bid.
- C. Minor modifications in system design which, in the opinion of the Contractor, would aid in the adjusting and balancing of the systems may be provided subject to approval of the Owner's Representative at no additional cost to the Owner. Design modifications shall not lessen the operating efficiency of the systems.

3.2 WATER BALANCE

- A. Ascertain that piping systems have been cleaned, flushed, drained and properly refilled and that all strainer baskets have been removed, cleaned and properly reinstalled prior to beginning water balancing procedure.

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- B. In the event that TAB work is started prior to the completion of the water treatment portion of work, the TAB contractor shall make a random recheck as directed by the Owner's Representative. The results of this re-check shall be included in the final report.
- C. Variable flow pumping systems having two way control valves and using automatic pressure independent system of flow control for secondary hot water heating and chilled water systems.
 - 1. With one pump running and all manual and automatic control valves open, record GPM stamped on each automatic flow control device and read and record the pressure drop across those which have dual pressure taps, as well as across each coil and applicable equipment.
 - 2. Operate lag pump to be sure performance is the same at each step.

3.3 AIR BALANCE

- A. Check system visually and audibly for leakage and proceed with balancing as outlined by AABC or NEBB.
- B. Balance for full flow shall be based on dirty friction loss across the filters. Artificially blank-off sections on a uniform pattern as required to simulate this condition.
- C. Variable Volume Systems:
 - 1. With supply fan running at 100% speed and all terminals calling for full air flow, read and record flow and fan suction and discharge static pressure readings. Pressure readings shall be obtained using procedures outlined in AMCA Publication 203-90 Field Performance Measurement of Fan Systems. Plot on submitted fan curve.
 - 2. Set flow at each terminal for maximum values as indicated in terminal schedule using hand held operators terminal (HHOT) furnished with the terminal controls. Provide actual measured outlet flow to temperature controls sub-contractor for setting calibration constants in DDC controls. Normally diversity is taken in the fan selection. Close other terminals as required to get full flow as required for balancing. Pro-rate terminal flow to diffusers.
 - 3. Set minimum flow to values as indicated in terminal schedule.
 - 4. Where applicable, adjust return fan for specified differential flow. Record fan signal fan speed and other data at full flow and at minimum flow.
 - 5. Record all data on terminals and supply and return fan including voltage and amperage on primary air fans and return fans at full flow.

3.4 AIR HANDLING UNIT PERFORMANCE TESTING

- A. Recognizing that it will be unlikely that the performance testing will be done on a design day, cooling and heating coil performance shall be recorded as follows.
 - 1. With fan delivering design air flow and control valves open to deliver design water flow, read and record entering and leaving drybulb and wetbulb temperatures, air and waterside flow, pressure loss values and water temperatures.
 - 2. Through the contractor, request performance data from the equipment supplier based on the measured air flow and entering air temperatures and measured water flow and entering water temperature. Submit this data with test data for review.

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3.5 CONTROLS ADJUSTMENT

- A. Check the automatic temperature controls to ascertain that the specified sequence of operation is occurring. Record thermostat set point and room conditions in each space. This includes checking each terminal box to ensure that supply air goes to minimum position before heat comes on.
- B. Compare temperature of space (taken with test instrument) to temperature read by thermostat or temperature sensor. Tabulate results.
- C. In cooperation with the controls contractor, set adjustments of automatically operated dampers to operate as specified, indicated, and / or noted.
- D. Check all controls for proper calibrations, and list all controls requiring adjustment by control installers.

3.6 CONTRACTOR'S RESPONSIBILITIES

- A. Final testing and balancing of the HVAC systems shall be performed as specified in this section. It is the responsibility of the Contractor to be completely familiar with all the provisions and responsibilities of the Balancer, and to provide such certification, cooperation, and support required.
- B. The Contractor shall repair all deficiencies noted by the Balancer in a timely manner. The Balancer will notify the contractor in writing, on a daily basis, of any deficiencies discovered and Contractor will notify the Balancer immediately, in writing, upon completion of the repairs. The cost for extra re-testing by the Balancer due to un-repaired items that were certified as repaired, will be the responsibility of the Contractor. *The final testing and balancing report will contain no punch list items. All deficiencies will have been corrected prior to submission of the final report. Preliminary reports are not to be submitted to the Owner.*
- C. The Contractor shall:
 - 1. Allow adequate time in the construction schedule to perform the Testing and Balancing work.
 - 2. Notify the Balancer upon commencement of work related to the HVAC system.
 - 3. Provide required shop drawings and equipment data.
 - 4. Provide test openings as required for testing and balancing HVAC systems.
 - 5. Provide updated job schedule and timely notice prior to scheduled events.
 - 6. Provide test openings and temporary end caps or otherwise seal off ends of ductwork to permit leakage testing prior to installation of diffusers, grilles, and similar devices.
 - 7. Make preliminary tests to establish adequacy, quality, safety, completed status, and satisfactory operation of HVAC systems and components. The systems shall be free of electrical grounds and short circuits.
 - 8. Perform duct leakage tests, in the presence of the Balancer, on all supply, return, outside air make-up, and exhaust air systems.
 - 9. Within the intent of the contract documents, provide, at the request of the Balancer, all equipment, material, supplies, workmen, and supervisions necessary to provide a satisfactory, operating system.
 - 10. During the test and balance period, operate all HVAC equipment as necessary to permit systems to be tested and balanced as fully operating, functional systems.
 - 11. Work harmoniously with the Balancer, providing all courtesies normally extended to professional consultants.
 - 12. Perform all work necessary to make ceiling plenums air-tight and functional.

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13. Remove and replace ceilings as necessary to permit test and balance operations.
 14. Remove and replace equipment, lights, or other items which obstruct testing and balancing operations. Where equipment, lights, or other items will interfere with future adjustments of the HVAC system, such equipment, lights, or other items shall be relocated by the Contractor, as directed by the Architect.
 15. Provide completed start-up forms on each piece of equipment.
 16. Replace belts and drives as required for proper balancing. Drives shall be adjusted and aligned by the Contractor to prevent abnormal belt wear and vibration.
 17. Adjust fan speed as required not to exceed RFLA of motor.
 18. Open all manually adjustable dampers and test dampers for smooth, vibration-free operation.
 19. Verify that all controls are installed and operating in accordance with the sequence of operation.
 20. Before requesting final testing and balancing, submit signed statement that HVAC systems are installed, adjusted, fully lubricated, operating satisfactorily, and are ready for use.
- D. Duct Leakage Report: The Contractor shall make all the supply, return, outside air, and exhaust duct systems (limited to 1,500 cfm and greater) operationally air-tight, with no more than 2% leakage for duct systems rated at 2" w.c. pressure class, and 1% leakage for systems exceeding 2" w.c. pressure class. Leakage test to be performed by Contractor with all air device openings and fan connections sealed airtight. Test the systems prior to applying any insulation or concealing in soffits or chases. Use a portable fan capable of producing a static pressure equal or greater than the duct test pressure. This fan to have a flow measuring assembly consisting of a straight section of duct with an orifice plate, pressure taps, and a calibrated performance curve for determining leakage rates.
1. Test each section equal to the external static pressure indicated for that fan or air handler with the portable fan assembly. After the fan achieves that steady state design pressure, record the air flow quantity across the orifice and the percent of design air flow. If the test fails, the Contractor shall reseal and retest at no additional cost to the Owner.
 2. Repair all duct leaks that can be heard or felt, even if the system has passed the leakage test.
 3. Submit duct leakage reports to the Balancer and the Engineer for their review and approval.

3.7 TEST DATA SCHEDULES

- A. Submit typewritten schedules of test data readings.
- B. Schedules shall record the specified reading, the first reading taken and the final balanced reading for the following items.
- C. Where Commissioning Forms are provided, equipment data shall be recorded on these forms for comparison with submitted design data.
- D. Witness and record the testing of the ductwork for leakage to insure proper sealing. The Balancer shall randomly select sections of the completed duct system for testing. The sections selected shall not exceed more than 20% of the measured linear footage of supply, return, exhaust or plenum duct length. All selected ductwork shall be leak tested in accordance with SMACNA. Maximum allowable leakage at any tested section shall not exceed 2% of the total air. If any of the selected duct sections exceed the specific

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leakage allowance, those sections shall be repaired by the Contractor and retested by the Balancer. If initial testing exceeds specification allowance, testing of all remaining duct ductwork shall be required at the Contractor's expense. All additional costs for duct leak repair and retesting shall be the responsibility of the Contractor.

- E. Advise Contractor in writing of all ductwork that shall be repaired to reduce air leakage. Retest to confirm minimum allowable leakage. The cost of retest of failed systems will be the responsibility of the Contractor.
- F. In the case of off season performance testing of air handling equipment and refrigeration equipment, include manufacturer's projected performance for comparison.
 - 1. Motors:
 - a. Designation.
 - b. Nameplate HP, voltage and full load amperes.
 - c. RPM.
 - d. Motor amperes and voltage under operating conditions.
 - e. For belt drive applications, motor amperes and voltage under no load condition.
 - 2. Fans:
 - a. Designation.
 - b. Nameplate data.
 - c. RPM.
 - d. Static pressure, inlet and discharge.
 - e. CFM from pitot tube traverse of discharge duct.
 - f. Final pitot tube traverse sheets showing all readings.
 - 3. Main and Sub-main Ducts:
 - a. Designation and location.
 - b. CFM from pitot tube traverse.
 - c. Final pitot tube traverse sheets showing all readings.
 - 4. Coils - Water:
 - a. Designation.
 - b. Nameplate data (if available).
 - c. Pressure entering strainer valve and leaving flow control device.
 - d. Pressure entering and leaving flow control device where two taps are provided.
 - e. Temperature entering and leaving water.
 - f. Static pressure, entering and leaving air.
 - g. Dry bulb and wet bulb temperature, entering and leaving air (4 readings at quarter points where coils are over 20 sq.ft. F.A.)
 - h. CFM over coil including all final readings used to obtain cfm.
 - i. GPM from flow regulator nameplate.

END OF SECTION 15051

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SECTION 15055
MOTORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Motors for equipment furnished under Division 15.

1.3 STANDARDS

- A. NEMA Publications MG-1, MG-2, MG-13.

1.4 QUALITY ASSURANCE

- A. Motor efficiencies in accordance with IEE Standard 112 Method B as defined by NEMA MG1-1.23 a and b.

1.5 SUBMITTALS

- A. Submission for acceptance is required. All three phase motors are based on NEMA Premium™ efficiency motors as described below by the minimum allowable efficiency. As a result, all motor starting codes are based on Code letter F or greater as defined by NEC Article 430. In the event that a manufacturer provides a motor with a code letter less than F, the overcurrent protection of the motor shall be coordinated with the Division 16 Contractor to comply with NEC Article 430.
- B. Product 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.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. A.O. Smith/Century E-Plus
- B. Baldor Electric Company, Premium Efficiency.
- C. Emerson Electric Company, U.S. Electrical Motors Div., Premium Efficiency Type 'DE' & 'RE'.
- D. The Louis Allis Company, High Efficiency.
- E. General Electric Company, Premium Efficiency Energy Saver®
- F. Reliance Electric Manufacturing Company, XE™ Premium Efficiency Motors.

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2.2 FABRICATION

A. 3/4 HP and Larger Horsepower Motors:

1. NEMA Premium™ efficiency type having the following minimum efficiencies:

Minimum Nominal Full-Load Motor Efficiency (%)						
	Open Motors			Totally Enclosed		
Number of Poles	2-Pole	4-Pole	6-Pole	2-Pole	4-Pole	6-Pole
Speed (RPM)	3600 RPM	1800 RPM	1200 RPM	3600 RPM	1800 RPM	1200 RPM
HP						
0.75	---	85.5	---	---	85.5	---
1	82.5	85.5	82.5	77.0	85.5	82.5
1.5	84	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93	91.7	91.0	92.4	91.7
20	91	93	92.4	91.0	93.0	91.7
25	91.7	93.6	93	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93	94.7	94.1	93.0	94.5	94.1
60	93.6	95	94.5	93.6	95.0	94.5
75	93.6	95	94.5	93.6	95.4	94.5
100	93.6	95.4	95	94.1	95.4	95.0
125	94.1	95.4	95	95.0	95.4	95.0
150	94.1	95.8	95.4	95.0	95.8	95.8
200	95	95.8	95.4	95.4	96.2	95.8
250	95	95.8	95.4	95.4	96.2	95.8
300	95	95.8	95.4	95.4	96.2	95.8

2. Open drip proof, except motors located outdoors to be TEFC or as otherwise specified.
3. Continuous duty, 40°C ambient.
4. Regreasable ball bearing design.
5. Speed/Torque curves shall be NEMA Design B so that overload protection provided by standard motor starters will be adequate to prevent over-heating during stall or slightly prolonged motor acceleration.
6. Class B insulation, except motors for variable speed drive application to be specially built for Adjustable Frequency Drive (AFD) duty and include Class F insulation and be suitable for operation down to 10% on fan and pump applications.
7. Assembly to meet application.
8. 1.15 service factor.
9. Suitable for starter type as scheduled on drawings or in Specification Section 15056 – Motor Starters.

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10. Slide bases as required.
11. 60 Hz. terminal box large enough to accommodate the required conduit and wiring.
12. 200, 208, 230 or 460 volt, 3 phase as scheduled.

B. Fractional Horsepower Motors:

1. Permanent split capacitor.
2. 115 volt, 1 phase, 60 Hz.
3. Thermally protected.
4. Other features of motors supplied as an integral part of a factory assembly shall be acceptable as the manufacturers standard based on acceptance of the assembly as a whole.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Motors:

1. Install in accordance with requirements of the duty.
2. Lugs to be provided under this Division.
3. All motors shall have overload protection as required by NEC. Any motor without integral protection shall have a starter that provides overload protection furnished by Division 15.

END OF SECTION 15055

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SECTION 15057
ADJUSTABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this Section.

1.2 WORK INCLUDED

- A. Adjustable frequency drive units (AFD) for all motors identified as operating at variable speed.

1.3 QUALITY ASSURANCE

- A. All adjustable frequency drives and bypass assemblies and control panel enclosures must be the product of a single manufacturer.
- B. AFD shall be UL or ETL listed. Components used in all options shall be UL listed. The entire AFD and bypass assembly shall be U.L. marked with a short circuit current rating of at least 100,000 amperes. The VFD short circuit rating shall be posted in the operating instructions or on the product label. This shall be in compliance with the UL listing and rating requirement.
- C. The AFD shall be designed to meet the power line transient conditions defined within ANSI/IEEE C62.41-2002 (or Latest Edition) and shall have a voltage withstand rating of 6 KV in accordance with UL 1449.
- D. AFD shall be certified for with FCC emission limits for Class A computing devices. If required to meet these limits, isolation transformers, and/or line filters shall be provided.
- E. Ambient noise generated by the AFD shall be limited to an amount equal to 3 dbA greater than the fan or pump system noise level at design rpm. If acoustic enclosures are required to meet these limitations provide same with the AFD.
- F. AFD manufacturer shall submit an analysis to certify that the drive, when installed in the electrical distribution system shown on the Contract Documents is in compliance with the requirements of IEEE 519 – 1992 (or Latest Edition). The Point of Common Coupling (PCC) shall be defined as the secondary lugs of the Utility Company Transformer. The transformer impedance shall be 5.75% with the appropriate short circuit current based on this value.
- G. AFD and option design and construction thereof shall comply with all applicable provisions of the latest National Electrical Code.
- H. Power components shall undergo burn in to ensure product function. Circuit boards shall be tested under thermal cycling and the complete unit shall be tested under full load conditions to ensure maximum product reliability.
- I. A Factory Authorized Service Engineer is to be provided for start up which shall include verification of proper installation and wiring. Inspect all components, circuit boards and

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control wiring. Ensure proper power source and control signal. Apply power and provide full operational testing and calibration. Also provide training for owner's operators.

- J. Provide full three year on-site parts and labor warranty including travel time and expense. Warranty period shall begin at date of substantial completion.
- K. AFD's shall be fully protected during the duration of construction of the project. Units shall be covered to protect from all dirt, dust and debris. Contractor will be responsible for replacing any unit that has dirt, dust or debris infiltration into the unit.
- L. The supplier shall offer a service support group which shall be able to provide the following additional services; not included in this contract:
 - 1. Emergency service calls.
 - 2. Overnight service parts.
 - 3. Service contracts.
 - 4. In-plant training of client personnel in basic troubleshooting.
 - 5. Coordinate enrollment of client personnel in factory-held service schools.

1.4 SUBMITTALS

- A. Submission for acceptance is required. Submittal shall show compliance with all paragraphs and statements listed in part 2 below.
- B. A complete harmonic analysis showing compliance with IEEE 519 - 1992 (or Latest Edition) shall be provided with the submittal as defined in paragraph 1.3 above.
- C. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.
- D. Refer to Section 15010, Mechanical General Provisions for requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Adjustable Frequency Drive Units:
 - 1. ASEA Brown Bovari (ABB)
 - 2. Century (MagnaTek)
 - 3. Cutler Hammer
 - 4. Danfoss/Graham
 - 5. Hitachi
 - 6. Reliance Electric
 - 7. Square D
 - 8. Trane
 - 9. SSD Drives, Inc.
 - 10. Toshiba
 - 11. York

2.2 EQUIPMENT REQUIREMENTS

- A. Adjustable Frequency Drive:
 - 1. The adjustable frequency drive shall convert either 208/230 or 460 volt $\pm 10\%$, three phase, 60 HZ (± 2 HZ) utility power to adjustable voltage/frequency, three

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- phase, AC power for stepless motor control from 5% to 105% of base speed.
2. The adjustable frequency drive (AFD) shall produce an adjustable AC voltage/frequency output for complete motor speed control using transistorized sinecoded PWM technology, and an input power factor near unity over the entire speed range. The AFD shall not produce excessive or objectionable motor acoustical noise. The AFD shall not induce voltage line notching back to the utility line and total harmonic distortion (THD) shall not exceed the limits set in IEEE Std. 519 -1992 (or Latest Edition) when installed in the electrical distribution system shown on the Contract Documents. The AFD shall be automatically controlled by a grounded electronic control signal.
 3. The AFD shall be self contained, totally enclosed in a NEMA 1 ventilated cabinet and capable of operation between 0° and 40°C except where located outdoors enclosure to be NEMA 3R or 4X watertight and dust-tight enclosure, depending on the manufacturers offering. The entire AFD assembly shall be mounted in a common enclosure requiring only a power in and a power out connection.
 4. The AFD maximum output current rating shall be as follows:

Horsepower (HP)	FLA @ 208 V	FLA @ 460 V
5	16.7	7.6
7-1/2	24.2	11.0
10	28.0	14.0
15	46.2	21.0
20	59.4	27.0
25	----	34.0
30	----	40.0
40	----	52.0
50	----	65.0
60	----	77.0
75	----	99.0
100	----	124.0

5. AFD shall be a minimum of 97% efficient at 100% rated output power, 60 HZ.
6. The AFD shall have the following basic features:
 - a. Operator control interface.
 - (1) Hand/Off/Auto operator switch.
 - (2) Panel mounted digital display capable of indicating unit status, frequency and fault diagnostics, including overcurrent, overvoltage, overheating, ground fault or short circuit.
 - b. Electronic control follower board, 0-5 VDC, 0-10 VDC or 4-20 mA or 0-135 ohms (coordinate requirement with controls contractor).
 - c. Minimum/maximum adjustable speeds (Minimum speed factory set at 12 HZ, maximum speed factory set at 60 HZ, may vary based on application).
 - d. Manual speed potentiometer control for use when AFD is in manual control mode.
 - e. Adjustable linear timed acceleration and deceleration for soft starting/stopping (adjustable from 1-300 sec) recommended range 20-60 seconds depending on inertial load. Factory set at 60 seconds.
 - f. 3-80 HZ controlled speed range (factory set at maximum frequency of 60 HZ).
 - g. Output terminals for remote frequency meter and ammeter.
 - h. RFI/EMI filter.
 - i. Manual bypass circuit with three contactors to provide full speed starter operation for motors 100 HP and less and an electronic, solid state, full-

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- wave, soft-start controller for all motors 125 HP and larger for operation in the event of AFD electronics failure complete with disconnect and overload protection in all three phases. Provide a three-phase power monitor as manufactured by Time Mark Corporation Model 258 or equal, providing solid state protection by opening starter for loss of any phase, low voltage or any or all phases, and phase reversal. Monitor shall be field adjustable for drop-out voltage. Monitor shall be UL recognized.
- j. Line circuit breaker disconnect (door-interlocked) with current limiting fuses on the line side of the circuit breaker having a minimum AIC rating of 200,000 Amps. The disconnect switch shall have a minimum short circuit rating of 100,000 amps.
 - k. Provide line impedance reactors to the power line to reduce the total harmonic distortion (THD) level to that allowed by IEEE 519-1992 (or Latest Edition). If the harmonic distortion level required by IEEE 519-1992 (or Latest Edition) can be met without these devices, they may be omitted.
 - l. Isolation transformer with electrostatic shields for optimum noise protection and phase shifting capability shall be provided where the addition of line impedance reactors will not lower the total harmonic distortion (THD) level to that allowed by IEEE 519 – 1992 (or Latest Edition). If the harmonic distortion level required by IEEE 519 - 1992 (or Latest Edition) can be met with only line reactors, then phase shifting isolation transformers may be omitted.
7. The AFD controller shall include the following protective circuits/features:
- a. Current limit shall be provided at 100% of the motor FLA. If current exceeds 100% of the motor current, the AFD will slow down the motor. If the current continues to rise the AFD shall shutdown on overcurrent. Current limit will be adjustable by qualified service personnel for application of AFD to smaller than nameplate motors.
 - b. Current limit/soft stall feature - current limit/soft stall allows continuous operation while in an overload condition. It limits the current by slowing down the frequency. The soft stall feature will be field set and the current limit adjusted to 100% of the motor FLA or drive FLA whichever is smaller.
 - c. Instantaneous electronic trip - automatically safely shutdown motor if:
 - (1) Current exceeds 200% of design.
 - (2) Phase-to-phase output short circuit occurs.
 - (3) Phase-to-ground output short circuit occurs.
 - (4) Phase loss occurs.
 - d. The AFD shall be programmable to provide restart automatically, if desired, when input line returns to normal in the event of:
 - (1) Intermittent power outage.
 - (2) Phase loss.
 - (3) Overvoltage shutdown.
 - (4) Intermittent voltage spike.
 - e. Insensitive to incoming power phase.
 - f. Line-to-line fault protection.
 - g. Line-to-ground short circuiting and accidental motor grounding protection.
 - h. Electronic overload protection.

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- i. Over-temperature protection.
8. The AFD shall be designed and constructed to operate within the following service conditions:
 - a. Elevation up to 3300 feet without derating.
 - b. Ambient temperature range - 0°C to 40°C.
 - c. Atmosphere - non-condensing relative humidity to 90%.
 - d. A-C line voltage variation - 10% to +10%.
 - e. A-C line frequency variation ± 2 HZ.
9. Bases of Design: Danfoss FC102 or Trane TR200.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Adjustable Frequency Drive:

1. Furnish adjustable frequency drive for each motor identified as requiring an adjustable frequency drive or variable speed operation.
2. Receive, unload and deliver drives to electrical contractor on job-site for storage, uncrating and installation by Division 16.
3. Furnish all necessary wiring diagrams to electrical contractor for installation and power wiring.
4. Coordinate the purchased equipment with the motor served and with the automatic temperature control system, paying specific attention to the signal sent and received and the ground source.
5. Start-up shall be by a factory trained field service engineer. Start-up shall be done with the cooperation of the controls contractor. The minimum speed shall be set for 20% at the AFD. The control signal shall be full scale so that the minimum speed will be 20% (adjustable).
6. AFD to be mounted where indicated on the drawings or within sight of the motor controlled.
7. Where a remote disconnect is provided for a motor controlled by an adjustable frequency drive, coordinate with the supplier of the disconnects to ensure that a late make, early break auxiliary contact rated for ten amps continuous duty is provided on the disconnect. This auxiliary contact must be wired into the AFD start circuit to ensure shut-down of the AFD in the event of the disconnect being opened.
8. AFD may be mounted directly to masonry, CMU or concrete walls using appropriate fastening methods, including back plates. When the wall is an exterior wall or any wall where condensation may occur, provide appropriate stand-off, i.e., (Uni-strut channel).
9. AFD may be mounted directly to equipment such as factory or field built AHU. In this case, through bolts and backing plates along with an appropriate stand-off shall be used. Seal all holes. Self-tapping screws with exposed ends will not be acceptable.
10. When AFD is required to be located in areas where walls are not available, provide a Unistrut type frame securely mounted to floor adequately braced to form a rigid mounting surface.
11. AFD shall be generally mounted with the center of the unit at 60" above the finished floor. Service clearance shall be provided in accordance with the National Electric Code and under no circumstances less than the following:

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<u>Voltage to Ground</u>	<u>Minimum Clearance Distance</u>
110V or 120V	3'-0"
208V, 220V, 240V or 277V	3'-6"
460V or 480V	4'-0"
Greater than 480V	5'-0"

12. Adjustable frequency drives shall be accessible.
13. Provide housekeeping pad for all floor mounted adjustable frequency drives.

END OF SECTION 15057

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SECTION 15090
SUPPORTS, HANGERS, ANCHORS AND SLEEVES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Inserts, Shells and Upper Attachments.
- B. Pipe Hangers, Rods, Supports and Accessories.
- C. Duct Hangers and Supports.

1.3 QUALITY ASSURANCE

- A. Design of pipe supporting elements shall be in accordance with ANSI B31.1.
- B. Fabrication and installation of pipe hangers and supports shall be in accordance with the following Manufacturers Standardization Society (MSS) Standards.
 - 1. SP-58 Pipe Hangers and Supports: Materials, Design and Manufacture.
 - 2. SP-69 Pipe Hangers and Supports: Selection and Application.
 - 3. SP-89 Pipe Hangers and Supports: Fabrication and Installation Practices.
- C. Steel angles, channels and plate shall be in accordance with ASTM A36, red primed or hot dipped galvanized for interior applications, and hot galvanized for exterior applications.
- D. Bolts, including nuts and washers, used for fabricating steel members shall be in accordance with ASTM A325 and shall be stainless steel or plated for corrosion protection. Plain steel components are unacceptable.
- E. Welding of steel members shall be in accordance with AWS D1.1.
- F. Duct hangers and supports shall be in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible as applicable.

1.4 APPLICABLE PUBLICATIONS

- A. Applicable sections of the publications listed below form a part of this Section. The publications are referenced to in the text by the basic designation only.
 - 1. American Institute of Steel Construction (AISC)
 - 2. American National Standards Institute (ANSI)
 - 3. American Society for Testing and Materials (ASTM)
 - 4. American Welding Society (AWS)
 - 5. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

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6. Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)

1.5 SUBMITTALS

- A. Submit schedule indicating type of hanger to be used by system and pipe size. Include rod size for each hanger size.
- B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Inserts, Shells and Upper Attachments:
 1. Anvil International, Inc.
 2. Carpenter Paterson, Inc.
 3. Cooper B-Line®, Inc.
 4. Elcen Metal Products
 5. Hilti
 6. Michigan Hanger Company
 7. PHD Manufacturing, Inc.
 8. Unistrut®
- B. Pipe Hangers, Rods, Supports and Accessories:
 1. Anvil International, Inc.
 2. Carpenter Paterson, Inc.
 3. Cooper B-Line®, Inc.
 4. Elcen Metal Products
 5. Hilti
 6. Michigan Hanger Company
 7. PHD Manufacturing, Inc.
 8. Unistrut®
- C. Duct Hangers and Supports: Fabricated per Specifications

2.2 FABRICATION

- A. Inserts, Shells and Upper Attachments:
 1. Inserts; MSS Type 18; malleable iron body and nut, galvanized finish, opening in top of insert for reinforcing rod, lateral adjustable. Rated for 1,140 lbs. Based on Anvil Fig. 282.
 2. Shells: Steel shell and expander plug, snap off end fastener. Based on Phillips Concrete Fasteners Red Head.
 3. Upper Attachments:
 - a. Top beam clamps; MSS Type 19: Malleable iron galvanized finish clamp, hardened steel cup point set screw and locknut. Rating is contingent on rod and bolt size. Based on Anvil Fig. 94.
 - b. Bottom Beam Clamp; MSS Type 23: Malleable iron galvanized finish clamp, hardened steel cup point set screw and locknut, and retaining clip. Rating is contingent on rod and bolt size. Based on Anvil Fig. 86 Clamp

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- and Fig. 89 Retaining Clip (or Fig. 87).
- c. Welded Beam Attachment; MSS Type 22: Carbon steel suitable for eye rod or rod and locknut, rating is contingent on rod and bolt size. Based on Anvil Fig. 66.
 - d. Center Beam Clamp; MSS Type 21: Malleable iron jaw and square head bolt and nut with galvanized finish. Rating is contingent on rod and bolt size. Based on Anvil Fig. 134.
 - e. Center Beam clamp; MSS Type 29: Forged steel, weldless eye nut, tie rod to secure clamp to beam all with galvanized finish, rating is contingent on rod and bolt size. Based on Anvil Fig. 292 or 292L.

B. Pipe Hangers, Rods, Supports and Accessories:

1. Pipe Hangers:

- a. Clevis Hanger; MSS Type 1: Carbon steel, galvanized for interior and exterior use, sized to accommodate required insulation. Rating is contingent on rod and bolt size. Based on Anvil Fig. 260 or 300.
- b. Pipe Rings; MSS Type 10: Carbon steel, galvanized for black steel and insulated pipe copper or copper plated or rubber coated for copper pipe. Threaded swivel, sized to accommodate required insulation. Rating is contingent on rod and bolt size. Based on Anvil Fig. 69 or Fig. 97C for copper pipe.
- c. Adjustable Roller Hanger; MSS Type 43: Cast iron roll, carbon steel yoke rod roll and hex nut with galvanized finish. Sized to accommodate insulation. Rating is contingent on rod and bolt size. Based on Anvil Fig. 181.

2. Rods:

- a. Size 3/8" and up: All thread steel rod electro galvanized. Sizing for pipe or equipment support as follows:

<u>Copper Tube, Plastic Fiberglass Reinforced Pipe Size</u>	<u>Steel, Cast Iron or Glass Pipe Size</u>	<u>Rod Size</u>	<u>Max Equip. Load</u>
¼" to 2"	¼" to 2"	3/8"	730 lbs.
2-1/2" to 5"	2-1/2" to 3"	½"	1350 lbs.
6"	4" to 5"	5/8"	2160 lbs.
8" to 12"	6"	¾"	3230 lbs.
14"	8" to 12"	7/8"	4480 lbs.
16"	14" to 16"	1"	5900 lbs.
18" to 20"	18" to 20"	1-1/4"	9500 lbs.
22" to 42"	22" to 42"	1-1/2"	13,800 lbs.

- b. Rods may be reduced one size for double rod hangers with 3/8" minimum diameter, or when other paragraphs require a minimum of 2 hangers per section provided the minimum diameter of 3/8" is maintained. Based on Anvil Fig. 146.

3. Supports:

- a. Pipe Saddle; MSS Type 38: Cast iron saddle, black steel lock nut nipple, cast iron reducer all with galvanized finish. Suitable for standard field cut and threaded galvanized steel pipe. Cast iron floor flange. Based on Anvil Fig. 264 Saddle, Fig. 63 Floor Flange.

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- b. Pipe Saddle Cold Piping; MSS Type 40. Single bonded unit consisting of a galvanized metal shield and a molded section of rigid polyurethane foam insulation. Rigid urethane foam shall have a density of 4 pounds per cubic foot, a thermal conductivity of 0.13 Btu.in/sq.ft./hr.°F at 75°F mean temperature. Insulation thickness to be equal to thickness specified for pipe being supported.
 - c. Adjustable Pipe Roll and Base; MSS Type 46: Cast iron base plate steel stand and roll, adjusting screws with galvanized finish. Based on Anvil Fig. 274.
 - d. Welded Steel Bracket; MSS Type 32: Welded carbon steel rate for 1500 lbs., with galvanized finish. Rating is contingent on rod and bolt size. Based on Anvil Fig. 195.
 - e. Riser Clamps; MSS Type 8: Carbon steel, galvanized finish for black steel or galvanized pipe, plastic coated for cold steel, copper, glass or brass pipe rated for a minimum of 220 lbs. at 3/4" size. Based on Anvil Fig. 261.
4. Accessories:
- a. Protective Shields; MSS Type 40: Carbon steel, galvanized minimum of 12" length sized for required insulation. Based on Anvil Fig. 167.
 - b. Protective Saddles; MSS Type 39: Carbon steel plate, minimum of 12" length, sized for required insulation. Based on Anvil Fig. 160 thru 165.
 - c. Steel Turnbuckle; MSS Type 13: Forged steel, galvanized finish with locknuts. Rated at a minimum of 730 lbs. at 3/8" size. Based on Anvil Fig. 230.
 - d. Steel Clevis; MSS Type 14: Forged steel, galvanized finish with steel pin and cotter pin. Rated for a minimum of 730 lbs. at 3/8" size. Based on Anvil Fig. 299.
 - e. Weldless Eye Nut; MSS Type 17: Forged steel, galvanized finish. Rated for a minimum of 730 lbs. at 3/8" size. Based on Anvil Fig. 290 or 290L.
- C. Duct Hangers and Supports: Fabrication and application of duct hangers and supports shall be in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, Latest Edition, as applicable.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Where applicable install in accordance with the manufacturers written installation instructions.
- B. Where supports are in contact with copper pipe provide copper plated support, or wrap pipe with sheet lead.
- C. Where supports are in contact with glass, aluminum or brass pipe provide plastic coating on supports, or wrap pipe with sheet plastic.
- D. General interior supports, including attachments and pipe supports that are plain steel shall be cleaned of all rust, primed and painted black within one week of installation. At substantial completion all supports shall be free of rust and in a "like new condition".
- E. Hangers and supports, including attachments & pipe supports, exposed to weather or located in utility tunnels or accessible utility trenches or subject to spillage shall be hot dip galvanized after fabrication. At substantial completion all supports shall be free of rust and

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in a “like new condition”.

3.2 INSTALLATION

A. Inserts, Shells and Upper Attachments:

1. Inserts:

- a. Contractor shall have inserts at site and dimensioned location drawings ready at the beginning of the involved concrete work.
- b. Install inserts by securing to concrete forms and inserting reinforcing rod thru the opening provided in the insert in accordance with shop drawings.
- c. Provide necessary supervision while concrete is being poured to correct any misalignment caused by the concrete.

2. Shells: Size shell length to assure a minimum of 1" solid concrete remaining from shell end to concrete face.

3. Upper Attachment:

- a. Select proper attachment for building construction.
- b. For plain steel devices, prime with black paint prior to installation.
- c. Adjust attachment location for proper alignment and no more than 4 deg. offset from a perpendicular alignment.
- d. If proper alignment cannot be achieved from the existing building structure provide a trapeze type support size to handle the design load with a minimum safety factor of 5.

B. Pipe Hanger, Rods, Supports and Accessories:

1. Select proper hanger for piping systems.
2. The location of hangers and supports shall be coordinated with the structural work to ensure that the structural members will support the intended load.
3. Provide hex head nut on rod at top and bottom of clevis hanger yoke, and at each rod connection to intermediate and upper attachment. Rod nuts shall be securely locked in place.
4. Hanger rods shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing.
5. Hangers shall be fabricated to permit adequate adjustment after erection while still supporting the load. Turnbuckles shall be provided where required for vertical adjustment of the piping.
6. For vibration isolation hanger intermediate attachment requirements for isolated equipment refer to Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
7. Supports for vertical piping shall be located at each floor or at intervals of not more than 15 feet and at intervals of not more than 8 feet from end of risers. Where supports are provided on intermediate floors spaced 15 feet or less between floors, no additional supports are required other than those specified for end of risers.
8. A hanger or support shall be provided adjacent to each piece of equipment to ensure that none of the pipe weight is supported from the equipment.
9. The maximum spacing between pipe supports for straight runs shall be in accordance with the following chart. If any deviation from the table exists within the manufacturers written installation instructions, whichever spacing reflecting the smaller centerline to centerline dimension shall be used.

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MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT
SPACING TABLE

a. Steel Pipe (Schedule 40 & 80):

Up to 1":	7 ft. on center
1-1/4" and larger:	10 ft. on center

b. Copper Pipe (Types L, K and M):

Up to 1" size:	5 ft. on center
1-1/4" and larger:	7 ft. on center

c. Ductile Iron and Cast Iron: Two hangers per section length.

d. Polyvinyl Chloride (PVC):

Up to 1-1/2":	3 ft. on center
2" and larger:	4 ft. on center

10. Hanger centerline spacing shall be reduced by 50% in areas of concentrated valves and/or fittings, also no more than a maximum distance of 12 inches from valves, fittings and/or couplings, or 24 inches from a change in direction.
11. Parallel piping may be supported by trapeze hangers consisting of steel angle, channel, or beam suspended by steel rods attached to upper structure. Piping may be supported above, or suspended below, the angle, channel, or beam.
12. Provide protective shields on all cold and dual temperature piping required to be insulated.
13. Provide protective saddles sized to match insulation thickness on all hot piping required to be insulated. Fill void between saddle and pipe with insulation as specified.
14. Provide turnbuckles on all hangers which require leveling or aligning.
15. Provide steel clevis where detailed and/or required.
16. Provide weldless eye nuts on hanger terminations where disassembly or swing may be required. Use in combination with steel clevis.

- C. Duct Hanger and Supports: Installation of duct hangers and supports shall be in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, Latest Edition, as applicable.

END OF SECTION 15090

SECTION 15133 - REFRIGERATION PIPING AND SPECIALTIES

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.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Refrigerant (RS/RL/RHG) Piping.
- B. Valves and Specialties

1.3 DEFINITIONS

- A. The pipe sizes given in this document shall be construed as nominal pipe sizes.

1.4 QUALITY ASSURANCE

- A. All material provided under this section shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such products, and shall be of the manufacturer's most recent design that is in regular production.
- B. Each item provided under this section shall meet the requirements for that item as installed and used, in accordance with the following standards:
 - 1. Metallic Piping Systems employing mechanical joints and grooved-end pipe - ASME/ANSI B-31.9
 - 2. Refrigeration Piping and Heat Transfer Components - ASME/ANSI B31.5
 - 3. Safety Code for Refrigeration Systems – ASHRAE 15
 - 4. Refrigerant Containing Components and Accessories – UL 207
- C. Each piping system shall be in accordance with the system design pressures shown in paragraph 2.1 - Materials, this specification section.
- D. All materials provided under this section shall be new, except where the specifications and/or drawings permit the reuse of certain existing materials.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. The work and materials listed in this Section shall be provided in accordance with the standards and requirements set forth in the applicable portions of the latest editions of the referenced publications.
 - 1. American National Standards Institute (ANSI) Standards
 - 2. American Petroleum Institute (API) Specification
 - 3. American Society of Mechanical Engineers (ASME) Publications

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4. American Society for Testing and Materials (ASTM) Publications
5. American Welding Society (AWS) Publication
6. American Water Works Association (AWWA) Standards
8. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Publications
9. National Fire Protection Association (NFPA) Standards
10. National Sanitation Foundation (NSF) Testing Laboratory Standards.
11. Plastic Pipe Institute (PPI) Manual.
12. Underwriters Laboratories (UL)

1.6 SUBMITTALS

- A. All submittals shall be made in accordance with Section 15010 requirements.
- B. Materials List: Submit a list identifying the specific type of material that will be used for each piping system. Include pipe, pipe fittings, valves and joints. Include the basic designation of the publication applicable for each type of material and method.
- C. Refrigeration Piping Requirements: Submit a letter from the refrigeration equipment manufacturer stating that the refrigeration piping system, as shown on the contract documents, is acceptable for the equipment the manufacturer proposes to furnish, or submit drawings prepared by an authorized representative of the refrigeration equipment manufacturer.
- D. Welding Qualifications: Submit current welder qualifications for all welders proposed for this project. Welding certificates shall be for the company performing the welding at this project as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.
- E. Welding Inspection Reports: Submit certified welding inspection reports as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Refrigerant (RS/RL/RHG) Piping.
System Design Pressure: 300 psig.
 1. Piping carrying Refrigerants shall be either ACR copper, or carbon steel.
 2. ACR Copper Refrigerant Piping:
 - a. Piping, 3" and smaller: Type ACR hard-drawn copper tubing, ASTM B88, ANSI H23.1.
 - b. Fittings, 3" and smaller, all types, wrought copper: ASTM B16.22, ANSI B16.22. All 90° elbows shall be the long radius type.
 - c. Brazing: Contractors Option:
 - (1) 5% silver, 6% phosphorus, balance copper, 1190°F melting point. AWS A5.8 number BCuP -3. J.W. Harris Stay-Silv® 5 or equal.
 - (2) 15% silver, 5% phosphorus, balance copper, 1190°F melting point. AWS 5.8 number BCuP-5. J.W. Harris Stay-Silv® 15 or equal.
 - (3) 6% silver, 6.1% phosphorus, balance copper, 1190°F melting point. QQ-B-654A number BCuP -5. J.W. Harris Dynaflow® 5

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or equal

d. Unions used shall be specifically designed for refrigeration piping.

3. Carbon Steel Refrigerant Piping:

- a. Piping, 1-1/2" and smaller, Schedule 80 carbon steel, seamless; ASTM A-53, Grade B, Type S.
- b. Piping, 2" thru 10": Schedule 40 carbon steel, seamless or electric resistance welded, ASTM A-53, Grade B, Type S or ERW.
- c. Piping, 12" through 24": Standard Wt., carbon steel, electric resistance welded, ASTM A-53, Grade B, Type ERW.
- d. Piping, 30" and larger: Standard Wt., carbon steel, double submerged arc welded, API - 5L, Grade B, Type DSAW.
- e. Fittings, 1-1/2" and smaller, carbon steel, 2000 lb rating, socket weld type, ASTM A105, ANSI B16.11.
- f. Fittings, 2" and larger, Schedule 40 butt-welding type; ASTM A234, WPB. Weld-o-lets and thread-o-lets will be limited to 2 pipe sizes smaller than the pipe to which they are connected.
- g. Unions used shall be specifically designed for refrigeration piping.
- h. Flanges for installation in steel piping runs of refrigerant piping shall be 300 lb rated forged carbon steel, weld-neck type, with raised face, bored to match the mating pipe; ASTM A181, Grade 2, or ASTM A-105, Grade 2. Flanges shall have the manufacturer's trademark affixed in accordance with MSS SP-25.
- i. Flanges for connections to flat-faced surfaces shall be flat-faced carbon steel flanges, 300 lb rating, ANSI B16.5. Flanges shall have the manufacturer's trademark affixed in accordance with MSS SP-25.
- j. Valves (or other equipment) having flange facings not compatible with either of the above types shall be furnished complete with mating flanges and gaskets.
- k. Flange Gaskets shall be Neoprene and shall have a non-blooming surface, a Durometer hardness of 75 (+/- 5), a tensile strength of not less than 2500 psi, and compression recovery of 50 percent. The gasket material shall be in accordance with ASTM F104, Line Call-out F712400A9B4E34K5M9. Based on Garlock Blue-Gard® Style 3300 or acceptable equivalent.
- l. Bolting studs: ASTM A-193, Grade B7; Nuts shall be heavy-duty hexagonal type, ASTM A-194, Grade 2H.

2.2 VALVES AND SPECIALTIES

A. Solenoid Valves:

1. Liquid line shut off.
2. Normally closed.
3. Manual lift stem.
4. Pilot operated.
5. Synthetic seat for permanent tight shut-off.
6. 120 volt solenoid coil (interchangeable).
7. Top grade brass, bronze and/or semi-steel body materials.
8. Acceptable Manufacturers: Sporlan, Alco, Hubbell, Phillips, Henry.

B. Filter Drier:

1. Replaceable core type.

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2. Heavy steel, cadmium plated with external coat of paint.
 3. All internal parts cadmium plated.
 4. Outlet seal gasket with spring to prevent bypassing.
 5. Copper fittings brazed to steel shell, suitable for soldering with Sil-Fos or Phos-Copper solder.
 6. Molded porous core elements.
 7. Tie rod assembly to permit external assembly with one piece insert.
 8. Bolt and nut attachment.
 9. Size for refrigerant capacity and tonnage at 2 psi pressure drop.
 10. Acceptable Manufacturers: Sporlan, Alco, Hubbell, Phillips, Henry.
- C. Moisture and Liquid Indicators:
1. Suitable for R-410A.
 2. Accurately calibrated to change color for indication of moisture.
 3. Large full view sight glass.
 4. Removable indicator element for sizes 1-3/8" and up. Remove before soldering.
 5. Full line size for liquid lines up to 2-1/8" O.D. 3/8" bypass indicator with preformed installation kit on larger sizes.
 6. Acceptable Manufacturers: Sporlan, Alco, Hubbell, Phillips, Henry.
- D. Sight Glasses:
1. Similar to Sporlan "See-all" moisture and liquid indicator with solder type connections.
 2. Install sight glass of the same size as the liquid line.
- E. Miscellaneous Valves and Accessories:
1. Drain valves for all pressure vessels.
 2. Dual pressure relief valves with manifold for all pressure vessels.
 3. Refrigerant service valves where indicated.
 4. Pressure - Temperature Test Ports and Test Kit:
 - a. Brass or stainless steel body with threaded cap and gasket.
 - b. Two self closing valves with intermediate pocket for added pressure protection.
 - c. Pressure temperature test kits consisting of 0- 100 psi pressure gauge with adapter, 25-125°F testing thermometer, 0-220°F testing thermometer, gauge adopted and protective carrying case (two required).
- F. Liquid Recirculation Package and High Pressure Receiver:
1. Single package, factory assembled and wired.
 2. Accumulator and recirculation receiver welded steel, 250 psi design working pressure, sized for proper liquid and gas separation and large enough to hold R-22 surge volume. Internal manifolds for low velocity and vortex eliminators to prevent pump cavitation.
 3. Dual liquid recirculation pumps. (One pump to be full standby). Centrifugal, type complete with motor, isolating valves, check valves and strainer.
 4. 30" Durco Pump Co. liquid level gauge with gauge valves, high liquid level float switch to cut-out compressors and low liquid level float switch to cut-out liquid pump.
 5. Oil control by means of bypass line with metering valve and sight glass from pump discharge to compressor suction.

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6. The control panel is complete with bus bars, two pump starters with fused disconnects, control section with alarm circuit, indicating lights and the necessary switches. It's mounted on the steel base with controls and pumps factory wired and the entire assembly is protected by a NEMA 1 enclosure. Alternate NEMA classifications are available as options.
 7. Steel base and structure.
 8. Acceptable Manufacturers: Freezing Equipment Sales, Co.; Frick, Vilter, York
- G. Chillers, Liquid, Shell Only:
1. Shell and tube chiller designed for refrigerant flow through the tubes and water flow through the shell. Water side designed for 125 psig working pressure and refrigerant side for 225 psig working pressure.
 2. Acceptable Manufacturers: Standard Refrigeration, Armstrong.
- H. Thermometers:
1. Red reading type, glass front, iron or phenol case, adjustable pattern, separable socket.
 2. Shall have 9 inch scale and 12 inch case.
 3. Operating range shall occur in middle half of total range
 4. Acceptable Manufacturers: Mueller, Taylor, Rochester.
- I. Gauges:
1. Liquid pressure gauges constructed with bronze tube, stainless steel movement, white dial, black micrometer, adjustable pointer, iron case with black flange iron or phenol screwed ring, bottom connection.
 2. Case diameter size shall be 4-1/2 inches minimum.
 3. Operating range shall occur in middle half of total gauge range.
 4. Provide needle valve for all gauges.
 5. Acceptable Manufacturers: Crosby-Ashton Type AAO, Ashcroft, Lonegran
- J. Locking Refrigerant Caps
1. Precision machined from high grade brass surrounded by a protective aluminum shroud. 3 year warranty. Provide one multi key per project to maintenance personnel.
 2. Acceptable Manufacturers: NOVENT, C&D Valve
- K. Refrigerant Charge: ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
1. Furnish and install piping, fittings and appurtenances required to complete the piping systems shown on the drawings. Elbows shall be long radius type. Tees may not be field fabricated.
 2. Run piping to true alignment, generally parallel or perpendicular to building walls, floors and ceilings, and with uniform grades and spacing, so as to present a neat and workmanlike appearance.
 3. Care shall be paid to the exact locations of piping with respect to equipment, ducts, conduits, slabs, beams, lighting fixtures, columns, ceiling suspension

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- systems, etc. to provide maximum access to mechanical and electrical equipment in the building. Close coordination and cooperation shall be exercised with other trades in locating the piping in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements made to avoid conflict.
4. Not all necessary pipe offsets are indicated on the drawings because of the small scale. The various runs of piping to be installed shall be studied and adjustments made in exact routings as may be required for proper installation.
 5. Conflicts arising during the erection of piping shall be brought to the attention of the Owner's Representative. No improvising or field changes will be permitted without the approval of the Owner's Representative.
 6. Use full lengths of pipe wherever possible. Short lengths of pipe with couplings will not be permitted. Cut to exact measurement and install without forcing or spring unless otherwise shown on the drawings or specified.
 7. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing any pipe, care shall be taken that the inside is thoroughly cleaned and free of cuttings and foreign matter. Measures shall be taken to preserve this cleanliness after erection.
 8. Arrange pipe connections to valves and specialties so that there is clearance for easy removal of the valve or specialty from the line, and also for the removal of the valve bonnet and interior, and the specialty top and bottom and interior, except where otherwise approved by the Owner's Representative.
 9. Erect piping in such a manner so as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending movements at joints or connections to equipment. Make allowances throughout for expansion and contraction of piping. Provide each riser and horizontal run of piping with expansion loops, expansion joints, or expansion compensators where indicated and required. Securely anchor and adequately guide pipe as required or where indicated to force expansion to the expansion device without bending, binding, or misalignment of pipe. Branch connections from mains to risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Where indicated, in lieu of expansion loops, expansion joints, or expansion compensators, horizontal runs of pipe shall be anchored at approximately midway of the run to force expansion, evenly divided, toward the mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.
 10. Installed piping shall not interfere with the operations or accessibility of doors or windows and shall not encroach on aisles, passageways and equipment, and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.
 11. Where lines are purposely pitched for drainage, an accurate grade shall be maintained. No lines shall be supported in such a manner as to permit deflection, due to gravity, sufficient to pocket the lines when full of liquid. Grade mains as indicated by arrows on the drawings and in accordance with gradient as indicated in attached Piping Schedule.
 12. Piping found to have water hammer or other objectionable vibrations which cannot be eliminated by proper grading or other natural means, shall be braced, trapped or hung with shock absorbing hangers and equipped with air chambers, mechanical shock absorbers, flexible pipe connections or otherwise silenced using approved means.
 13. Use building steel wherever possible for supporting pipe hangers. Main structural steel shall not be drilled, cut or burned for hangers without the approval of the Owner's Representative. Expansion bolts shall be used only upon the approval of the Owner's Representative.
 14. Install unions or flanges in piping connections to equipment, regulating valves,

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and wherever necessary to facilitate the dismantling of piping and/or removal of valves and other items requiring maintenance.

15. Avoid bushings. Reducing fittings shall be used wherever practical.
16. The drawings indicate the size of piping and connections, and if certain sizes are omitted or unclear, obtain additional information before proceeding.
17. The piping drawings have been worked out with a view to the most economical installation, taking into consideration accessibility and appearances, and the Contractor must follow the drawings accurately and if it is found impractical to install the work in accordance with the drawings and specifications, the Contractor shall notify the Owner's Representative before making any changes and get their approval or revised drawings before proceeding with the work. Verify all measurements on the job before cutting pipes or having piping fabricated, and be responsible for the correct location of all pipe connections, also check sizes and standard of outlets on the equipment, including the dimensions and drilling of flanges, etc.
18. Copper tubing and galvanized steel shall not be mixed in any one run of piping.
19. Change in direction shall be made with fittings, except that bending of steel and copper pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.
20. Threaded joints shall be made with tapered threads in accordance with ANSI B2.1, and made tight with an approved pipe thread joint compound or material, applied to the male threads only. Use compounds sparingly and apply with caution to ensure that compounds do not enter piping systems. When pipe joint is made up a maximum of 3 threads shall be visible.
21. Joints for plastic pipe shall be made in accordance with PPI Piping Manual.
22. Connections between ferrous and nonferrous metallic pipe shall be made with dielectric unions or flanges.
23. Connections between plastic and metallic pipe, between plastic and glass pipe, and between metallic and glass pipe, shall be made with transition fittings manufactured for the specific purpose.
24. Unions and flanges shall not be concealed in walls, partitions, or above inaccessible ceilings.

B. Valve and Specialties Applications

1. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
2. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
3. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
4. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - a. Install valve so diaphragm case is warmer than bulb.
 - b. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line. Verify proper location for the bulb with the valve manufacturer
 - c. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
5. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety relief-valve discharge line to outside according to ASH RAE 15.

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6. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube on each circuit.
 7. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - a. Solenoid valves.
 - b. Thermostatic expansion valves.
 - c. Hot-gas bypass valves.
 - d. Compressor.
 8. Install filter dryers in liquid line between compressor and thermostatic expansion valve on each circuit.
 9. Install receivers sized to accommodate pump-down charge.
 10. Install flexible connectors at compressors.
 11. Locking Refrigerant Caps: Provide at all exterior refrigerant service access ports (Schrader valves).
 12. Install gauges with dial in vertical position. Locate between shut-off valve and equipment directly adjacent to equipment within normal visual range of operator standing on floor.
 13. Provide gauges where shown on drawings, including the following locations:
 - a. Ice builders; leaving each builder on the pumped liquid return header.
 - b. Barrel chiller; entering and leaving the pumped liquid lines.
 - c. Compressor oil coolers; entering and leaving condenser water lines.
 - d. Evaporative condenser; entering and leaving refrigerant lines.
 - e. Refrigerant pumps; entering and leaving the pumped liquid lines.
 14. Provide nickel plated brass escutcheons or floor plates, around pipes piercing floors and walls in finished spaces. Fit around insulation or around pipe if uninsulated. Secure to pipe with setscrew. Provide deep escutcheon where sleeve projects beyond finished surface
- C. Refrigerant Systems Additional Requirements:
1. Installation shall be in accordance with ANSI B31.5 Refrigeration Piping, unless specified otherwise herein.
 2. Brazing procedures and operators shall be qualified in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code.
 3. Refrigerant pipeline accessories that may be damaged by heat shall be disassembled prior to joint brazing. Reassemble accessories after joint brazing operations are completed.
 4. Joints shall be made with solder-type fittings. The outside surface of the tube where engaged in the fitting, and the inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before brazing. Self-cleaning compounds are not allowed. Care shall be taken to prevent annealing of tube and fittings when making connections. Brazed joints shall be made with flux and the previously specified silver-brazing alloy. The brazing alloy shall be applied and drawn through the full fitting length. Excess brazing alloy shall be wiped from the joint before the brazing alloy hardens. Joints shall be made with heat applied uniformly around the entire circumference of the tube and fittings. Remove all excess flux for a clear visual inspection of all brazed connections.
 5. Refrigerant piping installed below concrete slab- on-grade shall be installed in continuous runs without joints, and shall be encased in PVC plastic conduit. Ends of conduit shall be sealed watertight.

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3.2 BRAZING AND SOLDERING

- A. Operator and Procedure Qualifications: All welding and/or brazing operators and all welding and brazing procedures shall be qualified in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code.
- B. Welding:
 - 1. All pipe welding performed under this division of the specifications shall be examined in accordance with ANSI B31.1 requirements for each piping system. The pipe weld examination is hereby made a part of the work of this division of the specifications. An independent outside inspection firm, regularly performing this type of examination, shall be hired by the contractor or subcontractor performing the welding as part of the work of their contract. The examination shall be performed by a representative of the Inspection Company (hereafter called the Inspector) who is qualified and certified for each examination method required.
 - 2. The Inspection Company performing the examination shall certify in writing that all pipe welds performed under this contract conform to the requirements of ANSI B31.1 for each piping system and to all other governing codes.
 - 3. Before final acceptance of the welded piping, certified test reports shall be submitted for review. The reports shall include the following data: name and location of project, date of test, type of piping system, working pressure and temperature, standard used for testing and applicable test method, number and location of welds tested and names of persons performing test.
 - 4. Welders and procedures for fire protection system piping qualified in accordance with NFPA No. 13.
- C. Brazing: Silver braze joints in accordance with MSS-SP-73 "Silver Brazing Joints for Wrought and Cast Solder Joint Fittings".
- D. Soldering:
 - 1. Joints in copper tubing shall be made with solder- type fittings. Outside surface of the tube where engaged in the fitting, and inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before soldering. Self-cleaning compounds shall not be used. Care shall be taken to prevent annealing of tube and fittings when making connections. The solder joint shall be made with flux and wire form solder, except brazed joints. The flux shall be a mildly corrosive liquid or a petroleum based paste containing chlorides of zinc and ammonium. Solder shall be applied and drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Joints in copper tube sizes 2-1/2 inches and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multi-flame torch. Use of oxy-acetylene cutting torch in lieu of multi-flame torch is not permitted. Disassemble valves and other accessories that may be damaged by heat before soldering.

3.3 TESTING OF PIPING SYSTEMS:

- A. Each piping system, after erection, shall be subjected to a pressure test. The test requirements shall be as follows:
 - 1. General: Furnish everything required for the tests. Notify Architect/Engineer at least 48 hours before any testing is performed. Independent Agent/Owner shall

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- verify pressure test and sign off. Report to be furnished to Architect/Engineer. Testing shall be performed at the completion of each phase of the project.
2. HVAC related systems shall be tested with water at 1-1/2 times the system working pressure, but not less than 100 psig. Joints will be visually examined for leaks.
 - a. Initial Hydrostatic Test: Before insulation is applied to field connections, hydrostatically pressure test each pipe as a complete unity with fresh water to 150 psig or not less than 1.5 times systems pressure rating, whichever is greater. Pressure testing with air will not be permitted, unless approved prior to testing. Limit pressure rise to 100 psi per minute at beginning of test and pressure drop to 100 psi at conclusion of test. Remove air from system before start of tests. Pressure must hold for a minimum of four (4) hours with a 4-psi maximum drop. Examine system for leaks and porosity. Replace porous sections and repair leaks in accordance with pipe manufacturer's instructions, repeat tests until system is proven tight. During a 4-hour pressure holding period, valve off system and completely disconnect method of system pressurization.
 - b. Cycle Test: Pressure cycle test system at 150 psig or 1.5 times system pressure rating, whichever is greater, for 10 cycles. Each cycle shall consist of a one-minute period at 150 psig or 1.5 times system pressure rating and a 4-minute period when the pressure is dropped at least 40%. Examine system for leaks and porosity, repair leaks, replace porous pipe, and repeat test until system is proven tight.
 - c. Post Cycle Hydrostatic Test: Repeat initial hydrostatic test.
 - d. Operational Test: Operate complete system with water flowing through system. During 48 hours, cycle system 8 hours on and 8 hours off for 3 complete cycles. Examine system for leaks until system is proven tight.
 - e. Second Hydrostatic Test Series: After successful completion of operational testing, repeat first hydrostatic test series sequence. Examine pipe system for leaks and porosity. Repair leaks, replace porous pipe, and repeat test until system is proven tight. After successful completion of the second hydrostatic test series, backfill trenches.
 - f. Final Hydrostatic Test: After completion of the final phase of construction, repeat the initial hydrostatic test on the entire piping system(s).
 3. Refrigerant Piping Systems shall be tested with dry carbon dioxide, or nitrogen, at 315 psig for the high side, and at 245 psig for the low side. If leaks are to be detected by use of an electronic halogen detector, or a halide torch, the system shall be pressurized with refrigerant gas prior to introduction of dry carbon dioxide or nitrogen into the system. Pre-charging of system with refrigerant gas is not necessary for soap bubble leak detection method.
 4. Leaks, if any, shall be located, repaired, and retested in accordance with the test method specified for the system in which the leaks are located.
- B. Prior to testing a system, the Contractor shall provide the proper Building Official and the Owner's Representative with not less than 72 hours notice of the proposed test. The Contractor shall obtain approval of the test results. Where written approval is required, the Contractor shall obtain such written approval, and submit a copy of the approval.
 - C. Work requiring testing shall not be covered, or otherwise concealed, until testing is completed and approval is granted.
 - D. Work, or portions of work, that is altered in any way after testing and approval shall be

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retested, witnessed, and approval obtained.

- E. Systems requiring hydrostatic tests shall be protected from damage caused by freezing. After tests are completed drain all sections of pipe, including traps, or fill undrained sections and traps with antifreeze solution. Vent all high points to release vacuum and ensure complete drainage of closed systems, and blow out piping with compressed air to remove trapped water.
- F. Duration of tests, unless specified otherwise, shall be the time required to examine each joint in the system being tested.
- G. Systems requiring hydrostatic testing under pressure shall be vented at high points to ensure that all piping is completely filled with the testing medium.
- H. Disconnect pressure boosting apparatus, or vacuum pumps, during the test time span specified for systems employing the pressure loss/time span test method.
- I. During tests, isolate system components that have test pressures less than pressures specified for system tests.
- J. Use clean soapy water applied to exterior of joints to locate leaks in systems using compressed air, dry carbon dioxide, or nitrogen, under positive pressure as a test medium.

END OF SECTION 15133

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SECTION 15210
VIBRATION ISOLATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Vibration isolators.
- B. Braided Flexible pipe connectors.

1.3 QUALITY ASSURANCE

- A. The vibration isolation materials manufacturer shall be responsible for the proper selection of spring rates to accomplish the specified minimum static deflections for all spring and pad type isolators based on the weight distribution of equipment to be isolated.
- B. The vibration isolation materials manufacturer shall be responsible for the structural design of steel beam bases and concrete inertia bases to support mechanical equipment scheduled to receive a supplementary base.
- C. Vibration isolation shop drawings shall show isolator locations, and load on each isolator, deflection, compressed spring height, solid spring height, spring diameters and color coding.
- D. Where grooved-joint flexible pipe connectors are specified, manufacturer shall design the isolation system and include drawings showing all supports, restraints, etc. as required to ensure performance.

1.4 SUBMITTALS

- A. Submit a schedule indicating make, model, type and deflection for each system or weight range.
- B. Product data and shop drawings, 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 manufacturer's certification of installation quality.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Vibration Isolators:
 - 1. Amber/Booth Company

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2. Mason Industries, Inc.
3. Peabody Noise Control, Inc. - Kinetics.
4. Vibration Mountings and Controls, Inc.

B. Braided Flexible Pipe Connectors:

1. Flexonics
2. Keflex, Inc.
3. Mason Industries, Inc.
4. Metraflex Co.
5. Proco Products, Inc.
6. Southeastern Hose
7. Unisource Manufacturing Inc.
8. Wheatley Gaso, Inc.

2.2 MATERIALS

A. Vibration Isolators:

1. Type D: Vibration Hangers: Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30° arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Based on Mason Model 30N.

B. Flexible Pipe Connectors:

1. Braided flexible pipe connectors constructed of stainless steel annular corrugated metal surrounded with a woven braid of high tensile stainless steel. Units capable of absorbing pump vibration and noise accept thermal expansion and reduce piping stress due to minor misalignment and pressure variations. Sizes 1/2" through 2" to have carbon steel male pipe thread connections. Sizes 2-1/2" and larger to have carbon steel plate flanges with ASA #150 bolt hole patterns. Based on Keflex KSSPC.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All floor mounted equipment shall be installed on a housekeeping pad, in addition to any isolation or inertia base requirement as specified in Section 15050 - Basic Materials and Methods.
- B. Installation of all vibration isolation materials and supplemental equipment bases specified in this section of the specifications shall be accomplished following the manufacturers written instructions.
- C. On completion of installation of all isolation materials and before start up of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.
- D. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified. Electrical conduit connections to isolated equipment shall be looped to allow free motion of isolated

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equipment.

- E. Adjust all isolators for uniform support.
- F. Readjust all isolators after system start-up to assure constant support.

3.2 INSPECTION

- A. The Contractor shall notify the local representative of the vibration isolation materials manufacturer prior to installing any vibration isolation devices. The Contractor shall seek the representatives guidance in any installation procedures he is unfamiliar with.
- B. The local representative of the vibration isolation materials manufacturer shall conduct periodic inspections of the installation of materials herein specified, and shall report in writing to the Contractor any deviations from good installation practice observed.
- C. On completion of installation of all noise and vibration isolation devices herein specified, the local representative of the isolation materials manufacturer shall inspect the complete system and report in writing any installation errors, improperly selected isolation devices, or other fault in the system that could effect the performance of the system.
- D. The installing Contractor shall submit a report to the Owner's Representative including the manufacturer's representatives final report indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.

3.3 VIBRATION ISOLATION SCHEDULE:

A. Fan Terminal Boxes:

- 1. Base type: None required.
- 2. Isolator Type: "D"
- 3. Deflection: .75"
- 4. Accessories: Flexible pipe connector.

B. Packaged Air Handling Units:

- 1. Base type: None required.
- 2. Isolator Type: Internal spring type provided with AHU.
- 3. Deflection: 2"
- 4. Accessories: Flexible duct connectors (internal fan isolation and Section 15860 – Flexible duct connectors).

END OF SECTION 15210

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SECTION 15250
INSULATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Duct Systems Insulation.
- B. Piping Systems Insulation.
- C. Cold Pipe Hanger Support Blocks.
- D. Accessories.

1.3 QUALITY ASSURANCE

- A. All products within the conditioned air stream or active plenums shall comply with the NFPA 90A Flame/Smoke rating of 25/50 and comply with UL 181 erosion limitations. Fire hazard ratings shall be as determined by NFPA-255, "Method of Test of Surface Burning Characteristics of Building Materials" - ASTM E84 or UL 723.
- B. All adhesives, cements, finishes, jackets, etc., shall be UL listed or labeled for use as applied to insulation and designed specifically for use in the installation.
- C. All insulation shall be installed in accordance with National Commercial & Industrial Insulation Standards (NCIA).

1.4 SUBMITTALS

- A. Submit schedule indicating type of insulation, thickness, vapor barrier or coating by system and size.
- B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.
- C. Submit details of insulated removable covers using the actual equipment dimensions, concrete base sizes and piping arrangements.
- D. Refer to Section 15010, Mechanical General Provisions for requirements.

1.5 GENERAL REQUIREMENTS

- A. Factory-applied insulation is specified under the applicable equipment Section of these specifications. It is listed here for reference only.
- B. Acoustical duct liner is specified under Section 15840 - Shop Fabricated Ductwork. It is listed here for reference only.

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- C. Packages and standard containers of materials shall be delivered unopened to job site and shall have the manufacturer's label attached giving a complete description of the material.

1.6 DEFINITIONS

- A. The term "exposed" means exposed to view in finished spaces, in equipment rooms, in fan rooms, in closets, in utility corridors, in tunnels, on roof, in storage rooms, and in other spaces as indicated.
- B. The term "concealed" means concealed from view, and includes all spaces not defined as exposed.
- C. The term "unconditioned" space shall mean all places where the temperature surrounding the pipe has not been conditioned consistent with conditioned spaces, and shall include mechanical equipment rooms, non-active ceiling plenums, and non-accessible chases. This term shall also include conditioned spaces where the humidity levels are allowed to rise above 70% RH.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Closed Cell Elastomeric Insulation:
 - 1. Armacell LLC
 - 2. Johns Manville
 - 3. Rubatex
- B. Jackets:
 - 1. Southern Asbestos Company
 - 2. John Mansville
 - 3. Owens-Corning Fiberglas
- C. Foamglass Insulation:
 - 1. Pittsburgh Corning
 - 2. Cell-U-Foam Corp.
 - 3. Owner Approved Equal
- D. Insulation Coatings, Mastics, Adhesives, and Sealants
 - 1. Foster
 - 2. Childers
 - 3. Pittsburgh Corning
 - 4. Armacell

2.2 DUCT INSULATION AND FIREPROOFING REQUIREMENTS – Refer to Construction Documents.

2.3 MATERIALS

- A. Duct Insulation:
 - 1. Rigid Fiberglass: Resin bonded fibrous glass, flame retardant, factory applied all

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- service jacket (ASJ) vapor barrier, maximum vapor permeance of .02 perm/in and puncture resistance of 50 units, minimum density 3.0 lb/cf, maximum conductivity per 1" thickness of .23 at 75°F mean temperature. Based on Knauf Insulation Board.
2. Blanket Fiberglass: Flexible fibrous glass, flame retardant factory laminated foil-skrim-kraft (FSK) vapor barrier, 2" stapling flange, maximum vapor permeance of .02 perm/in., minimum density of 1.5 lb/cf, maximum conductivity per 1" thickness of .28 at 75°F mean temperature. Based on Knauf Duct Wrap.
- B. Pipe Insulation (to 450F):
1. Closed Cell Elastomeric (Small Pipe Sizes up to 5 Inches): Flexible, elastomeric, closed cellular, tubular molded to accommodate piping, smooth outer surface suitable for painting with vinyl lacquer type coating, water resistant, non absorbent, ozone resistant, minimum density of 4 lb/cf, maximum conductivity per 1" thickness of .27 at 75°F mean temperature. Based on Armacell LLC AP Armaflex and Self-seal Armaflex 2000.
 2. Foamglas: Rigid, preformed sections of 100% rigid cellular glass complying with ASTM C552 standards, non-absorptive of moisture after immersion, water vapor permeability 0.00 perm/in. impervious to common acids (except hydrofluoric), non-combustible, 90 PSI compressive strength when capped with hot asphalt, 7.5 #/cu.ft. density, thermal conductivity 0.28 BTU-In./Hr./Sq.Ft./F @ 50°F. Based on Pittsburgh Corning Foamglas.
- C. Cold Pipe Hanger Support Blocks: Lightweight, rigid, closed cell material having 100 lb/sq.in. compressive strength when capped with hot asphalt according to ASTM C240. Based on Pittsburgh Corning Foamglas.
- D. Accessories:
1. PVC pipe jacket and fitting covers used with insulation for pipe, elbows, tees, couplings, 25/50 flame/smoke ratings, suitable for temperatures to 500°F.
 2. Glass Cloth Pipe, Duct and Equipment Jacket: Glass lagging cloth, 8 oz/sy treated weight. Secure with elastomeric insulating adhesive on elastomeric insulation, for fiberglass insulation use appropriate mastic finish as recommended by the insulation manufacturer with the perm rating of the mastic equal to or less than that of the insulation it is sealing.
 3. Corner angles shall be minimum 28 gauge, 1 inch by 1 inch aluminum adhered to 2 inch by 2 inch heavy kraft paper.
 4. Glass tape shall be a minimum density of 1.6 ounces per square yard, 4 inch wide with a 10 x 10 thread count per inch of width. Glass cloth shall be untreated.
 5. Staples shall be outward clinching type, Type 304 or 316 stainless steel in accord with ASTM A 167 or Monel® coated.
 6. Wire shall be soft annealed galvanized, or copper, 16 gauge, or nickel copper alloy.
 7. Closed cell elastomeric insulated finish shall be a white water based flexible, acrylic latex enamel equal to WB Armaflex finish.
 8. Insulation Tape: Closed cell elastomeric insulation: 2" wide x 1/8" thick.
 9. Elastomeric Insulation Adhesive: Air drying contact adhesive for securing sheets to flat or curved metal surfaces and joining seams and butt joints of elastomeric insulation. Suitable for temperatures to 180F, dried film not to exceed 25 for flame spread and 50 for smoke development when tested per ASTM E 84-84A method.
 10. Vapor Barrier Mastic: Air drying flexible water based mastic used for applying a vapor barrier joint with glass cloth at insulation joints. Suitable for temperatures to 180°F, wet and dried film not to exceed 25 for flame spread and 50 for smoke development when tested per ASTM E 84-84A method. Maximum Perm rating of 0.08. , Childers Products Company, Inc. CP-35 Chil Therm® WB, Foster Products

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Corp. Product Data 30-80 Foster Vapor Safe® Coating, Marathon Industries, Inc. 590 LO-PERM, Richard's Paint Manufacturing CO., Inc. VBM-4, Vimasco Corp. 749 Vapor-Blok, or equal.

11. Acrylic Latex Finish and Sealers:
 - a. Elastomeric Insulations: Air drying flexible water based finish used for finishing flexible elastomeric insulation. Suitable for temperatures to 180°F, wet and dried film not to exceed 25 for flame spread and 50 for smoke development when tested per ASTM E 84-84A method. Armacell LLC WB Armaflex finish.
 - b. Foamglass Insulation: Air drying flexible water based sealer used for applying a vapor barrier seal over microscopic cracks that develop in the insulation. Suitable for temperatures to 180°F, wet and dried film not to exceed 25 for flame spread and 50 for smoke development when tested per ASTM E 84-84A method. Maximum Perm rating of 0.08. , Childers Products Company, Inc. CP-35 Chil Therm® WB, Foster Products Corp. Product Data 30-80 Foster Vapor Safe® Coating, Marathon Industries, Inc. 590 LO-PERM, Richard's Paint Manufacturing CO., Inc. VBM-4, Vimasco Corp. 749 Vapor-Blok, or equal.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Install all insulation in strict accordance with the manufacturers written installation instructions.
- B. All insulation work shall be performed by skilled mechanics regularly engaged in the insulation trade.
- C. Properly coordinate the insulation work with the other trades so that installation is performed with a minimum of conflict.
- D. Insulation shall not be applied on any piping or duct system requiring testing until testing is completed and approved by Owner's Representative.
- E. Insulation shall not be applied until all systems are clean, dry, free of dirt, dust or grease.
- F. The finished installation shall present a neat and acceptable appearance which includes but is not limited to: all jackets smooth, all vapor barriers sealed properly, no evidence of "ballooning" of the jackets, or sagging insulation, all valves, dampers, gauges, unions, etc. accessible. The Owner's Representative shall be the final judge of acceptance of workmanship.
- G. All equipment nameplates on hot equipment shall be left uncovered. All equipment nameplates on cold equipment shall have a removable section sized to expose the nameplate. This section shall be clearly marked "NAMEPLATE".
- H. If proper maintenance procedures require access to the insulated equipment removable panels, sections or covers shall be provided to accomplish this. These access devices shall be constructed in a manner to assure easy access and sturdy construction. The contractor shall assume the responsibility to coordinate all equipment requiring insulation to be either factory or field insulated.
- I. Insulation and accessories shall be applied only at suitable application temperature and conditions as recommended by the manufacturer. Do not apply insulation to any surface

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while it is wet.

- J. Insulation shall be protected from moisture and weather during storage and installation.
- K. Insulation which has sustained moisture damage, torn jackets, or other damage due to improper storage or other reasons shall not be used. If evidence of this is sighted the Owner's representative reserves the right to require the insulating contractor to remove any and/or all insulation until the Owner's Representative is satisfied that there is no longer any inferior insulation installed on this project.
- L. Insulation, fabric and jacketing shall be protected from damage during construction. Damage by the insulator shall be repaired without cost to the Owner. Damage by others shall be reported in writing to the contractor.
- M. The insulation subcontractor is responsible for proper material storage at the work site.
- N. Work performed prior to receipt of approved documents or submittals, later proving to be incorrect or inappropriate, shall be promptly replaced by the contractor without cost to the purchaser.
- O. Insulation shall not be installed until adequate access and clearances at control mechanisms, dampers, sleeves, columns and walls have been provided.
- P. All insulation at handholes, access doors or other openings, and adjacent to flanges and valves shall be neatly finished where exposed to view.
- Q. Where an insulated pipe or ductwork passes through a sleeve or opening in a non-rated partition, the full specified thickness of the insulation shall pass through the sleeve or opening. Where an insulated pipe or ductwork passes through a rated partition, the insulation shall be stopped at the partition. The void between the pipe and the sleeve shall be sealed with an approved fire-stopping material, and the insulation trimmed and sealed to the partition sufficient to cover the sleeve.
- R. All materials, accessories and methods of installation and fabrication are subject to the Owner's Representatives inspection and approval during any phase of the work.
- S. The insulation subcontractor shall prevent the accumulation of insulation debris in the buildings and on the premises of the Owner.
- T. The insulation subcontractor shall be responsible for his own safety program at the work site, and shall provide instruction on safe practices for his workers assigned to the project. All employees are subject to the work rules at the job site.
- U. The insulation subcontractor shall familiarize himself with the progress and execution of the job and notify the proper parties of interferences and any problems with the proper installation of his materials.

3.2 INSTALLATION

A. Duct Insulation:

1. General:

- a. Insulate or internally line all flexible duct connectors equal to or greater than adjacent insulation thickness.
- b. The tops of all diffusers shall be insulated same as connecting ductwork to

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- prevent condensation.
 - c. Duct insulation at fire dampers shall be extended over supporting angle iron and sealed to wall.
- 2. Rigid Fiberglass Insulation:
 - a. Use boards in largest possible size to minimize seams. Do not use "scraps".
 - b. Provide corner angles where insulation is subject to harm.
 - c. All fasteners shall be non corroding.
 - d. The insulation shall be applied by use of cup head weld pins. Such fasteners shall be spaced in accordance with NCIA recommendations, where NCIA standards do not address exact dimensions, cup head weld pins shall be spaced on 12" centers. Pin caps shall be covered with a round vapor seal patch that matches the jacket on the ASJ board. On cold ducts, these shall be coated so as to not cause condensation.
 - e. Ducts having sharp bends shall have the insulation scored as required to conform to the curved surfaces to provide a neat and acceptable appearance when finished.
 - f. Insulation edges and joints shall be finished with two coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent insulation. One coat of mastic shall be applied to the insulation prior to the application of the glass cloth, which shall be embedded in the mastic to ensure complete adhesion of the cloth.
 - g. Generally, rigid fiberglass material will only be used in finished or exposed areas, and it is intended that the finish present a neat and uniform appearance as to color and workmanship.
 - h. In finished areas, molded glass fiber insulation shall be used to insulate round ducts where commercially available sizes can be used.
 - i. Fittings on round ducts in finished areas shall be covered with premolded fiberglass fitting insulators equal to Insul-Cooustic where sizes are available. For sizes where premolded fittings are not available use miter-cut segments of molded pipe insulation, wired in place, with all joints sealed with adhesive and smoothed out with a coat of insulating cement.
 - j. On cold ducts, the fittings shall be finished with two coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent insulation. One coat of mastic shall be applied to the insulation prior to the application of the glass cloth, which shall be embedded in the mastic to ensure complete adhesion of the cloth. Hot ducts shall be finished in a similar manner, except the mastic need not be of the vapor barrier type.
- 3. Blanket Fiberglass Insulation:
 - a. Insulation shall be tightly wrapped on the ductwork with all circumferential joints butted and longitudinal joints lapped 2 inches and stapled. Joints shall be finished with two coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent insulation. One coat of mastic shall be applied to the insulation prior to the application of the glass cloth, which shall be embedded in the mastic to ensure complete adhesion of the cloth. Additionally secure insulation to bottom of rectangular ducts over 24 inches wide with weld pins at no more than 18 inches on center.
 - b. Insulation shall be butted with facing overlapping all joints shall be finished with two coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent insulation. One coat of mastic shall

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be applied to the insulation prior to the application of the glass cloth, which shall be embedded in the mastic to ensure complete adhesion of the cloth. Breaks, punctures, pin penetrations in facing shall be sealed with vapor barrier tape and vapor barrier adhesive.

B. Pipe Insulation:

1. General:

- a. All locations where the insulated surface is supported by hangers, the insulation shall be protected by shields or saddles properly skimmed to maintain a smooth outer surface, and proper insulation thickness. Chilled water piping, 3" and over shall have a section of foamglas insulation installed between the pipe and shield. 3 and 4" to be 12" long, 5" and 6" to be 18" long and 8" and over, 24" long. If the possibility exists that the hanger may conduct the temperature of the conveyed medium and thus cause condensation or personal injury due to high temperature, the hanger shall also be insulated. Joints between foamglas and pipe insulation shall be properly sealed.
- b. All devices connected to or in line with the piping system shall be insulated greater than or equal to the connecting piping. This includes but is not limited to valves, air separators, expansion tanks, control valves, control devices, gauge connections, thermometer stems, chemical feed equipment, piping flexible connectors, etc.
- c. The insulation at threaded unions in hot water piping shall be tapered and terminated with cement and glass lagging cloth and lagging adhesives.
- d. Insulate exterior surfaces of all anchors and guides for chilled water piping systems.
- e. A complete moisture and vapor barrier shall be installed wherever insulation is penetrated by hangers or other projections through insulation and in contact with cold surfaces for which a vapor seal is specified.
- f. Cover fittings, flanges, unions, valves, anchors, and accessories with premolded or segmented insulation of the same thickness and material as the adjoining pipe insulation. Where nesting size insulation is used overlap pipe insulation 2 inches or one pipe diameter. Fill voids with insulating cement and trowel smooth. Elbows shall have not less than 3 segments per elbow. Secure insulation with wire or tape until finish is applied. Blanket inserts in lieu of premolded or segmented insulation is not allowed. Cover fittings with preformed PVC fitting covers.
- g. Wrap all pressure gauge taps, thermometer wells and all other penetrations through insulation with closed cell insulation tape so as to prevent condensation.
- h. Seal all raw edges of insulation.
- i. For piping supported by hangers outdoors, apply a rainshield to prevent water entry.

3. Closed Cell Elastomeric:

- a. All joints shall be sealed with adhesives.
- b. Where the thickness is to be obtained by use of two layers of insulation, install with staggered joints.
- c. Finish:
 - 1) Concealed Indoors: No additional finish.
 - 2) Exposed Indoors: Provide PVC jacket over all insulation.
 - 3) Concealed Indoors: Provide PVC jacket over fittings fabricated

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from insulation sections or sheet.

4. Foamglas:
 - a. All joints, both longitudinal and circumferential shall be sealed with a vapor barrier mastic.
 - b. Thickness shown for refrigeration pipe to be obtained by use of two layers of insulation with staggered joints.
 - c. Finish:
 - 1) Exposed Indoors: Provide PVC jacket over all insulation that shall be sealed with an acrylic latex finish.
 - 2) Concealed: Provide PVC jacket over fittings fabricated from insulation sections or sheet. Provide ASJ over all other.

D. PVC Jacket:

1. Provide PVC sheet jacket over all exposed, indoor piping or insulation.
2. Provide PVC pipe jacket over all exposed, indoor foamglas or elastomeric pipe insulation.
3. Provide PVC fitting covers over all fittings fabricated from insulation sections or sheet material.
4. PVC pipe jacket shall be applied with special attention given to achieving positive seal at all longitudinal and circumferential joints using a welding solvent on the longitudinal joint as recommended by the manufacturer. Slip joints to have 4" minimum lap and no welding solvent.

E. Glass Cloth Jacket:

1. Provide where specified.
2. Provide acrylic latex finish.

F. Flexible Acrylic Latex:

1. Apply two coats to glass cloth jacket, concealed foamglas and closed cell elastomeric insulation.
2. Refer to Division 9 for color to be used. If no instructions are given, provide a white finish.

3.3 MISCELLANEOUS ITEMS

- A. General: Provide insulation of any portion of a system or piece of equipment not previously discussed where ambient operating conditions will allow condensation to occur or whose surface temperature exceeds 115°F. Insulation materials and method shall be as directed by the Designer.
- B. Final Inspection: At final inspection, the finished surfaces of all exposed insulation shall be clean and without stains or blemishes. Repair and clean the insulation surfaces and, if necessary, to obtain a new appearance, shall coat discolored surfaces with off-white latex water-base semi-gloss paint or lagging adhesive, without a change in the contract price.

END OF SECTION 15250

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SECTION 15780
PACKAGED SPLIT SYSTEM AIR CONDITIONING UNIT, AIR COOLED

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.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Packaged Split System Air Conditioning Unit, Air Cooled.

1.3 QUALITY ASSURANCE

- A. All electrical components shall be UL listed or labeled.
- B. All direct expansion coils shall be ARI certified.
- C. All components in the air stream shall conform to the NFPA 90A Flame/Smoke/Fire contribution of 25/50/0.
- D. All electrical devices shall conform to NEMA standards.
- E. All wiring shall conform to the NEC.
- F. After installation, the manufacturer's representative of all equipment provided in this section shall certify in writing to the Owner's representative that the equipment has been assembled and installed within the guidelines of the manufacturer's written installation instructions and that its performance meets or exceeds the operating characteristics specified and/or scheduled.

1.4 SUBMITTALS

- A. Submit dimension drawings, performance and product data for acceptance. Include fan curves with the system design point plotted, and clearly indicate fan efficiency.
- B. Product 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.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Packaged Split System Air Conditioning Unit, Air Cooled:
 - 1. Addison Industries
 - 2. Carrier
 - 3. Daikin Applied
 - 4. Rheem

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5. Desert-Aire

2.2 EQUIPMENT

A. Packaged Split System Air Conditioning Unit, Air Cooled:

1. Provide an air-to-air electric condensing unit (outdoor unit) in combination with a direct expansion fan coil (indoor unit), fully piped, wired and operational. Condensing unit shall be designed, tested, and fully charged for use with R-410A refrigerant. Combination unit shall be designed certified by UL and ARI, and complete package to have one (1) year limited parts warranty and compressor to have a four (4) year extended parts warranty.
2. Outdoor Section:
 - a. Cabinet shall be constructed of commercial grade galvanized steel, primed and painted to manufacturer's standard color. Access doors with neoprene gaskets shall be provided to allow access to coil, fan, motor and controls. Mounting legs shall be provided.
 - b. Compressor shall be high efficiency hermetic reciprocating type or scroll type equipped with a crankcase heater, automatically reversible oil pump, internal high pressure protection, and internal vibration isolation. Compressor motor shall have both thermal and current sensitive overload protection.
 - c. Outdoor coil shall be constructed of copper tubing with mechanically bonded aluminum fins having all joints brazed, factory installed coil refrigerant metering device to be mounted on unit liquid service valve, with device internal components to be removable for cleaning or replacement. Coil to be protected by a vinyl coated grille.
 - d. Outdoor fan shall be propeller type, direct driven, balanced statically and dynamically, and arranged for vertical air discharge. Fan shall be weatherproofed and approved for outdoor use. Fan motor shall be factory lubricated and internally protected.
 - e. Controls shall provide compressor short cycle protection and shall prevent compressor restart for a minimum of five minutes after shutdown. Liquid line low pressure switch, suction line accumulator with positive oil return, pressure relief switch and a loss of pressure indicator shall be provided.
 - f. Unit shall be equipped with filter drier, schrader access valves, refrigerant check valves in the refrigerant line, hot gas piping connection and valving, and expansion devices with interconnecting tubing to provide proper refrigerant flow control.
 - g. Low refrigerant and high refrigerant cut-outs to be arranged in lock out circuit for manual reset. Control wiring terminal board and 24 volt control circuit transformer to be provided. Terminal board shall be designed to match indoor unit terminal board and furnished complete with factory wiring from board to all internal components and accessory thermostat terminals for standardized point-to-point connectors.
 - h. Units with multiple compressors shall have independent refrigerant circuiting.
3. Indoor Section:
 - a. Cabinet shall be constructed of commercial grade galvanized steel, primed and painted to manufacturer's standard color, and insulated with fireproof, permanent, odorless glass fiber material. Access to be all

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- b. components shall be provided with neoprene gasketed access panel(s). Indoor coil shall be constructed of copper tubing with mechanically bonded aluminum fins having all joints brazed. Factory installed refrigerant metering device, refrigerant line fittings which permit mechanical connection on the liquid line and female sweat or mechanical connection on the gas line, and condensate pan with primary and auxiliary drain connections shall be provided. Unit shall also be equipped with hot gas reheat coil installed in the unit.
- c. Fan shall be forward curved, centrifugal type, driven by factory lubricated single speed, three phase fan motor complete with internal overload protection, and resiliently mounted. Fan shall have horizontal air discharge or vertical air discharge as shown on the Contract Documents.
- d. Unit shall be provided with factory installed electric heater for supplemental heating to mount in discharge air passage. Elements to be of heavy duty nichrome internally delta-connected on three phase. Heater to have line break high limit controls.
- e. Certain units require multiple power connections for energy management purposes and are indicated on the schedules. Coordinate this requirement.
- f. Unit shall be provided with 1 inch medium efficiency throwaway filters. Initial and one replacement set to be provided with unit. Filter retaining rack to be arranged for removal and replacement in space allotted.
- g. Unit control shall be through the Building Control System furnished in Specification Section 15900. Provide a clearly marked terminal strip with each unit for connection to BCS system.

4. Unit Accessories: Refer to Schedules shown on the Contract Documents.

PART 3 - EXECUTION

3.1 GENERAL

- A. Packaged Split System Air Conditioning Unit, Air Cooled:
 - 1. Install in accordance with manufacturer's recommendations.
 - 2. All openings made in walls or the roof the piping/electrical shall be patched and sealed completely, using materials of similar to existing type construction, to the Owner's satisfaction.
 - 3. All refrigerant piping shall follow refrigerant piping techniques.
 - 4. Condensate traps shall be minimum 4 inches deep and shall be field installed. Install plug in condensate drain on opposite side of unit from traps. Condensate drain connection shall be not less than 3/4".
 - 5. All wiring shall comply with applicable local and national codes. Final connections shall be made with greenfield type electrical conduit for ease in removal.
 - 6. Maintain necessary access space for filter change and normal maintenance. Piping and electrical connections shall be so located as to eliminate any interference with removal and replacement of filter.
 - 7. Maintain space clearances around heat pump per manufacturer's recommendation.
 - 8. After installation of unit, all interconnecting piping, controls and wiring, check each unit for satisfactory operation of fan on continuous and automatic control setting, unit operation on cooling, change over and heating and so indicate on tag pasted on unit indicating: "Checked for proper operation on Date by Name ."
 - 9. Insert installation and maintenance instructions and parts lists in a one inch ring binder marked "OPERATION AND MAINTENANCE INSTRUCTIONS" and furnish to Owner.

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10. Manufacturer shall review the drawings for piping distances. Contractor shall provide pipe sizes and any necessary accessories required by the Manufacturer as the result of their review.

END OF SECTION 15780

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SECTION 15840
SHOP FABRICATED DUCTWORK

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Galvanized Steel Rectangular Ductwork.

1.3 QUALITY ASSURANCE

- A. All ductwork shall be fabricated within the guidelines established by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) HVAC Duct Construction Standards - Metal and Flexible, latest edition.
- B. All ductwork shall be fabricated to withstand the pressure and velocity required on this project.
- C. All components, fasteners, sealants, adhesives, etc. in the conditioned air stream or exposed in active or non- active plenums shall conform to the NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems and Standard for Flame/Smoke/Fire Contribution of 25/50/0.
- D. All ductwork shall conform to UL standard UL 181 Factory Made Air Duct Materials and Duct Connectors, latest edition. Applicable sections shall apply to shop fabricated ductwork.
- E. After fabrication and installation of all shop fabricated ductwork the fabricator and installer, if not the same, shall certify in writing to the Owner's representative that all shop fabricated ductwork and installation of same meets or exceeds the quality standards established by SMACNA.

1.4 SUBMITTALS

- A. Submission for acceptance is required.
- B. Product 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.

1.5 SHOP DRAWINGS

- A. Shop Drawings: Provide shop drawings of sheet metal ductwork as follows:
 - 1. Draw to a scale of not less than 1/4 inch to one foot on the same size sheets as the contract drawings.
 - 2. Show duct sizes.
 - 3. Show fitting details.

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4. Show lighting and ceiling diffusers.
- B. Shop Drawings for Field Erected Casings: Submit shop drawings for air handling unit casings, field erected casings and plenums.
 1. Draw to scale of 1/2 inch to 1 foot on the same size sheets as the contract drawings.
 2. Show plan, sections, elevations and details of all joints and casings.
 3. Detail access doors and hardware.
 4. Detail coil, damper, humidifier, filter and fan installations. Provide access doors.
- C. Floor Plans: Provide sheet metal floor plans drawn to the same scale as the contract drawings.
 1. Use contract drawing sheet size.
 2. Show on each floor plan the floor penetrations, fire dampers and access doors, ducts with sized and bottom elevations, terminal types and air quantities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ductwork:
 1. Interior, exposed or concealed: Hot rolled steel continuously annealed and hot dipped galvanized sheet or coil, minimum G-90, 0.90 oz/sf coating suitable for forming without flaking or peeling, suitable for welding or soldering. Zinc coating shall not be impaired from double seaming, breaking or roll forming. 14 ga. and lighter conforming to ASTM A 653. 13 ga and heavier conforming to ASTM A 653.
 2. Exterior or Areas Requiring Painting: Hot rolled steel continuously annealed and hot dipped galvanized sheet or coil, minimum G-90, 0.90 oz/sf (.001 inch thick/side) coating with a mill applied phosphate film suitable for insulating the paint from the drying action of the zinc, capable of forming without flaking or peeling, suitable for welding or soldering. Zinc coating shall not be impaired from double seaming, breaking or roll forming. 14 ga. and lighter conforming to ASTM A 653. 13 ga. and heavier conforming to ASTM A 653.
- B. Duct Sealants: Provide sealants with a maximum 25 flame spread, and maximum 50 smoke in the dry state, conforming to ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials", and fire resistive and non-flammable in accordance with ASTM D 93, "Standard Test Methods for Flash Point" by "Pensky-Martens Closed Tester", when wet.

2.2 FABRICATION

- A. Galvanized Steel Ductwork:
 1. Fabricate ductwork as indicated on the drawings. Sizes given are inside clear dimensions. Unless otherwise indicated on the drawings, the metal gauge shall be in accordance with SMACNA-HVAC Duct Construction Standards - Metal and Flexible, Latest Edition.
 2. Elbow Fabrication:
 - a. 90 deg. elbows 12" or less in width shall be radiused whenever possible.
 - b. All radiused elbows shall be full radiused (R=1.5).
 - c. All mitered 90 deg. elbows shall have turning vanes. Ducts with a

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width/depth ratio of 1 or more shall have double thickness turning vanes; single thickness is permissible for less than 1.

3. Tee or Take-off Fabrication:
 - a. Take-off to round run-outs shall be conical or bell mouth. Where conical or bellmouth fittings can not be used due to take-off size to main, provide factory fabricated side takeoff fitting equal to Flexmaster U.S.A., Inc. Type "STO". Provide with handle extension for insulated ducts to clear the insulation thickness specified.
 - b. Take-off to square or rectangular shall be 45 deg. clinch collar or proportional divisions.
 - c. A volume damper shall be located downstream of each take off on square and rectangular take-offs, and integral to round run-outs.
 4. Transitions:
 - a. Concentric Transition: Maximum angle 45 deg. diverging, 60 deg. converging (SMACNA Fig. 2-7).
 - b. Eccentric Transition: Maximum angle 30 deg. diverging or converging (SMACNA Fig. 2-7).
 5. At the Contractor's option, ductwork may be joined at the transverse joints with prefabricated galvanized Ductmate Industries, Inc. ("25" or "35") or Ward Industries, Inc. sections, or with fabricated TDF or TDC T-24 type flanged transverse joints with bolted corners, gaskets, and sealants, constructed in accordance with the SMACNA HVAC Duct Construction Standards - Metal and Flexible, latest edition, Table 1-12. Ductmate "25" may be used only on ductwork with a pressure classification of 2" w.g. or less on the discharge side of air handling units or fan power terminal units. Plastic joint clips are not acceptable. Flanged and prefabricated joints by different manufacturers shall not be jointed. Formed on flanges shall not be used.
- B. Ductwork, General: Each duct section shall have both ends covered with polyethylene or other suitable material to protect against the entrance of dirt, debris or water during shipment and storage prior to installation.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Install in strict accordance with the Sheet Metal and Air Conditioning Contractor's National Association, Inc.'s (SMACNA) recommendations.
- B. The drawings, due to their small scale, are diagrammatic in nature and are not necessarily complete in all details. For this reason not all necessary offsets, risers or falls are shown. Coordinate the installation of the ductwork with all other trades and to provide all necessary offsets, etc. as required for completion of this project without any additional cost to the Owner and/or Engineer.
- C. All ductwork shall be run parallel or perpendicular to building structure whenever possible.
- D. All ductwork shall be properly sealed.
- E. Coordinate the location, provide the necessary access and install all devices provided in other specification sections within Division 15. Including but not limited to fire, smoke and/or balancing dampers, access and mounting for control devices, air flow measuring stations,

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etc. as apply to this project.

- F. All ducts passing through partitions or walls shall pass through at a 90 degree angle. The duct shall be sleeved with the space between the sleeve and duct properly sealed with firestopping material (Refer to Division 7 for Firestopping materials). The sleeve shall be permanently affixed to the wall (see Section 15090: Supports, Hangers, Anchors and Sleeves for sleeve specifications).
- G. Coordinate the proper duct pressure classification with the systems served and to construct the ductwork to withstand these pressures. (See 3.6 Schedules; System Pressure Classification and Duct Material Schedules.)
- H. All ducts located outdoors and not of welded construction shall have seams and transverse joints sealed water tight with duct sealer, arranged to shed water and finished with insulating duct coating as specified in Section 15860 - Sheet Metal Specialties.

3.2 CLEANING AND PROTECTION

- A. During construction, ductwork shall be cleaned of dirt and debris internally section by section as it is installed. At end of each day, ductwork not finally connected to equipment shall be provided with a temporary closure of polyethylene film or other covering material that will prevent entrance of duct, debris or water. Clean exterior surfaces of any material which might cause corrosion or if the duct is to be painted, it shall be cleaned suitable for painting. After substantial completion of the ductwork system, the system shall be operated with filters in place to blow-out any remaining dust from the system. Protect all equipment and property from damage or fouling during this cleaning. All prefilters used during cleaning shall be replaced prior to turning the system over to the Owner.

3.3 DUCT SEALING REQUIREMENTS

- A. All ducts shall have SMACNA Seal Class A (all transverse joints, longitudinal seams and duct wall penetrations).

3.4 LEAK TESTING

- A. Duct Leakage Report: The Contractor shall make all the supply, return, outside air, and exhaust duct systems (limited to 1,500 cfm and greater within their scope of work) operationally air-tight, with no more than 2% leakage for duct systems rated at 2" w.c. pressure class, and 1% leakage for systems exceeding 2" w.c. pressure class. Leakage test to be performed by Contractor with all air device openings and fan connections sealed airtight. Test the systems prior to applying any insulation or concealing in soffits or chases. Use a portable fan capable of producing a static pressure equal or greater than the duct test pressure. This fan to have a flow measuring assembly consisting of a straight section of duct with an orifice plate, pressure taps, and a calibrated performance curve for determining leakage rates.
 - 1. Test each section equal to the external static pressure indicated for that fan or air handler with the portable fan assembly. After the fan achieves that steady state design pressure, record the air flow quantity across the orifice and the percent of design air flow. If the test fails, the Contractor shall reseal and retest at no additional cost to the Owner.
 - 2. Repair all duct leaks that can be heard or felt, even if the system has passed the leakage test.
 - 3. Submit duct leakage reports to the Balancer and the Engineer for their review and approval.
 - 4. Refer to specification section 15051 for more information.

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3.5 INSTALLATION

A. Galvanized Steel Ductwork:

1. Install ductwork as indicated on the drawings. If any conflict occurs notify the Owner's Representative prior to any extensive rerouting.
2. Install ductwork to allow clearance for the installation of duct insulation.

3.6 SCHEDULES

A. Ductwork shown to be round or oval is to be provided under Section 15846 - Pre-Fabricated Ductwork.

B. System Pressure Classification and Duct Material Schedule for Shop Fabricated Ductwork:

	<u>System</u>	<u>Section</u>	<u>Maximum Pressure</u>	<u>Duct Material</u>
3.	Supply To Terminal	A.C Unit	3" pos.	A
4.	Supply	Terminal to Diffuser	1" pos.	A
5.	Supply	AHU to grille	3 pos.	A
6.	Return	Inlet Grille to Terminal	2" neg.	A
7.	Return	Term to Return Air Fan	4" neg.	A
8.	Return	All AHU Return	1" neg.	A
9.	General Exhaust	Inlet to Unit	1" neg.	A
10.	Air Transfer Duct	All	2" neg.	A

Schedule Legend:

Duct Material

A Galvanized Steel

END OF SECTION 15840

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SECTION 15846
PRE-FABRICATED DUCTWORK

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Single Wall Round or Flat Oval Galvanized Steel Ductwork and Fittings.
- B. Single Wall Round Snaplock Seam Galvanized Steel Ductwork and Fittings.

1.3 QUALITY ASSURANCE

- A. All ductwork shall be fabricated within the guidelines established by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) HVAC Duct Construction Standards - Metal and Flexible, latest edition.
- B. All ductwork shall be fabricated to withstand the pressure and velocity required on this project.
- C. All components, fasteners, sealants, adhesives, etc. in the conditioned air stream or exposed in active or non- active plenums shall conform to the NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems and Standard for Flame/Smoke/Fire Contribution of 25/50/0.
- D. All ductwork shall conform to UL standard UL 181 Factory Made Air Duct Materials and Duct Connectors, latest edition. Applicable sections shall apply to shop fabricated ductwork.
- E. After fabrication and installation of all shop fabricated ductwork the fabricator and installer, if not the same, shall certify in writing to the Owner's representative that all shop fabricated ductwork and installation of same meets or exceeds the quality standards established by SMACNA.

1.4 SUBMITTALS

- A. Submission for acceptance is required.
- B. Product 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.

1.5 SHOP DRAWINGS

- A. Shop Drawings: Provide shop drawings of ductwork as follows:

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1. Draw to a scale of not less than 1/4 inch to one foot on the same size sheets as the contract drawings.
 2. Show duct sizes.
 3. Show fitting details.
 4. Show lighting and ceiling diffusers.
- B. Floor Plans: Provide sheet metal floor plans drawn to the same scale as the contract drawings.
1. Use contract drawing sheet size.
 2. Show on each floor plan the floor penetrations, fire dampers and access doors, ducts with sizes and bottom elevations, terminal types and air quantities.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Single Wall Round or Flat Oval Galvanized Steel Ductwork and Fittings:
1. Autoduct, Inc.
 2. Eastern Sheet Metal
 3. Hamlin Sheetmetal, Inc.
 4. Impulse Air.
 5. Lindab
 6. Semco Manufacturing, Inc.
 7. United McGill
- B. Single Wall Round Snaplock Seam Galvanized Steel Ductwork and Fittings:
1. Alco Manufacturing Company.
 2. Crown Products Company.
 3. Hughes.

2.2 FABRICATION

- A. Single Wall Round or Flat Oval Ductwork and Fittings:
1. Materials: Hot rolled, continuously annealed, hot dipped galvanized steel minimum of G-90, 0.90 oz/sf coating, conforms to ASTM A653.
 2. Metal Gauges: Conform to the Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA) HVAC Duct Construction Standards - Metal and Flexible, latest edition. The following table shall establish a minimum guideline unless the manufacturer has U.L. Standard 181 test results that show that lighter gages (thinner wall thickness) with intermediate corrugations (ribs) allow the gage reduction:

Pipe Diameter	Positive Internal Static Pressure in W.G.					
	0" - 2.0"		2.1" - 4.0"		4.1" - 10.0"	
	Spiral		Spiral		Spiral	
	Pipe	Fittings	Pipe	Fittings	Pipe	Fittings
6" - 10"	28	26	28	24	28	24
12"	28	26	28	24	26	24
14"	28	26	26	24	26	24
16"	26	24	26	22	24	22

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18" - 26"	26	24	24	22	24	22
27" - 36"	24	22	22	20	22	20
37" - 50"	22	20	20	20	20	20
51" - 60"	20	18	18	18	18	18
61" - 84"	18	16	18	16	18	16

Major Axis Dimension Positive Internal Static Pressure in W.G.

	0" - 2.0"		2.1" - 4.0"		4.1" - 10.0"	
	Flat Oval		Flat Oval		Flat Oval	
	Pipe	Fittings	Pipe	Fittings	Pipe	Fittings
6" - 24"	24	20	24	20	24	20
25" - 36"	22	20	22	20	22	20
37" - 48"	22	18	22	18	22	18
49" - 60"	20	18	20	18	20	18
61" - 70"	20	16	20	16	20	16
71" - Up	18	16	18	16	18	16

3. Duct Construction: Spiral wound, lockseam construction, slip joint or flanged connections as noted below under couplings.

4. Fitting Construction:

a. 90 Deg. and 45 Deg. Ells: Solid - welded seam construction for dust collector use, Solid - welded seam or spot welded and bonded for general use. Radiused ells to be full radiused unless otherwise noted, mitered ells to have single thickness, turning vanes, slip joint or flanged connections.

b. Tees or Crosses: Solid - welded seam construction for dust collector use, Solid - welded seam or spot welded and bonded for general use. Tangential, unless otherwise noted or detailed, conical take off or reduction, slip joint or coupled ends. 180 Deg. or 45 Deg. as indicated.

c. Bellmouth: Solid - welded seam construction for dust collector use, Solid - welded seam or spot welded and bonded for general use. Spun metal, smooth converging bellmouth, round, gauge equal or greater than connecting duct.

d. Access Section:

1) 7" Diameter and Less: Minimum 12" long flanged section, minimum four bolts per flange.

2) 8" Diameter and Larger: Round or rectangular access cover, on welded raised section, pressure sensitive release suitable for manual release or emergency vacuum release, chain retainer, (see Para. 3.5: Schedules for Sizes).

e. Couplings:

1) Joints 36" or less shall have 2" slip coupling.

2) 38" or over shall be spiral mate or oval mate.

f. Based on United McGill

B. Single Wall Round Snaplock Seam Galvanized Steel Ductwork and Fittings:

1. Materials: Hot rolled, continuously annealed, hot dipped galvanized steel minimum of G-90, 0.90 oz/sf coating, conforms to ASTM A653.

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2. Metal Gauges: Minimum of 26 gauge, with remaining sizes conforming to the Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA) HVAC Duct Construction Standards Metal and Flexible, latest edition. The following table shall establish a minimum guideline:

Round Ducts:

<u>Duct Diameter</u>	<u>Spiral Pipe</u>	<u>Fittings and Longitudinal Seam Pipe</u>
3" thru 14"	26	24
15" thru 26"	24	22
27" thru 30"	22	20

3. Duct Construction: Snaplock seam construction, slip joint or flanged connections.
4. Fitting Construction:
- a. 90 Deg. and 45 Deg. Ells: Adjustable ells to be full radiused unless otherwise noted, slip joint or flanged connections.
 - b. Tees or Crosses: Adjustable, unless otherwise noted or detailed, conical take off or reduction, slip joint or coupled ends. 180 Deg. or 45 Deg. as indicated.
- C. Ductwork, General: Each duct section shall have both ends covered with polyethylene or other suitable material to protect against the entrance of dirt, debris or water during shipment and storage prior to installation.
- D. DUCT SEALANT: Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, used indoors or outdoors. Foster 32-19 Duct Fas, Childers CP-146 Chil Flex or Duro Dyne SAS.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS:

- A. Install in strict accordance with the manufacturer's written installation instructions.
- B. The drawings, due to their small scale, are diagrammatic in nature and are not necessarily complete in all details. For this reason not all necessary offsets, rises or falls are shown. Coordinate the installation of the ductwork with all other trades and to provide all necessary offsets, etc. as required for completion of this project without any additional cost to the Owner, Architect or Engineer.
- C. All ductwork shall be run parallel or perpendicular to building structure and seams or spirals shall be aligned whenever possible.
- D. All sizes indicated on the drawings are inside clear dimensions.
- E. All ductwork shall be properly sealed in a neat clean manner with all excess sealer wiped clean.
- F. Coordinate the location of, provide the necessary access and install all devices provided in other specification sections within Division 15, including but not limited to fire, smoke and/or balancing dampers, access and mounting for control devices, air flow measuring stations, etc., as apply to this project.
- G. All ducts passing through partitions or walls shall be properly and neatly sealed. If

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partition or wall carries a fire rating (fire damper indicated or if architectural plans indicate a rated wall) the duct shall be sleeved with the space between the sleeve and duct properly sealed with firestopping material (Refer to Section 15050 and/or Division 7 for firestopping requirements). The sleeve shall be permanently affixed to the wall (see Section 15090: Supports, Hangers, Anchors and Sleeves for sleeve specification).

- H. Coordinate the proper duct pressure classification with the system served and to provide the proper ductwork to withstand these pressures. (See Para. 3.5 Schedules: System Pressure Classification and Duct Material Schedule.)

3.2 CLEANING AND PROTECTION

- A. During construction, ductwork shall be cleaned of dirt and debris internally section by section as it is installed. At end of each day, ductwork not finally connected to equipment shall be provided with a temporary closure of polyethylene film or other covering material that will prevent entrance of dust, debris or water. Clean exterior surfaces of any material which might cause corrosion or if the duct is to be painted, it shall be cleaned suitable for painting. After substantial completion of the ductwork system the system shall be operated with filters in place to blow-out any remaining dust from the system. Protect all equipment and property from damage or fouling during this cleaning. All prefilters used during cleaning shall be replaced prior to turning the system over to the Owner.
- B. During field investigations, if the Owner or Engineer inspect ductwork and find dust, debris, water or any other contaminant the contractor will be responsible for cleaning or replacing, at the discretion of the Owner and Engineer, the ductwork section at the contractor's expense.

3.3 LEAK TESTING

- A. Duct Leakage Report: The Contractor shall make all the supply, return, outside air, and exhaust duct systems (limited to 1,500 cfm and greater) operationally air-tight, with no more than 2% leakage for duct systems rated at 2" w.c. pressure class, and 1% leakage for systems exceeding 2" w.c. pressure class. Leakage test to be performed by Contractor with all air device openings and fan connections sealed airtight. Test the systems prior to applying any insulation or concealing in soffits or chases. Use a portable fan capable of producing a static pressure equal or greater than the duct test pressure. This fan to have a flow measuring assembly consisting of a straight section of duct with an orifice plate, pressure taps, and a calibrated performance curve for determining leakage rates.
 - 1. Test each section equal to the external static pressure indicated for that fan or air handler with the portable fan assembly. After the fan achieves that steady state design pressure, record the air flow quantity across the orifice and the percent of design air flow. If the test fails, the Contractor shall reseal and retest at no additional cost to the Owner.
 - 2. Repair all duct leaks that can be heard or felt, even if the system has passed the leakage test.
 - 3. Submit duct leakage reports to the Balancer and the Engineer for their review and approval.
 - 4. Refer to specification section 15051 for more information.

3.4 INSTALLATION

- A. General:
 - 1. Install generally as indicated.
 - 2. Conceal ductwork in finished spaces unless indicated otherwise.

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3. Do not install ductwork in or allow to enter or pass through electrical rooms, elevator machine room, or spaces housing switchboards, panelboards or distribution boards, except ductwork that serves electrical rooms, elevator machine rooms or spaces.
4. Exercise special care to provide tight fitting well fabricated, well braced ductwork systems.
5. Field assemble rectangular, round or flat oval ductwork as follows:
 - a. Use slip joints, couplings, etc. sealed with adhesive pre-applied to couplings or duct mate spiralmate or oval mate on duct sizes 1" and larger.
 - b. Isolate dissimilar metals with elastomeric sealant tape or fiber gaskets and gaskets and washers for bolts.
6. In high pressure ductwork (above 2" w.g.), do not use 2 piece mitered 90 degree elbows with or without vanes unless approved by engineer.
7. Make duct connections from hoods, openings, fans and other devices.

3.6 SCHEDULES

A. System Pressure Classification and Duct Material Schedule:

System I.D. #	System	Section	Maximum Pressure	Duct Material
1.	Supply	AHU to Terminal	3" pos.	A
2.	Supply	Terminal to Diffuser	1" pos.	A
3.	Return	Terminal to AHU	2" neg.	A

Schedule Legend:

Duct Material

A Galvanized Steel

B. Access Door Schedule:

1. Round Duct:

	<u>Duct Size</u>	<u>Access Door Size</u>
a.	up to 7" dia.	12" long removable section
b.	8" to 12" dia.	8" x 12"
c.	13" to 18" dia.	12" x 12"
d.	19" dia. and up	14" x 20"

2. Flat Oval Duct

	<u>Duct Size</u> <u>Major Axis</u>	<u>Minor Access</u>	<u>Access Door Size</u>
a.	8" to 16"	8" to 11"	8" x 12"
b.	17" to 24"	12" to 13"	12" x 12"
c.	25" and up	14" and up	14" x 20"

END OF SECTION 15846

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SECTION 15860
SHEET METAL SPECIALTIES

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Duct access doors.
- B. Volume dampers.
- C. Flexible duct connectors.
- D. Hardware cloth.
- E. Install miscellaneous control devices.

1.3 QUALITY ASSURANCE

- A. All products provided for enhancement of Life Safety shall be UL listed and bear the appropriate label stating compliance.
- B. All products located in the conditioned air stream or located in return air plenums shall conform to the NFPA 90A Flame/Smoke/Fuel Contribution of 25/50/0 and all other applicable requirements of NFPA 90A.
- C. Provide Florida Product Approval Numbers for all Products required by the Florida Building Code.

1.4 SUBMITTALS

- A. Submission for acceptance is required.
- B. Product 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.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Duct Access Doors:
 - 1. Air Balance, Inc.
 - 2. Cesco Products
 - 3. Greenheck, Inc.
 - 4. Nailor Industries, Inc.

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5. Prefco Products, Inc.
6. Ruskin Manufacturing, Co.
7. Pottorff

B. Volume Dampers:

1. Air Balance, Inc.
2. Arrow United Industries, Inc.
3. Cesco Products
4. Greenheck, Inc.
5. Nailor Industries, Inc.
6. Prefco Products, Inc.
7. Ruskin Manufacturing, Co.
8. Pottorff

C. Flexible Duct Connectors:

1. Ductmate Industries, Inc.
2. Duro-Dyne
3. Elgen
4. Ventfabric

D. Hardware Cloth:

1. McNichols Co.
2. Owner Approved Equal.

2.2 FABRICATION

A. Duct Access Doors:

1. Low Pressure Ductwork:

- a. Rating up to 2" wg positive or negative.
- b. Frame: Minimum 22 gauge galvanized steel or aluminum, minimum 5/8" knock over edge, neoprene gasket between frame and duct and frame and door.
- c. Door: Minimum 24 gauge galvanized steel or aluminum, continuous hinge and cam latches or minimum 2 cam latches, double wall construction, fiberglass insulated thickness to match ductwork.
- d. Based on Ruskin Manufacturing Co. ADH24.

2. High Pressure Ductwork:

- a. Rating: Up to 10" wg positive pressure.
- b. Frame: Minimum 16 gauge galvanized steel with "Z" shaped reinforced corners, polyurethane gasket between frame and duct and frame and door.
- c. Door: Minimum 16 gauge galvanized steel or aluminum, minimum 2 spring latches, double wall construction, fiberglass insulated with thickness to match ductwork.
- d. Based on Ruskin Manufacturing Co. ADHP-3.

B. Volume Dampers:

1. Provide volume dampers where indicated and construct as follows:

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- a. Provide single blades to a maximum of 10 inch blade width.
- b. Provide inside end synthetic bearings and locking quadrants with wing nuts.
- c. Friction locks are not permitted.
- d. Break damper blades on both edges for stiffness.
- e. Provide multi-blades on dampers 12 inches and larger with inside pins and molded synthetic bearings, and 2 inches wide by 1/8 inch thick structural galvanized channel frame.
- f. Provide galvanized connecting bar with molded synthetic bearings on multi-blade dampers.
- g. Provide stand off bracket for installation in externally insulated duct.
- h. Based on Ruskin Manufacturing, Co. MD35 for rectangular ducts (MDSR25 for round ducts) with velocities up to 1500 feet per minute.
- i. Based on Ruskin Manufacturing, Co. CD30AF1 for rectangular ducts (CDR82 for round ducts) with velocities over 1501 feet per minute.

C. Flexible Duct Connectors:

1. Indoor Applications:

- a. Material: Heavy glass fabric double - Coated with neoprene, Minimum of 30 oz/sy, Resistant to abrasion and damage due to repeated flexing, waterproof and air tight, minimum 26 gauge galvanized steel or .032" aluminum edge a minimum of 2-1/2" wide each side, coordinate flex width with schedule in 3.3: Schedules.
- b. Rating:
 - (1) Temperature: -10°F to 200°F
 - (2) Pressure: 10" positive
10" negative
 - (3) Based on Ventfabric and Ventglass

2. Outdoor Applications

- a. Material: Heavy glass fabric double-coated with hypalon minimum of 26 oz/sy resistant to abrasion and damage due to repeated flexing, water proof, airtight and resistant to damage from direct sunlight, minimum 26 gauge galvanized steel or .032" aluminum edge at minimum of 2-1/2" wide each side. Coordinate flex width with schedule in 3.3 schedule.
- b. Rating:
 - 1) Temperature: -10°F to 250°F
 - 2) Pressure: 10" positive
10" negative
 - 3) Based on Ventfabrics Ventlon.

D. Hardware Cloth: 4 mesh galvanized steel, plain weave with .035 wire.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Install all products in strict accordance with the manufacturer's written installation instructions.
- B. Coordinate the installation of products provided within other sections of Division 15 including

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but not limited to control dampers, air flow measuring stations, etc.

3.2 INSTALLATION

A. Duct Access Doors:

1. Coordinate the proper class access door with the system requirements.
2. Duct access doors shall be mounted so as to allow maximum access and/or door swing while also providing easy access from the floor or other personal accessible structures.
3. Duct access doors shall be provided wherever required for proper maintenance of equipment, access to duct mounted control devices, or visual inspection and setting of dampers, etc. All doors, due to the small scale of the drawings, may not be shown, it is the contractor's responsibility to coordinate with all trades concerned to provide the necessary quantity and properly locate all doors.

E. Volume Dampers: Install at branch take-offs.

1. Install a 24" long yellow strip of material to each damper handle for easy visual location. These strips must be in place prior to Substantial acceptance.

F. Flexible Duct Connectors:

1. Flexible duct connectors shall be omitted where air handling units are provided with internally isolated fans and internal isolation.
2. Provide flexible duct connectors immediately adjacent to all in-line or ductwork connected fans and/or fan equipped units without internal vibration isolation.
3. Flexible duct connectors shall be properly selected and installed to ensure against collapsing under negative pressure and unacceptable ballooning under positive pressure. Leakage is not permissible. See width schedule in 3.3: Schedules.

H. Hardware Cloth: Install over all open ended ducts. Provide sheetmetal pocket over raw edges and secure with sheetmetal screws through the metal edge cover.

I. Install Miscellaneous Control Devices:

1. Install dampers furnished under Section 15900. Provide necessary blank off sections where dampers are installed in factory fabricated mixing box openings.
2. Install air flow measuring stations furnished under Section 15900. Coordinate size and location with proper access before approving release of units for fabrication and shipment.
3. Install duct smoke detectors provided under Division 16.

3.3 SCHEDULES

A. Access Door Schedule:

1. Square or Rectangular Duct work:

Access Door Mounting

	<u>Surface Max. Dim.</u>	<u>Access Door Size</u>
1.	6"	12" long Remov. Section
2.	7" to 8"	6" x 6"
3.	9" to 12"	8" x 8"

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4.	13" to 18"	12" x 12"
5.	19" and up	16" x 16"
6.	Special Situations	See Plans

B. Flexible Duct Connector Schedule

1. Indoor and Outdoor Material Width Schedule

	<u>Duct Size</u> <u>(Max. Dim.)</u>	<u>Pressure</u> <u>(Max.)</u>	<u>Width</u>
a.	12" and less	positive	3"
b.	13" and up	positive	6"
c.	12" and less	negative	3"
d.	13" and up	negative	3"

END OF SECTION 15860

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SECTION 15870
GRILLES, REGISTERS AND DIFFUSERS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Grilles.
- B. Registers.
- C. Diffusers.

1.3 QUALITY ASSURANCE

- A. Manufacturer shall certify cataloged performance and ensure correct application of all air outlet types.
- B. All components within the conditioned air stream or exposed in active or non-active plenums shall conform to the NFPA 90A standard for Flame/Smoke/Fire Contribution of 25/50/0.

1.4 SUBMITTALS

- A. Submit schedule and product data for acceptance. Coordinate submittal by "G" number and include construction details, capacity ratings including air side pressure drops and NC levels.
- B. Product 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.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Grilles:
 - 1. Anemostat
 - 2. Krueger
 - 3. Metal Aire Division of Metal Industries, Inc.
 - 4. Nailor
 - 5. Price
 - 6. Titus
 - 7. Trox
- B. Registers:

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1. Anemostat
2. Krueger
3. Metal Aire Division of Metal Industries, Inc.
4. Nailor
5. Price
6. Titus
7. Trox

C. Diffusers:

1. Anemostat
2. Krueger
3. Metal Aire Division of Metal Industries, Inc.
4. Nailor
5. Price
6. Titus
7. Trox

2.2 FABRICATION

- A. Fixture designations as shown on the drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all devices in strict accordance with the manufacturer's written installation instructions.
- B. Coordinate the proper grille style and frame style with the final approved ceiling construction and install grilles, registers and diffusers in accordance with the requirements of the architectural reflected ceiling plan.
- C. Due to the small scale of the drawings the contractor shall assume the responsibility to coordinate the air outlet and inlet locations with the reflected ceiling plans, lighting plans, sections and or details.
- D. Any unlined or otherwise exposed parts beyond the grille, register or diffuser face exposed to sight shall be painted black.
- E. Coordinate the color requirements for all grilles, registers and diffusers with the Owner's Representative.
- F. Insulate the back pans of all diffusers per the requirements of Specification Section 15250.
- G. Air distribution devices installed in lay-in ceilings shall have a 24"x24" extended panel.
- H. Devices installed in sheetrock or other hard ceilings shall be surface mount type.

END OF SECTION 15870

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SECTION 15880
FILTERS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Extended Surface, Pleated, Panel Type Filters.

1.3 QUALITY ASSURANCE

- A. Filter testing to be in accordance with UL Standard 900.

1.4 SUBMITTALS

- A. Submission for acceptance is not required.
- B. Product 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.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Extended Surface, Pleated, Panel Type Filters:
 - 1. Airguard.
 - 2. American Air Filters.
 - 3. Camfil-Farr (30/30)
 - 4. Farr.
 - 5. Flanders Filters, Inc. (Pre-Pleat HV)
 - 6. Glasfloss Industries, Inc.
 - 7. Purolator Products Air Filtrtion Co.
 - 8. Tri-Dim Filter Corporation.

2.2 FABRICATION

- A. Extended Surface, Pleated, Panel Type Filters:
 - 1. Extended surface pleated, cotton/synthetic fiber media, cardboard frame, wire support grid, dry type.
 - 2. Dry filtering principal.
 - 3. 2" thick, 25% average efficiency, UL Class 2 approved, maximum face velocity 500 FPM.
 - 4. Initial maximum air friction at 500 FPM equals .30. Air friction at change-out equals 1.00" w.g.

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5. Based on AAF AM-Air 300.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Install filters in strict accordance with manufacturers recommendations.
- B. Particular attention to prevent air bypass through filter support system.
- C. Do not operate fan systems without final filters in place.
- D. Provide one extra set of final filters.

END OF SECTION 15880

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SECTION 15900
BUILDING AUTOMATION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- 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.
- F. Refer to Specification Section 01810 for commissioning requirements.

1.2 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.
- C. Building Automation System (BAS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BAS Contractor and to be interfaced to the associated work of other related trades.
- D. BAS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer and ongoing service provider for the BAS work.
- E. Control Sequence: An BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BAS network.

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- I. BAS Integration: The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BAS as required by this Division.
- J. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BAS Contractor’s cost to the designated third party trade contractor for installation. BAS Contractor shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.
- L. Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BAS wiring and terminations.
- M. Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- N. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.
- O. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.
- P. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- Q. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- R. The following abbreviations and acronyms may be used in describing the work of this Division:
- | | | |
|--------|---|---|
| ADC | - | Analog to Digital Converter |
| AI | - | Analog Input |
| AN | - | Application Node |
| ANSI | - | American National Standards Institute |
| AO | - | Analog Output |
| ASCII | - | American Standard Code for Information Interchange |
| ASHRAE | | American Society of Heating, Refrigeration and Air Conditioning Engineers |
| AWG | - | American Wire Gauge |
| CPU | - | Central Processing Unit |
| CRT | - | Cathode Ray Tube |
| DAC | - | Digital to Analog Converter |
| DDC | - | Direct Digital Control |
| DI | - | Digital Input |
| DO | - | Digital Output |
| EEPROM | - | Electronically Erasable Programmable Read Only Memory |
| EMI | - | Electromagnetic Interference |
| FAS | - | Fire Alarm Detection and Annunciation System |
| GUI | - | Graphical User Interface |
| HOA | - | Hand-Off-Auto |

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ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

1.3 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. Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform Microsoft SQL Server as dictated elsewhere in this specification.
- D. 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.
- E. 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, training services, permits and licenses, transportation, shipping,

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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.

- F. 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.
- G. 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.
- H. 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 by IP address.
 - 6. Energy management
 - 7. Standard applications for terminal HVAC systems.
 - 8. Indoor Air Quality monitoring and control

1.4 QUALITY ASSURANCE

- A. General
 - 1. The Building Automation System Contractor shall be the primary manufacturer-owned branch office 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 manufacturer, installer and service provider of BAS.
 - 3. The BAS Contractor shall have a branch facility within a 50-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. Maximum response time shall be 3 hours.
 - 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 ten (10) 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

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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:
 - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b. Manage the financial aspects of the BAS Contract.
 - c. Coordinate as necessary with other trades.
 - d. Be responsible for the work and actions of the BAS workforce on site.

1.5 References

- A. All work shall conform to the following Codes and Standards, as applicable:
 1. National Fire Protection Association (NFPA) Standards.
 2. National Electric Code (NEC) and applicable local Electric Code.
 3. Underwriters Laboratories (UL) listing and labels.
 4. UL 864 UUKL Smoke Control
 5. UL 268 Smoke Detectors.

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6. UL 916 Energy Management
 7. NFPA 70 - National Electrical Code.
 8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 9. NFPA 92A and 92B Smoke Purge/Control Equipment.
 10. Factory Mutual (FM).
 11. American National Standards Institute (ANSI).
 12. National Electric Manufacturer's Association (NEMA).
 13. American Society of Mechanical Engineers (ASME).
 14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) [user note: add ASHRAE 62 IAQ as applicable].
 15. Air Movement and Control Association (AMCA).
 16. Institute of Electrical and Electronic Engineers (IEEE).
 17. American Standard Code for Information Interchange (ASCII).
 18. Electronics Industries Association (EIA).
 19. Occupational Safety and Health Administration (OSHA).
 20. American Society for Testing and Materials (ASTM).
 21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 22. Americans Disability Act (ADA)
 23. ANSI/EIA 909.1-A-1999 (LonWorks)
 24. ANSI/ASHRAE Standard 195-2004 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.6 Work By Others

- 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
VAV box nodes	BAS	15	BAS	16
BAS conduits and raceway	BAS	BAS	BAS	BAS
Automatic dampers	BAS	15	N/A	N/A
Manual valves	15	15	N/A	N/A
Automatic valves	BAS	15	BAS	N/A
VAV boxes	15	15	N/A	N/A
Pipe insertion devices and taps including thermowells, flow and pressure stations.	BAS	15	BAS	N/A
BAS Current Switches.	BAS	BAS	BAS	N/A
BAS Control Relays	BAS	BAS	BAS	N/A
Power distribution system monitoring interfaces	16	16	BAS	16

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Smoke Detectors	16	16	16	16
Fire/Smoke Dampers	15	15	16	16
Fire Dampers	15	15	N/A	N/A
VFDs	15	16	BAS	16
Fire Alarm shutdown relay interlock wiring	16	16	16	16
Fire Alarm smoke control relay interlock wiring	16	16	BAS	16
Control damper actuators	BAS	BAS	BAS	16

1.7 Submittals

A. Shop Drawings, Product Data, and Samples

1. The BAS contractor shall submit its qualifications to 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. Include proposed floor plans for graphical representation.
 - 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.

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- 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.

PART 2 - PRODUCTS

2.1 General Description

- A. The Building Automation System (BAS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks. The BAS shall be compatible for use with virtual server technology.
- B. The Building Automation System shall consist of the following:

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1. Standalone System Controller
 2. Equipment Controller(s)
 3. Input/Output Module(s)
 4. Local Display Device(s)
 5. Portable Operator's Terminal(s)
 6. Distributed User Interface(s)
 7. Network processing, data storage and communications equipment
 7. Other components required for a complete and working BAS
- C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
 2. The System shall maintain all settings and overrides through a system reboot.
- E. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
- F. Acceptable Manufacturers (NO SUBSTITUTIONS)
- 1) Johnson Controls. This shall be a continuation of the Johnson Controls, Inc BAS that was previously installed in Phase I.

2.2 BAS Architecture

- A. Automation Network
1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard “off the shelf” products available through normal PC vendor channels.
 2. The BAS shall network multiple user interface clients, automation engines, system controllers and application-specific controllers.
 3. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
 4. System controller shall reside on the automation network.
 5. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
- B. Control Network
1. System controller shall provide supervisory control over the control network and shall support the following communication protocols:
 - a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
 - ◇ The system controller shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

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- ◇ The system controller shall be tested and certified as a BACnet Building Controller (B-BC).
 - b. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
 - 2. Control networks shall provide either “Peer-to-Peer,” Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
 - 3. DDC Controllers shall reside on the control network.
 - 4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
 - 5. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
 - 6. The PICS shall be submitted on award prior to pre-construction meeting.
- C. Integration
- 1. BACnet Protocol Integration - BACnet
 - a. The neutral protocol used between systems will be BACnet over IP and comply with the ASHRAE BACnet standard 135-2003.
 - b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
 - c. The ability to command, share point object data, and schedules between the host and BACnet systems shall be provided.

2.3 User Interface

- A. User Interface Application Components
- 1. Operator Interface
 - a. An integrated browser based client application shall be used as the user operator interface program.
 - b. The System shall employ an event-driven rather than a device polling methodology to dynamically capture and present new data to the user.
 - c. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
 - d. The user interface software shall provide help menus and instructions for each operation and/or application.
 - e. The system shall support customization of the UI configuration and a home page display for each operator.
 - f. The system shall support user preferences in the following screen presentations:
 - ◇ Alarm
 - ◇ Trend
 - ◇ Display
 - ◇ Applications
 - g. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
 - h. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:

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- ◇ User access for selective information retrieval and control command execution
 - ◇ Monitoring and reporting
 - ◇ Alarm, non-normal, and return to normal condition annunciation
 - ◇ Selective operator override and other control actions
 - ◇ Information archiving, manipulation, formatting, display and reporting
 - ◇ BAS internal performance supervision and diagnostics
 - ◇ On-line access to user HELP menus
 - ◇ On-line access to current BAS as-built records and documentation
 - ◇ Means for the controlled re-programming, re-configuration of BAS operation and for the manipulation of BAS database information in compliance with the prevailing codes, approvals and regulations for individual BAS applications
 - i. The system shall support a list of application programs configured by the users that are called up by the following means:
 - ◇ The Drop Down Menu
 - ◇ Hyperlinks within the graphics displays
 - ◇ Key sequences
 - j. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.
2. Navigation Trees
- a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
 - b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
3. Alarms
- a. Alarms shall be routed directly from System Controllers to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - ◇ Log date and time of alarm occurrence.
 - ◇ Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
 - ◇ Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
 - ◇ Provide the ability to direct alarms to an e-mail address or telephonic text message. This must be provided in addition to the pop up window described above. Systems that use e-mail and/or text message as the exclusive means of annunciating alarms are not acceptable.
 - b. The BAS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
 - c. The BAS shall annunciate application alarms at minimum, as required by Part 3.
4. Reports and Summaries

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- a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - ◇ All points in the BAS
 - ◇ All points in each BAS application
 - ◇ All points in a specific controller
 - ◇ All points in a user-defined group of points
 - ◇ All points currently in alarm
 - ◇ All points locked out
 - ◇ All BAS schedules
 - ◇ All user defined and adjustable variables, schedules, interlocks and the like.
 - b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
 - c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
 - d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Excel or Crystal Reports.
5. Schedules
- a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
 - ◇ Weekly schedules
 - ◇ Exception Schedules
 - ◇ Monthly calendars
 - b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
 - c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
 - d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
 - e. Changes to graphical schedules made from the User Interface shall directly modify the System Controller schedule database.
 - f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
 - g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.
6. Password
- a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
 - b. Each user shall have the following: a user name, a password, and access levels.
 - c. The system shall allow each user to change his or her password at will.

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- d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
 - e. A minimum of five levels of access shall be supported individually or in any combination as follows:
 - ◇ Level 1 = View Data
 - ◇ Level 2 = Modify and Control
 - ◇ Level 3 = Administrator
 - f. Operators shall be able to perform only those commands available for their access level. Display of menu selections shall be limited to only those items defined for the access level.
 - g. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
7. Screen Manager
- a. The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of two (2) active display windows.
8. Dynamic Color Graphics
- a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
 - b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
 - c. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
 - ◇ All graphics shall be fully scalable
 - ◇ The graphics shall support a maintained aspect ratio.
 - ◇ Multiple fonts shall be supported.
 - ◇ Unique background shall be assignable on a per graphic basis.
 - ◇ The color of all animations and values on displays shall indicate if the status of the object attribute.
 - d. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device
 - e. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.
 - ◇ The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
 - ◇ In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.
 - ◇ The graphic editing tool shall be restricted by access level.

- f. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.
9. Historical trending and data collection
- a. Each System Controller shall store trend and point history data for all analog and digital inputs and outputs, as follows:
 - ◇ Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed:
 - Defined time interval
 - Upon a change of value
 - ◇ Each System Controller shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
 - b. Trend and change of value data shall be stored within the controller and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.
 - c. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format.
10. Trend data viewing and analysis
- a. Provide a trend viewing utility that shall have access to all database points.
 - b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
 - c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
 - d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
 - e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
 - f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
 - g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.
 - h. The Display shall support the user's ability to change colors, sample sizes, and types of markers.
11. Database Management – Refer to attached ISS Standards.
- a. Where a separate SQL manufacturers database is utilized for information storage the System shall provide a Database Manager that separates the database monitoring and managing functions by supporting two separate windows.
 - b. Database secure access shall be accomplished using standard SQL authentication including the ability to access data for use outside of the Building Automation application.

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- c. The database managing function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
 - ◇ Backup
 - ◇ Purge
 - ◇ Restore
- d. The Database Manager shall support four tabs:
 - ◇ Statistics – shall display Database Server information and Trend, Alarm (Event), and Audit information on the Databases.
 - ◇ Maintenance – shall provide an easy method of purging records from the Server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting the database, and allowing for the retention of a selected number of day's data.
 - ◇ Backup – Shall provide the means to create a database backup file and select a storage location.
 - ◇ Restore – shall provide a restricted means of restoring a database by requiring the user to log into an Expert Mode in order to view the Restore screen.
- e. The Status Bar shall appear at the bottom of all Database Manager Tabs and shall provide information on the current database activity. The following icons shall be provided:
 - ◇ Ready
 - ◇ Purging Record from a database
 - ◇ Action Failed
 - ◇ Refreshing Statistics
 - ◇ Restoring database
 - ◇ Shrinking a database
 - ◇ Backing up a database
 - ◇ Resetting internet information Services
 - ◇ Starting the Device Manager
 - ◇ Shutting down the Device Manager
 - ◇ Action successful
- f. The Database Manager monitoring functions shall be accessed through the Monitoring Settings window and shall continuously read database information once the user has logged in.
- g. The System shall provide user notification via taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
- h. The Monitoring Settings window shall have the following sections:
 - ◇ General – Shall allow the user to set and review scan intervals and start times.
 - ◇ Email – Shall allow the user to create and review e-mail and phone text messages to be delivered when a Warning or Alarm is generated.
 - ◇ Warning – shall allow the user to define the Warning limit parameters, set the Reminder Frequency, and link the e-mail message.
 - ◇ Alarm – shall allow the user to define the Alarm limit parameters, set the Reminder Frequency, and link the e-mail message.
 - ◇ Database login – Shall protect the system from unauthorized database manipulation by creating a Read Access and a Write Access for each of the Trend, Alarm (Event) and Audit databases as well as an Expert Mode required to restore a database.
- i. The Monitoring Settings Taskbar shall provide the following informational icons:

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- ◇ Normal – Indicates by color and size that all databases are within their limits.
 - ◇ Warning - Indicates by color and size that one or more databases have exceeded their Warning limit.
 - ◇ Alarm - Indicates by color and size that one or more databases have exceeded their Alarm limit.
 - j. The System shall provide user notification via Taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
- B. Portable Operator Terminal – Refer to attached ISS Standards.
- C. Ready Access Portal User Interface – Refer to attached ISS Standards.

2.4 System Controllers

A. System Controllers

1. The System Controllers shall be a fully user-programmable, supervisory controller. The System Controllers shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other-System Controllers.
2. Automation network – The System Controllers shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each System Controllers shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
 - a. The web based UI software shall be imbedded in the System Controllers. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 - b. The System Controllers shall support a minimum of two (4) concurrent users.
 - c. The web based user shall have the capability to access all system data through one System Controllers.
 - d. Remote users connected to the network through an Internet Service Provider (ISP) shall require VPN access with ISS approval and also have total system access through one System Controllers.
 - e. Systems that require the user to address more than one System Controllers to access all system information are not acceptable.
 - f. The System Controllers shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the System Controllers.
 - g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
 - h. The web based UI shall support the following functions using the latest version of Microsoft Internet Explorer:
 - ◇ Configuration
 - ◇ Commissioning
 - ◇ Data Archiving
 - ◇ Monitoring
 - ◇ Commanding
 - ◇ System Diagnostics
 - i. Systems that require workstation software or modified web browsers are not acceptable.

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4. Processor – The System Controllers shall be microprocessor-based with a minimum word size of 32 bits. The System Controllers shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. System Controllers size and capability shall be sufficient to fully meet the requirements of this Specification.
5. Memory – Each System Controllers shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock – The System Controllers shall include an integrated, hardware-Based, real-time clock.
7. The System Controllers shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power - On/Off
 - b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
 - c. Ethernet Connection Speed – 10 Mbps/100 Mbps
 - d. FC Bus – Normal Communications/No Field Communications
 - e. Peer Communication – Data Traffic between System Controllers Devices
 - f. Run – System Controllers Running/System Controllers in Startup/ System Controllers Shutting Down/Software Not Running
 - g. Bat Fault – Battery Defective, Data Protection Battery Not Installed
 - h. Fault – General Fault
8. Communications Ports – The System Controllers shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers and portable operator's terminals.
 - a. USB port
 - b. Ethernet port
9. Diagnostics – The System Controllers shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The System Controllers shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure – In the event of the loss of normal power, The System Controllers shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
 - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
11. Certification – The System Controllers shall be listed by Underwriters Laboratories (UL).
12. Controller network – The System Controllers shall support the following communication protocols on the controller network:
 - a. The System Controllers shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - ◇ The System Controllers shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - ◇ The System Controllers shall be tested and certified as a BACnet Building Controller (B-BC).

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- ◇ A BACnet Protocol Implementation Conformance Statement shall be provided for the System Controllers.
- ◇ The Conformance Statements shall be submitted 10 days prior to bidding.
- ◇ The System Controllers shall support a minimum of 50 control devices.
- b. The System Controllers shall support LonWorks enabled devices using the Free Topology Transceiver FTT10.
 - ◇ All LonWorks controls devices shall be LonMark certified.
 - ◇ The System Controllers shall support a minimum of 64 LonWorks enabled control devices.

2.5 Network Controller

1. The Network Controller shall be a fully user-programmable, supervisory controller. The Network Controller shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other System Controllers.
2. The Network Controller shall be a fully user-programmable, digital controller that includes a minimum of 33 I/O points.
3. Automation Network – The Network Controller shall reside on the automation network and shall support a subnet of up to 100 Field controllers.
4. User Interface – Each Network Controller shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
 - a. The web based UI software shall be imbedded in the Network Controller. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 - b. The Network Controller shall support a minimum of two (2) concurrent users.
 - c. The Network Controller shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the Network Controller.
 - d. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
5. The Network Controller shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
6. The Network Controller shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only, shall not be acceptable.
7. The Network Controller shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
8. The Network Controller shall support the following number and types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - ◇ Analog Input, Voltage Mode
 - ◇ Analog Input, Current Mode
 - ◇ Analog Input, Resistive Mode

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- ◇ Binary Input, Dry Contact Maintained Mode
 - ◇ Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - ◇ Dry Contact Maintained Mode
 - ◇ Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following
 - ◇ Analog Output, Voltage Mode
 - ◇ Analog Output, Current Mode
 - d. Binary Outputs - shall output the following:
 - ◇ 24 VAC Triac
 - e. Configurable Outputs - shall be configured to output either of the following:
 - ◇ Analog Output, Voltage Mode
 - ◇ Binary Output, 24 VAC Triac Mode
9. The Network Controller shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
- a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the Network Controller and the furthest connected device.
10. The Network Controller shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the Field Trunk or the SA Bus.
11. The Network Controller shall support, but not be limited to, the following applications:
- a. Central Equipment including chillers and boilers
 - b. Lighting and electrical distribution
 - c. Built-up air handling units for special applications
 - d. Power generation and energy monitoring equipment
 - e. Interfaces to security and fire detection systems
 - f. The Network Controller shall support a Local Controller Display either as an integral part of the Network Controller or as a remote device communicating over the SA Bus.
12. The Network Controller shall be microprocessor-based with a minimum word size of 32 bits. The System Controllers shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. Network Controller size and capability shall be sufficient to fully meet the requirements of this Specification.
13. The Network Controller shall employ an industrial single board computer.
14. Each Network Controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
15. The Network Controller shall include an integrated, hardware-based, real-time clock.
16. The Network Controller shall employ nonvolatile Flash memory to store all programs and data. The Network Controller shall employ a data protection battery to save data and power the real time clock when primary power is interrupted.
17. The Network Controller shall provide removable, color coded, screw terminal blocks for 24 VAC power, communication bus and I/O point field wiring.

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18. The Network Controller shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power
 - b. Fault
 - c. SA Bus
 - d. FC Bus
 - e. Battery Fault
 - f. Ethernet
 - g. 10 LNK
 - h. 100 LNK
 - i. Run
 - j. Peer Com
19. Communications Ports – The Network Controller shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers and portable operator's terminals.
 - a. USB port
 - b. RJ-45 Ethernet port
20. Diagnostics – The Network Controller shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
21. Power Failure – In the event of the loss of normal power, The Network Controller shall continue to operate for a user adjustable period of up to 20 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
 - a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
22. Certification – The Network Controller shall be listed by Underwriters Laboratories (UL).File E107041, CCN PAZX, UL 916, Energy Management Equipment. FCC Compliant to CFR47, Part 15, Subpart B, Class A
23. Field Controller Bus – The Network Controller shall support the following communication protocols on the Field Controller Bus:
 - a. The Network Controller shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - ◇ The Network Controller shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - ◇ The System Controllers shall be tested and certified as a BACnet Building Controller (B-BC).
 - ◇ A BACnet Protocol Implementation Conformance Statement shall be provided for the NETWORK CONTROLLER.
 - ◇ The Conformance Statements shall be submitted 10 days prior to bidding.
 - ◇ The Network Controller shall support a minimum of 32 control devices.
 - b. The Network Controller shall support LonWorks enabled devices using the Free Topology Transceiver FTT10 on the Field Controller Bus (LonWorks Network).
 - ◇ All LonWorks controls devices shall be LonMark certified.

- ◇ The Network Controller shall support a minimum of 32 LonWorks enabled control devices.

2.6 DDC System Controllers

A. Equipment Controller

1. The Equipment Controller shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - a. The Equipment Controller shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - ◇ The Equipment Controller shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - ◇ The Equipment Controller shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - ◇ A BACnet Protocol Implementation Conformance Statement shall be provided for the Equipment Controller.
 - ◇ The Conformance Statement shall be submitted 10 days prior to bidding.
2. The Equipment Controller shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
4. The Equipment Controller shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
5. The Equipment Controller shall include a removable base to allow pre-wiring without the controller.
6. The Equipment Controller shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Field Controller Bus - Normal Data Transmission
 - g. Field Controller Bus - No Data Transmission
 - h. Field Controller Bus - No Communication
 - i. Sensor-Actuator Bus - Normal Data Transmission
 - j. Sensor-Actuator Bus - No Data Transmission
 - k. Sensor-Actuator Bus - No Communication
7. The Equipment Controller shall accommodate the direct wiring of analog and binary I/O field points.
8. The Equipment Controller shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - ◇ Analog Input, Voltage Mode
 - ◇ Analog Input, Current Mode
 - ◇ Analog Input, Resistive Mode
 - ◇ Binary Input, Dry Contact Maintained Mode

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- ◇ Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - ◇ Dry Contact Maintained Mode
 - ◇ Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following
 - ◇ Analog Output, Voltage Mode
 - ◇ Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - ◇ 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - ◇ Analog Output, Voltage Mode
 - ◇ Binary Output Mode
- 9. The Equipment Controller shall have the ability to reside on a Field Controller Bus (FC Bus).
 - a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the Equipment Controllers and the System Controllers.
 - c. The FC Bus shall also support Input/Output Module (IOM) communications with the Equipment Controller and with the System Controllers.
 - d. The FC Bus shall support a minimum of 100 IOMs and Equipment Controllers in any combination.
 - e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the Equipment Controller and the furthest connected device.
 - f.
- 10. The Equipment Controller shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the Equipment Controller and the furthest connected device.
- 11. The Equipment Controller shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
- 12. The Equipment Controller shall support, but not be limited to, the following:
 - a. Hot water, chilled water/central plant applications
 - b. Built-up air handling units for special applications
 - c. Terminal units
 - d. Special programs as required for systems control
- 13. The Equipment Controller shall support a Local Controller Display or third party device either as an integral part of the Equipment Controller or as a remote device communicating over the SA Bus or BACnet MS/TP link.
 - a. The Display shall use a BACnet Standard SSPC-135, clause 9 Master-Slave/Token-Passing protocol.
 - b. The Display shall allow the user to view monitored points without logging into the system.
 - c. The Display shall allow the user to view and change setpoints, modes of operation, and parameters.
 - d. The Display shall provide password protection with user adjustable password timeout.

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- e. The Display shall be menu driven with separate paths for:
 - ◇ Input/Output
 - ◇ Parameter/Setpoint
 - ◇ Overrides
- f. The Display shall use easy-to-read English text messages.
- g. The Display shall allow the user to select the points to be shown and in what order.
- h. The Display shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
- i. The display shall be a minimum of 4 lines and a minimum of 20 characters per line
- j. The Display shall have a keypad with no more than 6 keys.
- k. The Display shall be panel mountable.

2.7 Field Devices

A. Input/Output Module

- 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
- 2. The IOM shall communicate with the FEC over the FC Bus or the SA Bus **or** BACnet MS/TP link.
- 3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 - d. The Conformance Statement shall be submitted 10 days prior to bidding.
- 4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
- 5. The IOM shall have a minimum of 4 points.
- 6. The IOM shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - ◇ Analog Input, Voltage Mode
 - ◇ Analog Input, Current Mode
 - ◇ Analog Input, Resistive Mode
 - ◇ Binary Input, Dry Contact Maintained Mode
 - ◇ Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - ◇ Dry Contact Maintained Mode
 - ◇ Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following
 - ◇ Analog Output, Voltage Mode
 - ◇ Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - ◇ 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:

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- ◇ Analog Output, Voltage Mode
 - ◇ Binary Output Mode
7. The IOM shall include troubleshooting LED indicators to identify the following conditions:
- a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Normal Data Transmission
 - g. No Data Transmission
 - h. No Communication
- B. VAV Modular Assembly
1. The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
 2. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.
 3. The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.
 4. The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
 5. The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.
 6. The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 7. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.
 8. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
 9. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
 10. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
 11. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

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12. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
13. Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
14. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
15. The controller shall provide fail-safe operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
16. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.
17. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.
 - ◇ Absolute temperature loop error
 - ◇ Signed temperature loop error
 - ◇ Absolute airflow loop error
 - ◇ Signed airflow loop error
 - ◇ Average damper actuator duty cycle
18. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
 - ◇ Unreliable space temperature sensor
 - ◇ Unreliable differential pressure sensor
 - ◇ Starved box
 - ◇ Actuator stall
 - ◇ Insufficient cooling
 - ◇ Insufficient heating

The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
19. The controller shall provide a compliant interface for ASHRAE Standard 62 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.
20. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
21. Inputs:
 - a. Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
 - ◇ 0-10 VDC Sensors
 - ◇ 1000ohm RTDs
 - ◇ NTC Thermistors

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- b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”
- c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
- d. Provide side loop application for humidity control.

22. Outputs

- a. Analog outputs shall provide the following control outputs:
 - ◇ 0-10 VDC
- b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
- c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

23. Application Configuration

- a. The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

24. Sensor Support

- a. The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
- b. The VMA shall support an LCD display room sensor.
- c. The VMA shall also support standard room sensors as defined by analog input requirements.
- d. The VMA shall support humidity sensors defined by the AI side loop.

C. Network Sensors

- 1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - a. Zone Temperature
 - b. Zone Humidity
 - c. Zone Setpoint
 - d. Discharge Air Temperature
- 2. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
- 3. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.
- 4. The Network Zone Sensors shall include the following items:
 - a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint
 - b. An LED to indicate the status of the Override feature
 - c. A button to toggle the temperature display between Fahrenheit and Celsius
 - d. A button to initiate a timed override command
 - e. Available in either surface mount or wall mount
 - f. Available with either screw terminals or phone jack
- 5. The Network Discharge Air Sensors shall include the following:
 - a. 4 inch or 8 inch duct insertion probe
 - b. 10 foot pigtail lead
 - c. Dip Switches for programmable address selection

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- d. Ability to provide an averaging temperature from multiple locations
- e. Ability to provide a selectable temperature from multiple locations

2.8 System Software

- A. System Configuration Tool (SCT) – Awarded manufacturer shall use the tools below specific to their controller
1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a System Controller or an Integration Controller.
 2. The configuration tool shall provide an archive database for the configuration and application data.
 3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
 4. The configuration tool shall include the following features:
 - a. Basic system navigation tree for connected networks
 - b. Integration of LonWorks, and BACnet enabled devices
 - c. Customized user navigation trees
 - d. Point naming operating parameter setting
 - e. Graphic diagram configuration
 - f. Alarm and event message routing
 - g. Graphical logic connector tool for custom programming
 - h. Downloading, uploading, and archiving databases
 5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
 - a. BACnet Devices
 - b. LonWorks devices
 6. The configuration tool shall be capable of programming the Equipment Controllers.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the Equipment Controllers.
 - b. The configuration tool shall allow the Equipment Controllers to be run in Simulation Mode to verify the applications.
 - c. The configuration tool shall contain a library of standard applications to be used for configuration.
 7. The configuration tool shall be capable of programming the field devices.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
 - b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
 - c. The configuration tool shall contain a library of standard applications to be used for configuration
 8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
 - a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
 - b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
 - c. The wireless connection shall use the Bluetooth Wireless Technology.
 - d. The wireless connection shall be restricted by access level.

9. A copy of the software shall be given to the County either on a CD-ROM or USB flash drive.

B. Wireless MS/TP Converter

- a. The converter shall provide a temporary wireless connection between the SA or FC Bus and a wireless enabled portable PC.
- b. The converter shall support downloading and troubleshooting FEC and field devices from the PC over the wireless connection.
- c. The converter shall employ Bluetooth Wireless Technology.
- d. The converter shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
- e. The converter shall operate over a minimum of thirty three (33) feet within a building.
- f. The converter shall have LED indicators to provide information regarding the following conditions:
 - ◇ Power - On/Off
 - ◇ Fault – Fault/No Fault
 - ◇ SA/FC Bus – Bus Activity/ No Bus Activity
 - ◇ Blue – Bluetooth Communication Established/ Bluetooth Communication Not Established
- g. The SWCVT shall comply with FCC Part 15.247 regulations for low-power unlicensed transmitters.

C. Handheld VAV Balancing Sensor

- a. The sensor shall be a light weight portable device of dimensions not more than 3.2 x 3.2 x 1.0 inches.
- b. The sensor shall be capable of displaying data and setting balancing parameters for VAV control applications.
- c. The sensor shall be powered through a connection to either the Sensor-Actuator (SA) or the Field Controller (FC) Bus.
- d. The sensor shall be a menu driven device that shall modify itself automatically depending upon what type of application resides in the controller.
- e. The sensor shall contain a dial and two buttons to navigate through the menu and to set balancing parameters.
- f. The sensor shall provide an adjustable time-out parameter that will return the controller to normal operation if the balancing operation is aborted or abandoned.
- g. The sensor shall include the following
 - ◇ 5 foot retractable cable
 - ◇ Laminated user guide
 - ◇ Nylon carrying case
- h. The sensor shall be Underwriters Laboratory UL 916 listed and CSA certified C22.2 N. 205, CFR47.

2.9 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.

B. Temperature Sensors

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1. General Requirements:
 - a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
 - b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
 - c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	± .5°F.
Room Temp	± .5°F.
Duct Temperature	± .5°F.
All Others	± .75°F.

2. Room Temperature Sensors
 - a. Room sensors shall be constructed for either surface or wall box mounting.
 - b. Room sensors shall have the following options when specified:
 - ◇ Setpoint reset slide switch providing a ±3 degree (adjustable) range.
 - ◇ Individual heating/cooling setpoint slide switches.
 - ◇ A momentary override request push button for activation of after-hours operation.
 - ◇ Analog thermometer.
3. Room Temperature Sensors with Integral Display
 - a. Room sensors shall be constructed for either surface or wall box mounting.
 - b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
 - ◇ Display room and outside air temperatures.
 - ◇ Display and adjust room comfort setpoint.
 - ◇ Display and adjust fan operation status.
 - ◇ Timed override request push button with LED status for activation of after-hours operation.
 - ◇ Display controller mode.
 - ◇ Password selectable adjustment of setpoint and override modes.
4. Thermo wells
 - a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
 - b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
 - c. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
 - d. Thermo wells shall be constructed of 316 stainless steel.
5. 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.
6. Duct Mount Sensors

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- 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.
7. Averaging Sensors
- a. For ductwork greater in any dimension than 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.
8. Acceptable Manufacturers: Setra or approved equal.
- C. 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 sealite 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.
- D. 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.

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2. Low Differential Water Pressure Applications (0" - 20" 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 flow meter differential pressure or water 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:
 - ◇ .01-20" w.c. input differential pressure range.
 - ◇ 4-20 mA output.
 - ◇ Maintain accuracy up to 20 to 1 ratio turndown.
 - ◇ Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Setra, Mamac, or approved equal.
3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
 - a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
 - ◇ Differential pressure range 10" w.c. to 300 PSI.
 - ◇ Reference Accuracy: $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability).
 - 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, Mamac, or approved equal.
4. 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.
5. 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.
- E. Flow Monitoring
- 1. Air Flow Monitoring
 - a. Fan Inlet Air Flow Measuring Stations
 - ◇ At the inlet of each fan and near the exit of the inlet sound trap, airflow traverse probes shall be provided that shall continuously monitor the fan air volumes and system velocity pressure.
 - ◇ Each traverse probe shall be of a dual manifolded, cylindrical, type 3003 extruded aluminum configuration, having an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching airflow. The manifold should not have forward projecting sensors into the air stream. The static pressure manifold shall incorporate dual offset static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as $\pm 20^\circ$ in the approaching air stream.
 - ◇ The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Each airflow-measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.
 - ◇ Airflow measuring stations shall be manufactured by Air Monitor Corp., Tek-Air Systems, Inc., Ebtron, or Dietrich Standard.
 - b. Single Probe Air Flow Measuring Sensor
 - ◇ The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a hot wire anemometer and utilize two temperature sensors and a heater element temperature. The other sensor shall measure the downstream air temperature. The temperature differential shall be directly related to airflow velocity.
 - c. 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.

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- ◇ 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.
- d. 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 or approved equal.
- e. 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.

F. 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.

G. 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.

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- 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. Water Flow Switches
- a. Water flow switches shall be equal to Dwyer or approved equal..
7. 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.

2.10 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.

3. Electronic Valve Actuators

- a. Electronic valve actuators shall be manufactured by the valve manufacturer.
- b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
- c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
- d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply 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 each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
- e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, 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 the associated pump or chiller.
- f. 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.

D. Control Valves

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.
2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.

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4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
 5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
 6. Acceptable manufacturers: Belimo or approved equal.
- E. 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.

2.11 Miscellaneous Devices

- A. Variable Frequency Motor Speed Control Drives
- B. Local Control Panels
1. All control panels shall be factory constructed, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
 2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
 3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
 4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
 5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
 6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.
- C. 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.

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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.

PART 3 – PERFORMANCE / 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,

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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.
- 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.

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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 – General
 - 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. Water Differential Pressure Sensors
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
 - 7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
 - 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.

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- 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~~ **in same location as existing sensors.**
 - 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.
 - 13. Water Differential Pressure Status Switches:
 - a. Install with shut off valves for isolation.
- 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. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
 - 5. 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

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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.

Sequence of Operations – Refer to Construction Documents.

**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

- 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.
- 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 meet 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

<u>Term</u>	<u>Definition</u>
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.

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- 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.

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- 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

- 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.
- 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
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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
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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 waiver 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 waiver 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

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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.

END OF SECTION 15900

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SECTION 15950
SEQUENCE OF OPERATION

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.
- B. Provisions of Section 15010, Mechanical General Provisions, shall be made an integral part of this section.
- C. Refer to Specification Section 01810 for commissioning requirements.

1.2 WORK INCLUDED

- A. Provide all labor, material, documentation and services required for the implementation of the Sequences of Operation detailed herein.

1.3 RELATED WORK

- A. Section 15900 – Building Automation Systems

1.4 APPLICABLE PROVISION

- A. Were modulation of a valve or damper is referred to then it shall mean the direct digital control of the valve or damper based on a control algorithm resident in the BCS software at the remote field panel. Unless noted otherwise the control algorithm shall be PID control. Optimum loop response shall be ensured by the use of a built in automatic loop tuner.
- B. An Operator having the required level of password access shall be able to modify the Operator changeable or definable parameter(s) on-line from an I/O device such that the monitoring and control functions of the BCS shall not be affected during the period of the change. The mechanism by which the change is made shall be simple and shall be adequately described in the Operator's manuals. Where setpoints for control parameters such as setpoint or changeover temperatures, humidities, or times are referred to in this Section they shall be Operator changeable on-line.
- C. Where the sequences refer to the start/stop of a system this shall be initiated either by an Operator manually entered command or automatically by a software routine such as "Optimum Stop/Start", "Power Demand Control", "Programmed Stop/Start", etc. or via an interlock in the sequences of operation to other equipment or event(s).
- D. When the motor controller is equipped with a HOA the motors shall only be controlled by the BCS when the HOA switch is in the auto position.
- E. Firestats, freezestats, smoke and fire detectors and interlocked dampers shall be wired to shutdown motors when the HOA switch is in both the hand and auto positions. It shall not be possible for the BCS to override these or any other safety devices or any fire alarm system control functions, except in the case of an engineered smoke control system in which case freeze protection safeties shall be overridden.
- F. Refer to the Point Definition Sheets and System Schematics, which form part of these Contract Documents, to facilitate the interpretation of the sequences of operation as

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defined herein.

- G. Provide additional I/O points, whether or not such points are indicated in the Point Definition Sheets, if they are required in order to attain the requirements of the Contract Documents.
- H. Where fans and dampers are to be interlocked, provide hardwire interlocks between the motor terminal strip and damper such that the damper shall be driven open when the motor is required to start. Motor start-up shall not occur until the damper end switch indicates the damper is in the full open position.
- I. Where fans and dampers are hardwire interlocked, the interlocks shall apply in both the "hand" and "auto" positions of the HOA switch at the motor controller.
- J. Where electric heat coil control calls for the electric heating coil to be staged/cycled on and off to maintain the required temperature set point, the control algorithm shall incorporate a deadband, changeable by the Operator, which shall prevent the too frequent on/off cycling of the heating coil.
- K. Where electric heating coils are controlled by the BCS, the BCS shall not override any safety interlocks.
- L. Where there are fans not identified within the sequence of operation, point definition sheets or schematic drawings that provide supply and/or exhaust air that are not controlled via a thermostat, they shall be hardwire interlocked to the controlling device. The supply fans shall be hardwire interlocked with their associated exhaust fan (if applicable) to operate simultaneously. The dampers shall be hardwire interlocked with the fans via end switches such that the fans cannot operate when the damper is not fully open. The damper status shall not be monitored by the BCS. If the supply or exhaust fan serves a riser with multiple dampers, the end switches of the riser dampers shall be wired in parallel as a group then wired in series with the fan's associated damper end switch to prevent the fan from operating unless both the fan's damper is open and at least one of the riser dampers are open.
- M. The point list is provided for convenience and is not intended to be all-inclusive. All points required to provide the Sequence of Operation shall be included as if listed.
- N. All wiring required to provide the Sequence of Operation shall be included.

1.5 ABBREVIATIONS

AFD	Adjustable Frequency Drive
AUX	Starter Auxiliary Contact
AI	Analog Input
AO	Analog Output
CFM	Air Flow in CFM from Air Monitor
CSR	Current Sensing Relay
D	Damper Operation
DI	Digital Input
DO	Digital Output
DP	Differential Pressure
ES	End Switch
Fa	Failure Alarm
FR	Freezestat
FS	Flow Switch
H	Humidity Sensor

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Ha	High Static Pressure Alarm
IAQ	Indoor Air Quality
IGV	Inlet Guide Vanes
La	Low Static Pressure Alarm
Ma	Maintenance Alarm
Pd	Discharge Static Pressure
Pdd	Downduct Static Pressure
Pds	Discharge Static Pressure Safety
Ps	Suction Static Pressure
Pss	Suction Static Pressure Safety
R	Relay
Sa	Safety Alarm/Shut-down
SD	Smoke Detector
DP	Static Pressure Sensor
SR	Damper Smoke Rated
SS	Start-Stop
T	Temperature Sensor
Ta	Temperature Alarm
V	Valve Operator
VP	Virtual Point
X	Hardwired Item

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 SEQUENCE OF OPERATION – Refer to Construction Documents.

END OF SECTION 15950

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SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

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 Basic Electrical Requirements specifically applicable to Division 16 Sections, in addition to Division 1 - General Requirements - and any supplemental requirements/conditions.
- B. Work includes but is not limited to all electrical/ fire alarm required to demolish and install fan terminal boxes.

1.3 DESCRIPTION OF WORK

- A. The work required under this Division shall include all materials, labor and auxiliaries required to install a complete and properly operating electrical system.
- B. The Contractor shall furnish, perform, or provide all labor including planning, purchasing, transporting, storing, installing, testing, cutting and patching, trenching, excavating, backfilling, coordination, field verification, equipment (installation and safety), supplies, and materials necessary for the correct installation of complete electrical systems (as described or implied by these specifications and the applicable drawings) in strict accordance with applicable codes, which may not be repeated in these specifications, but are expected to be common knowledge of qualified Bidders.
- C. The Division 16 Contract Documents refer to work required in addition to (or above) the minimum requirements of the NEC and applicable local codes. All work shall comply with all applicable codes as a minimum and with the additional requirements called for in these Contract Documents.
- D. Only trained and qualified personnel shall be used by the Contractor to perform work. The Contractor shall not perform work which violates applicable Codes, even if called for in the Contract Documents. The Contractor's Bid shall include work necessary to completely install the electrical systems indicated by the Contract Documents in accordance with applicable Codes.
- E. Refer to other Division 16 Sections for additional work requirements.
- F. Connections of all items using electric power shall be included under this division of the specifications, including necessary wire, conduit, circuit protection, disconnects and accessories. Securing of roughing-in drawings and connection information for equipment involved shall also be included under this division. See other divisions for specifications for electrically operated equipment.
- G. The Contractor shall provide and install panic hardware on all electrical room doors where the electrical room houses equipment rated 1200 amps or more per NEC 110.26. All electrical room doors shall open in the direction of egress.

1.4 WORK SEQUENCE

- A. Install work in stages and/or phases to accommodate Owner's occupancy requirements. Coordinate electrical schedule and operations with Owner and Architect/Engineer.

1.5 CODES, FEES, AND STANDARDS

- A. Conform to all applicable requirements of Section 16014 Reference Standards and Regulatory

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Requirements.

- B. Obtain permits and request inspections from Authority Having Jurisdiction and applicable utility companies.
- C. Pay for all required licenses, fees, and inspections.
- D. Material shall be new and free of defects with UL listing or be listed with an approved, nationally recognized Electrical Testing Agency if and only if UL listing is not available for material.

1.6 PROJECT/SITE CONDITIONS

- A. Install work in locations shown or described in the Contract Documents, unless prevented by Project conditions.
- B. The Contractor shall install all equipment so that all Code required and manufacturer recommended servicing clearances are maintained. Contractor shall be responsible for the proper arrangement and installation of all equipment within any designated space. Should the Contractor determine that a departure from the Contract Documents is necessary, he shall submit to the A/E, for approval, detailed drawings of his proposed changes with his written reasons for the changes. No changes shall be implemented by the Contractor without the issuance of the required drawings, clarifications, and/or change orders.
- C. The Contractor shall verify finish dimensions at the project site in preference to using dimensions noted on Contract Documents.

1.7 INVESTIGATION OF SITE

- A. Check site and existing conditions thoroughly before bidding. Advise A/E of discrepancies or questions noted.
- B. Each Bidder shall visit the site and shall thoroughly familiarize himself with existing field conditions and the proposed work as described or implied by the Contract Documents. During the course of the site visit, and the existing field conditions in the areas of construction and demolition which will affect his work. The Contractor will receive no compensation or reimbursement for additional expenses he incurs due to failure to make a thorough investigation of the existing facilities. This shall include rerouting around existing obstructions.
- C. Submission of a proposal will be construed as evidence that such examination has been made and later claims for labor, equipment or materials required because of difficulties encountered will not be recognized.
- D. Existing conditions and utilities indicated are taken from existing construction documents, surveys, and field investigations. Unforeseen conditions probably exist and existing conditions shown on drawings may differ from the actual existing installation with the result being that new work may not be field located exactly as shown on the drawings. Contractor shall field verify dimensions of all site utilities, conduit routing, boxes, etc., prior to bidding and include any deviations in the contract. Notify A/E if deviations are found.
- E. All existing electrical is not shown. The Contractor shall become familiar with all existing conditions prior to bidding, and include in his bid the removal of all electrical equipment, wire, conduit, devices, fixtures, etc. that is not being reused, back to its originating point.
- F. The Contractor shall locate all existing utilities and protect them from damage. The Contractor shall pay for repair or replacement of utilities or other property damaged by operations in conjunction with the completion of this work.
- G. Remove existing power, lighting, systems, material and equipment which are made obsolete or which interfere with the construction of the project. Reinstall power, lighting, systems, materials and equipment which are required to remain active for the facility to be fully functional.
- H. All items removed and not re-used shall be immediately turned over to Owner as they are made

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available by renovation. Remove items from job site and deliver to Owner's storage location(s) as directed by project manager. Discard complete items which Owner elects to refuse.

- I. Investigate site thoroughly and reroute all conduit and wiring in area of construction in order to maintain continuity of existing circuitry. Existing conduits indicated in Contract Documents indicate approximate locations only. Contractor shall verify and coordinate existing site conduits and pipes prior to any excavation on site. Bids shall include hand digging and all required rerouting in areas of existing conduits or pipes.
- J. Work is in connection with existing buildings which must remain in operation while work is being performed. Work shall be in accord with the schedule required by the Contract. Schedule work for a minimum outage to Owner. Notify Owner 72 hours in advance of any shut-down of existing systems. Perform work during non-general office operating hours unless otherwise accepted by Fire Logistics project manager. Protect existing building and equipment during construction.
- K. Bid shall include all removal and relocation of all piping, fixtures or other items required for completion of alterations and new construction.
- L. See Section Minor Demolition for Remodeling for additional requirements due to existing conditions.

1.8 CONTRACT DOCUMENTS

- A. These specifications and applicable drawings shall be considered supplementary, one to the other and are considered Contract Documents. All workmanship, methods, and/or material described or implied by one and not described or implied by the other shall be furnished, performed, or otherwise provided just as if it had appeared in both sets of documents.
- B. Where a discrepancy or conflict is found between these specifications and any applicable drawing, the Contractor shall notify the A/E in written form. In the event that a discrepancy exists between specifications and any applicable drawing, the most stringent requirement shall govern unless the discrepancy conflicts with applicable codes wherein the code shall govern. The most stringent requirement shall be that work, product, etc which is the most expensive and costly to implement.
- C. The drawings are diagrammatic and are not intended to include every detail of construction, materials, methods, and equipment. They indicate the result to be achieved by an assemblage of various systems. Coordinate equipment locations with Architectural and Structural drawings. Layout equipment before installation so that all trades may install equipment in spaces available. Coordinate installation in a neat and workmanlike manner.
- D. Wiring arrangements for equipment shown on the drawings are intended to be diagrammatic and do not show all required conductors and functional connections. All wiring and appurtenances required for the proper operation of all equipment to be connected shall be provided.
- E. Specifications require the Contractor to provide shop drawings which shall indicate the fabrication, assembly, installation, and erection of a particular system's components. Drawings that are part of the Contract Documents shall not be considered a substitute for required shop drawings, field installation drawings, Code requirements, or applicable standards.
- F. Locations indicated for outlets, switches, and equipment are approximate and shall be verified by instructions in specifications and notes on the drawings. Where instructions or notes are insufficient to locate the item, notify the A/E.
- G. The Contractor shall take finish dimensions at the project site in preference to scaling dimensions on the drawings.
- H. Where the requirements of another division, section, or part of these specifications exceed the requirements of this division those requirements shall govern.

1.9 MATERIALS AND EQUIPMENT

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- A. Material shall be new (except where specifically noted, shown or specified as "Reused") and/or denoted as existing) and shall be UL listed and bear UL label. Where no UL label listing is available for a particular product, material shall be listed with an approved, nationally recognized Electrical Testing Agency. Where no labeling or listing service is available for certain types of equipment, test data shall be submitted to prove to the Engineer that equipment meets or exceeds available standards.
- B. Where Contract Documents list design selection or manufacturer, type, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to A/E's review and acceptance. Where Contract Documents list accepted substitutions, these items shall comply with Division 1 requirements and Section 16013 Substitutions.
- C. When a product is specified to be in accordance with a trade association or government standard and at the request of A/E the Contractor shall furnish a certificate that the product complies with the referenced standard and supporting test data to substantiate compliance.
- D. Where multiple items of the same equipment or materials are required, they shall be the product of a single manufacturer.
- E. Where the Contract Documents require materials and/or equipment installed, pulled, or otherwise worked on, the materials and/or equipment shall be furnished and installed by the Contractor responsible for Division 16 methods and materials unless specifically noted otherwise.
- F. Where the contract documents refer to the terms "furnish," "install," or "provide," or any combination of these terms) the materials and/or equipment shall be supplied and delivered to the project including all labor, unloading, unpacking, assembly, erection, anchoring, protecting supplies and materials necessary for the correct installation of complete system unless specifically noted otherwise.
- G. Before the Contractor orders equipment, the physical size of specified equipment shall be checked to fit spaces allotted on the drawings, with NEC working clearances provided. Internal access for proposed equipment substitutions shall be provided.
- H. Electrical equipment shall be protected from the weather during shipment, storage, and construction per manufacturer's recommendations for storage and protection. Should any apparatus be subjected to possible damage by water, it shall be thoroughly dried and put through a dielectric test, at the expense of the Contractor, to ascertain the suitability of the apparatus, or it shall be replaced without additional cost to the Owner. No additional time will be allowed and the project completion date shall be maintained.
- I. Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service. Replace or repair and test damaged equipment in compliance with industry standards at no additional cost to the Owner. Equipment required for the test shall be provided by the Contractor with no additional cost to the Contract.
- J. Material and equipment shall be provided complete and shall function up to the specified capacity/function. Should any material and/or equipment as a part or as a whole fail to meet performance requirements, replacements shall be made to bring performance up to specified requirements. Damages to finish by such replacements, alterations, or repairs shall be restored to prior conditions, at no additional cost to the Owner.
- K. Where tamperproof screws are specified or required, Phillips head or Allen head devices shall not be accepted. For each type used, provide Owner with three tools. Owner will designate the specific hardware design to correspond with existing devices elsewhere in the building, to limit special tool requirements.
- L. Where the Contract Documents denote equipment and/or material to be 'new' and/or 'existing' and also provide no denotation for other equipment as to it being 'new' and/or 'existing,' this is not

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to infer that the non-denoted equipment is either new or existing, or opposite of the equipment that is denoted. The use of the terms 'new' or 'existing' is meant to clarify denoted equipment/materials for that item only, and the lack of the terms 'new' or 'existing' in relation to identifiers/notes/denotations on the drawings is not to infer that this non-denoted equipment or materials is new or existing.

1.10 MISCELLANEOUS CIRCUITS REQUIRED

- A. Provide 120 volt, 20 amp circuit to all fire alarm panels, remote panels, etc (whether shown on drawings or not). Connect to spare 20 amp, 1 pole circuit breaker in nearest 120 volt panel. Re-label circuit breaker accordingly. Provide locking device on breaker. Coordinate location with fire alarm system engineer (and drawings/specifications) prior to bid and provide all electrical. Coordinate final location and electrical requirements with panel installer after bid and provide all electrical. Nearest panel to be nearest emergency panel, when building has emergency generator system.
- B. Provide 120 volt, 20 amp circuit to fire and smoke dampers (whether shown on drawings or not). Connect to spare 20 amp, 1 pole circuit breaker in nearest 120 volt panel. Re-label circuit breaker accordingly. Provide locking device on breaker. Coordinate location with fire protection engineer (and drawings/specifications) prior to bid and provide all electrical. Coordinate final location and electrical requirements with damper installer after bid and provide all electrical. Nearest panel to be nearest emergency panel, when building has emergency generator system.
- C. Provide 120 volt, 20 amp circuit to building control panels for HVAC system (whether shown on drawings or not). Connect to spare 20 amp, 1 pole circuit breaker in nearest 120 volt panel. Re-label circuit breaker accordingly. Provide locking device on breaker. Coordinate location with fire protection engineer (and drawings/specifications) prior to bid and provide all electrical. Coordinate final location and electrical requirements with damper installer after bid and provide all electrical

1.11 CARBON MONOXIDE ALARMS

- A. In accordance with Rule 9B-3.0472, whether shown on drawings or not, provide a carbon monoxide alarm within 10 feet of each room used for sleeping purposes where the building has a fossil-fuel-burning heater or appliance, a fireplace, or an attached garage. Carbon monoxide alarms shall be hard wired to the building electrical system and receive primary power from the building 120 volt electrical system. Carbon monoxide alarms shall have battery backup. Carbon monoxide alarms shall be interconnected so that when one device detects CO all devices within the building sound alarm. Alarms shall be listed in accordance with UL 2034-96, Standard for Single and Multiple Station CO Alarms. Provide strobe lights in all spaces intended for the hearing impaired or where required by Federal and/or State regulations.

1.12 SMOKE ALARMS

- A. Provide single and multiple station smoke alarms, whether shown on drawings or not, at locations required by Florida Building Code Chapter 9. Smoke alarms shall be hard wired to the building electrical system and receive primary power from the building 120 volt electrical system. Smoke alarms shall have battery backup. Smoke alarms shall be interconnected so that when one device detects smoke all devices within an individual dwelling unit sound alarm. Provide strobe lights in all spaces intended for the hearing impaired or where required by Federal and/or State regulations.

1.13 SUPERVISION OF THE WORK

- A. Reference the General Conditions for additional requirements.
- B. The Contractor shall provide experienced, qualified, and responsible supervision for work. A competent foreman shall be in charge of the work in progress at all times. If, in the judgement of the A/E, the foreman is not performing his duties satisfactorily, the Contractor shall immediately replace him upon receipt of a letter of request from the A/E. Once a satisfactory foreman has

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been assigned to the work, he shall not be withdrawn by the Contractor without the written consent of the A/E.

- C. Provide field superintendent who has had a minimum of four (4) years previous successful experience on projects of comparable size and complexity. Superintendent shall be on the site at all times during construction and must have, as a minimum, an active Journeyman's Electrical License in the State of Florida.
- D. Superintendent shall be employed by a currently licensed Florida Certified Electrical Contractor (EC) or a currently licensed Florida Registered Electrical Contractor (ER).

1.14 COORDINATION

- A. Provide all required coordination and supervision where work connects to or is affected by work of other trades, and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to Owner including but not limited to electrical work required for:
 - 1. Mechanical Division of the Specifications
- B. Contractor shall obtain set of Contract Documents from Owner for all areas of work noted above and include all electrical work in bid whether included in Division 16 Contract Documents or not.
- C. Installation studies shall be made to coordinate the electrical work with other trades. Work shall be preplanned. Unresolved conflicts shall be referred to the A/E prior to installation of the equipment for final resolution.
- D. For locations where several elements of electrical or combined mechanical and electrical work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings at 1/4" scale showing the actual physical dimension required for the installation to assure proper integration of equipment with building systems and NEC required clearances. Coordination drawings shall be provided for all areas of conflict as determined by the A/E.
- E. Secure accepted shop drawings from all required disciplines and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on accepted shop drawings differs from that shown or called for in Construction Documents, make adjustments to the wiring, disconnects, and branch circuit protection to match that required for the equipment installed.
- F. Damage from interference caused by inadequate coordination shall be corrected at no additional cost to the Owner and the contract time for completion will not be extended.
- G. The Contractor shall maintain an up-to-date set of Contract Documents (Drawings and Specifications) of all trades on the project site, including Architectural, Structural, Mechanical, Electrical and, where provided Interior Design.
- H. It is the responsibility of this Contractor to coordinate the exact required location of floor outlets, floor ducts, floor stub-ups, etc. with Owner and Architect (and receive their written approval) prior to rough-in. Locations indicated in Contract Documents are approximate.
- I. The Contract Documents describe specific sizes of switches, breakers, fuses, conduits, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). The Contractor shall coordinate the requirements of each load with each load's respective circuitry shown and with each load's requirements as noted on its nameplate data and manufacturer's published electrical criteria. The Contractor shall adjust circuit breaker, fuse, conduit, and conductor sizes to meet the actual requirements of the equipment being provided and installed and change from single point to multiple points of connection (or vice versa) to meet

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equipment requirements. Changes due to these coordination efforts shall be made at no additional cost to the Owner.

1.15 PROVISION FOR OPENINGS

- A. Locate openings required for work. Provide sleeves, guards or other accepted methods to allow passage of items installed.
- B. Coordinate with roofing Contractor on installation of electrical items which pierce roof. Roof penetrations shall not void roof warranty.
- C. Where work pierces waterproofing, it shall maintain the integrity of the waterproofing. Coordinate roofing materials which pierce roof for compatibility with membrane or other roof types with Contractor prior to installation.

1.16 SURFACE MOUNTED EQUIPMENT

- A. Surface mounted fixtures, outlets, cabinets, conduit, panels, etc. shall have factory applied finish and/or shall be painted as directed by Engineer. Paint shall be in accordance with other applicable sections of the specifications for this project.

1.17 CUTTING AND PATCHING

- A. New Construction:
 - 1. Reference Division 1 - General Requirements.
 - 2. Cutting of work in place shall be cut, drilled, patched and refinished by trade responsible for initial installation.
 - 3. The Contractor shall be responsible for backfilling and matching new grades with adjacent undisturbed finished surface.
- B. Existing Construction:
 - 1. See Section Minor Electrical Demolition for Remodeling for additional requirements.

1.18 INSTALLATION

- A. Erect equipment to minimize interferences and delays in execution of the work.
- B. Take care in erection and installation of equipment and materials to avoid marring finishes or surfaces. Any damage shall be repaired or replaced as determined by the A/E at no additional cost to the Owner.
- C. Equipment requiring electrical service shall not be energized or placed in service until A/E is notified and is present or have waived their right to be present in writing. Where equipment to be placed in service involves service or connection from another Contractor or the Owner, the Contractor shall notify the Owner in writing when the equipment will be ready. The Owner shall be notified as far in advance as possible of the date the various items of equipment will be complete.
- D. Equipment supports shall be secured and supported from structural members except as field accepted by the A/E in writing.
- E. Plywood material shall not be used as a backboard for mounting panel boards, disconnects, motor starters, and dry type transformers. Provide "cast in place" type inserts or install expansion type anchor bolts. Electrical equipment shall not be mounted directly to dry wall for support without additional channels as anchors. Channels shall be anchored to the floor and structure above. Panelboards and terminal cabinets shall be provided with structural framing located within drywall partitions.
- F. The Contractor shall keep the construction site clean of waste materials and rubbish at all times. Upon completion of the work, the Contractor shall remove from the site all debris, waste, unused

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materials, equipment, etc.

- G. Inserts, pipe sleeves, supports, and anchorage of electrical equipment shall be provided. Where items are to be set or embedded in concrete or masonry, the items shall be furnished and a layout made prior to the setting or embedment thereof, so as to cause no delay to the project schedule.

1.19 PROGRESS AND RECORD DRAWINGS

- A. Keep two sets of blueline prints on the job, and neatly mark up design drawings each day as components are installed. Different colored pencils shall be used to differentiate each system of electrical work. Cost of prints and this labor task shall be included under this Division. All items on Progress Drawings shall be shown in actual location installed. Change the equipment schedules to agree with items actually furnished.
- B. Prior to request for substantial completion observation, furnish a set of neatly marked prints showing "as-installed" (as-built) condition of all electrical installed under this Division of the specifications. Marked up prints are to reflect all changes in work including change orders, field directives, addenda from bid set of Contract Documents, request for information responses, etc. Marked up set of prints to show:
 - 1. All raceways 1-1/2" and above, exactly as installed.
 - 2. All site raceways exactly as installed.
 - 3. Any combining of circuits (which is only allowed by specific written permission) or change in homerun outlet box shall be made on as-builts.
 - 4. Any circuit number changes on plan shall be indicated on as-builts.
 - 5. Any panelboard schedule changes shall be indicated on as-builts and final panelboard schedules..
- C. Marked up prints as noted above are to be submitted to A/E for review.. Contractor shall review submitted "as-builts" with Engineer in the field. Contractor shall verify every aspect for accuracy.
- D. The changes and alterations shall be transferred to AutoCAD (Auto CAD Release 2007 or higher). Obtain CAD disk of the construction documents by the A/E, from the A/E. generate/update the CAD disks to include all changes, additions, etc. on the accepted marked up prints. Label each drawing "As-Built" and date. Submit as-built CAD disk and reproducible of the as-builts.
- E. After acceptance of marked up prints by A/E with all changes, additions, etc. included on accepted marked up prints, submit set prior to request for final payment and/or request for final observation.
- F. Where the Contractor has failed to produce representative "as-built" drawings in accordance with requirements specified herein, the Contractor shall reimburse Engineer all costs to produce a set of "as-built" drawings to the Architect/Owner satisfaction.

1.20 OBSERVATION OF WORK REPORT

- A. Reference the General Conditions.
- B. Items noted by A/E or his representative during construction and before final acceptance which do not comply with the Contract Documents will be listed in a "Observation of Work" report which will be sent to the Contractor for immediate action. The Contractor shall correct all deficiencies in a prompt concise manner. After completion of the outstanding items, provide a written confirmation report for each item to the A/E. The report shall indicate each item noted, and method of correction. Enter the date on which the item was corrected, and return the signed reports so items can be rechecked. Failure to correct the deficiencies in a prompt concise manner or failure to return the signed reports shall be cause for disallowing request for payments.

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- C. Items noted after acceptance during one-year guarantee period shall be checked by the Contractor in the same manner as above. The signed reports are to be returned by him when the items have been corrected.

1.21 SYSTEMS WARRANTY

- A. Reference the General Conditions.
- B. The work shall include a one-year warranty. This warranty shall be by the Contractor to the Owner for any defective workmanship or material which has been furnished at no cost to the Owner for a period of one year from the date of substantial completion of each System. Warranty shall not include lamps in service after one month from date of substantial completion of the System. Explain the provisions of warranty to the Owner at the "Demonstration of Completed System" meeting to be scheduled with the Owner upon project completion.
- C. Where items of equipment or materials carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material.
- D. Where extended warranty or guarantee are called for herein, furnish three copies to be inserted in Operation and Maintenance Manuals.
- E. All preventative maintenance and normal service will be performed by the Owner's maintenance personnel after final acceptance of the work which shall not alter the Contractor's warranty.

1.22 WASTE MATERIALS DISPOSAL

- A. Contractor shall include in his bid the transport and disposal or recycling of all waste materials generated by this project in accordance with all rules, regulations and guidelines applicable. Contractor shall comply fully with Florida Statute 403.7186 regarding mercury containing devices and lamps. Lamps, ballasts and other materials shall be transported and disposed of in accordance with all DEP and EPA guidelines applicable at time of disposal. Contractor shall provide owner with written certification of accepted disposal.

1.23 SUBSTANTIAL COMPLETION

- A. The Contractor shall be fully responsible for contacting all applicable parties [(A/E or Project Manager)] to schedule required observations of the work by Engineer. [A minimum of 72 hours notice shall be given for all required observations of the work by Engineer, and minimum of 120 hours for substantial completion observation. Time and date shall be agreed on by all applicable parties in writing.]
- B. Work shall be complete as required by authorities having jurisdiction and the general conditions of the contract prior to request for substantial completion observation. Work must be deemed substantially complete by A/E to fulfill requirements.

1.24 PROHIBITION OF ASBESTOS AND PCB

- A. The use of any process involving asbestos or PCB, and the installation of any product, insulation, compound of material containing or incorporating asbestos or PCB, is prohibited. The requirements of this specification for complete and operating electrical systems shall be met without the use of asbestos or PCB.
- B. Prior to the final review field visit, the Contractor shall certify in writing that the equipment and materials installed in this Project under this Division 16 contain no asbestos or PCB. Additionally, all manufacturers shall provide a statement with their submittal that indicates that their product contains no asbestos or PCB. This statement shall be signed and dated by a duly authorized agent of the manufacturer.

PART 2 - PRODUCTS (Not Applicable)

PART 3- EXECUTION (Not Applicable)

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END OF SECTION

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SECTION 16012
SUBMITTALS

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. Requirements for submittals specifically applicable to Division 16 Sections, in addition to Division 1 - General Requirements and any supplemental requirements/conditions.
- B. See Section 16013 - SUBSTITUTIONS for additional requirements when submittal consists of accepted substitution equipment.

1.3 SUBMITTAL OF "ACCEPTED SUBSTITUTE" EQUIPMENT/PRODUCT

- A. Representation: In submitting item, equipment, product, etc. that has been listed on contract drawings, in contract documents or in an addenda, Contractor represents that he:
 - 1. Has investigated substituted item and has determined that it is equal or superior to specified product in all aspects and that use of substituted item will not require any additional time to the Contract.
 - 2. Will coordinate installation of accepted substitution into work, making changes as may be required to complete work in all aspects.
 - 3. Waives all claims for additional costs related to substitution which may subsequently become apparent.
 - 4. Will provide the same warranties for the substitution as for the product specified.
 - 5. Will absorb all costs incurred by the substitution when affecting other trades including but not limited to electrical, structural, architectural, etc.
 - 6. Will absorb any cost incurred by the Engineer in review of the substituted product if the acceptance of the substituted item creates the need for system modification and/or redesign, or if the substituting contractor exhibits negligence in his substituting procedure thus submitting inferior, misapplied or miss-sized equipment. In the event of additional engineering costs, the billing structure shall be agreed upon prior to review by all involved parties.
- B. Substitutions that cannot meet space requirements or other requirements of these Specifications, whether accepted or not, shall be replaced at the Contractor's expense with no additional time added to the Contract.

1.4 SUBMITTALS

- A. Submittals shall consist of a minimum of one (or if required) two hard cover view type 3-ring binder(s) White, sized to hold 8-1/2" x 11" sheets; one (1) for "ELECTRICAL SUBMITTALS" (Power and Lighting); one (1) for "SYSTEMS SUBMITTALS" (Sections 16700 through 16799). Where "SYSTEMS SUBMITTALS" (Sections 16700 through 16799) is not applicable, only one (1) binder is required.
 - 1. Binder is to be adequately sized to comfortably hold required submittals. Minimum spline size to be 1", maximum spline size to be 3" (provide additional binders if 3" size is not sufficient to properly hold submittals).
 - 2. Binder cover and spline to have outer clear vinyl pockets. Provide correct designation of

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project in each pocket; see Binder Examples for Submittals included at end of this Section. Description sheet is to be white with black letters, minimum of 11" high and full width of pocket. Description is to describe project and match project drawing/project manual description. Description to include submittal type, i.e., "ELECTRICAL SUBMITTALS" for Power and Lighting, (and if required) "SYSTEMS SUBMITTALS" for Sections 16700 - 16799 submittals.

B. Submittals Binders to include:

1. First sheet shall be prepared and filled out by Contractor and shall list project addresses, telephones, etc.; see "PROJECT ADDRESSES" Form included at end of this section.
2. Second sheet in binder shall be a photocopy of the Electrical Index pages in Specifications.
3. Provide reinforced separation sheets tabbed with the appropriate specification reference number and typed index for each section in the Systems Schedule.
4. Submittals consisting of marked catalog sheets or shop drawings shall be inserted in the binder in proper order. Submittal data shall be presented in a clear and thorough manner. Clearly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Markings shall be made with arrows or circles (highlighting is not acceptable).
5. Shop Drawings: Drawings to include identification of project and names of Architect, Engineer, General Contractor, subcontractor and supplier, data, number sequentially and indicate the following:
 - a) Fabrication and erection dimensions.
 - b) Arrangements and sectional views.
 - c) Necessary details, including complete information for making connections with other work.
 - d) Kinds of materials and finishes.
 - e) Descriptive names of equipment.
 - f) Modifications and options to standard equipment required by the work.
 - g) Leave blank area, size approximately 4 by 2 1/2 inches, near title block (for A/E's stamp imprint).
 - h) In order to facilitate review of drawings, insofar as practicable, they shall be noted, indicating by cross reference the contract drawings, note, and specification paragraph numbers where items occur in the Contract Documents.
 - i) Conduit/raceway rough-in drawings.
 - j) Items requiring shop drawings include (but not limited to):
 1. Each section of 16700 broad section (i.e., fire alarm, television, etc.).
 2. Special and/or modified equipment
 3. UL listed fire and smoke stopping assemblies for each applicable penetration
 - k) See specific sections of Specifications for further requirements.
6. Product Data: Technical data is required for all items as called for in the Specifications regardless if item furnished is as specified.
 - a) Submit technical data verifying that the item submitted complies with the

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requirements of the Specifications. Technical data shall include manufacturer's name and model number, dimensions, weights, electrical characteristics, and clearances required. Indicate all optional equipment and changes from the standard item as called for in the Specifications. Furnish drawings, or diagrams, dimensioned and in correct scale, covering equipment, showing arrangement of components and overall coordination.

- b) In order to facilitate review of product data, insofar as practicable, they shall be noted, indicating by cross reference the contract drawings, note, and/or specification paragraph numbers where and/or what item(s) are used for and where item(s) occur in the contract documents.
- c) See specific sections of Specifications for further requirements.

1.5 PROCESSING SUBMITTALS

- A. Submit under provisions of the General Requirements of the Contract and this section of the Specifications, whichever is the most strict.
- B. Quantity of submittals with marking on each copy shall be submitted under provisions of General Requirements of the Contract, Division 1, and this and other sections of the Specifications. Original submittal must contain 3-ring binders with:
 - 1. Project Addresses
 - 2. Index
 - 3. Separation Sheets
 - 4. Basic Materials
 - 5. Long Lead Items
 - 6. Systems Product Data
- C. Remainder of submittals are to be submitted no later than 60 days after award of contract or 60 days prior to Request for Substantial Completion whichever is earlier.
- D. The Contractor shall review all submittals before submitting to the A/E. No request for payment will be considered until the submittals have been reviewed and submitted for approval.
- E. Product Data: For standard manufactured materials, products and items, submit one (1) copy or sets of data (per binder). If submittal is rejected, resubmittal shall contain same quantity of new data.
- F. Shop Drawings: For custom fabricated items and systems (16700) shop drawings, initially submit a transparency (suitable for reproduction) together with two (2) prints made therefrom. When submittal is acceptable, furnish one (1) print per binder made from the accepted transparency.
- G. Shop Drawing Review Notation.

<u>Action</u>	<u>Description</u>
1. No Exception Noted	No exceptions taken. Resubmittal not required.
2. Rejected	Not in compliance with Contract Documents. Resubmit.
3. Submit Specific Item	Resubmit item as specified.
4. Make Corrections Noted	Make corrections noted, resubmittal not required.
5. Revise and Resubmit	Make corrections noted, resubmittal is required

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6. Review not Required Not required for review. No action taken. Copy retained for reference.

- H. Acceptance: When returned to Contractor, submittals will be marked with A/E's stamp. If box marked "Rejected" "Revise and Resubmit" or "Submit Specific Item" is checked, submittal is not accepted and Contractor is to correct and resubmit as noted, otherwise submittal is accepted and Contractor is to comply with notation making necessary corrections on submittal. Review comments will generally not be on each individual submittal sheet, and will be on a separate sheet attached to shop drawing transmittal, submittal as a whole or each submittal section.
- I. Note that the acceptance of shop drawings or other information submitted in accordance with the requirements specified above, does not assure that the Engineer, Architect, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved, the ability of the material or equipment involved or the Mechanical/Electrical performance of equipment. Acceptance of shop drawings does not invalidate the plans and Specifications if in conflict, unless a letter requesting such change is submitted and accepted on the Engineer's letterhead.

1.6 DELAYS

- A. Contractor is responsible for delays in job progress accruing directly or indirectly from late submissions or resubmissions of shop drawings, or product data.

1.7 RE-SUBMITTALS

- A. The A/E shall be reimbursed for all costs to review resubmittals subsequent to the second submission for the same product. Cost will be billed to Contractor at Engineer's standard hourly rate.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION

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PROJECT ADDRESSES

OWNER:

ARCHITECT:

ENGINEER:

Matern Professional Engineering, Inc.
130 Candace Drive
Maitland, Florida 32751
Telephone No.: (407) 740-5020
Fax No.: (407) 740-0365

GENERAL CONTRACTOR:

SUBCONTRACTOR:

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SECTION 16013
SUBSTITUTIONS

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 general, administrative and procedural requirements for substitutions for Division 16 sections above and beyond the requirements of Division 1 General Requirements and any Supplemental requirements/conditions.
- B. Request for substitutions must be submitted no later than 10 days prior to bid due date.

1.3 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: Products, materials, equipment, finishes, and methods of construction are considered substitutions if they meet any one of the following conditions:
 - 1. Does not meet all the requirements of these specifications under Part 1 - General or Part 2 - Products for any section included in Division 16 - Electrical Specifications.
 - 2. Is a different design which accomplishes the same result as that design specified in Division 16 - Electrical Specifications.
 - 3. Is of similar or different design that:
 - a) Requires more space.
 - b) Requires more power.
 - c) Requires changes in other elements of the work such as (but not limited to) architectural, mechanical, structural, or other electrical work.
 - d) Affects the construction schedule.
 - 4. Is listed in these specifications on the Contract Documents or in any addenda as an accepted substitution.

1.4 REQUEST FOR SUBSTITUTION SUBMITTALS (10 Days Prior to Bid Due Date)

- A. A separate request for substitutions shall be submitted for each product, material, etc. that is defined as a substitution.
- B. Submittal must consist of written request for substitution with data as required below. Request must be very specific as to what specified item, request for substitution is submitted for.
- C. Each request for substitution submittal for each product, etc. shall include:
 - 1. Name of material or equipment for which it is to be substituted.
 - 2. Drawings, product data, performance data and/or other information necessary for the engineer to determine that the equipment meets all specifications and requirements.
 - 3. Proof that pole lighting fixture and pole meet applicable wind loading requirements. Pole lighting fixtures must be submitted showing proof that they comply with the applicable wind loading requirements for location of this project.
 - 4. Compliance Statement. Each request shall include the following compliance statement

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typed on letterhead of submitting company:

- a) Submittal complies with all aspects/requirements of Contract Documents. (Yes or No). If no, state deviance.
- b) Submittal complies with all applicable codes. (Yes or No). If no, state deviance.
- c) Submittal complies with all other elements of the work and does not require any other changes. (Yes or No). If No, state required change.
- d) Meets or exceeds the performance of specified product. (Yes or No). If no, state required change.

PART 2- PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 16014
REFERENCE STANDARDS AND REGULATORY REQUIREMENTS

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. Reference Standards and Regulatory Requirements specifically applicable to Division 16 sections.

1.3 REFERENCES

- A. The following references may be referenced within these specifications:

ADA	Americans with Disabilities Act
AHERA	Asbestos Hazard Emergency Response Act
AIA	American Institute of Architects
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	ASME International American Society of Mechanical Engineers International
ASTM	ASTM International American Society for Testing and Materials International
BICSI	BICSI, Inc.
BOCC	Board of County Commissioners Orange County
COO	City of Orlando
COOBC	City of Orlando Building Code
DMS/DOC	Department of Management Services Division of Communications
DOCA or DCA	State of Florida Department of Community Affairs
EIA/TIA	Electronics Industries Alliance/Telecommunications Industry Association
EJCDC	Engineers Joint Contract Documents Committee American Consulting Engineers Council
FAC	Florida Administrative Code

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FBC	Florida Building Code
FCC	Federal Communications Commission
FFPC	Florida Fire Prevention Code
FLA	State of Florida
FMC	Florida Building Code (Mechanical)
FS	Florida Statutes
ICC	International Code Council
IEEE	Institute of Electrical and Electronics Engineers, Inc
ICPEA	International Power Cable Engineer's Association
LTCR	Local Telephone Company Requirements
NECPA	National Energy Conservation Policy Act
NESC	National Electrical Safety Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UFSRS	Uniform Fire Safety Rules and Standards of Insurance Division of State Fire Marshal
UL	Underwriters Laboratories, Inc.
NEC	National Electrical Code

1.4 REGULATORY REQUIREMENTS

- A. Conform to all the applicable requirements of the following codes, standards, guidelines, etc.. If there should be conflicting requirements between these codes, standards, guidelines, etc., the more or most stringent requirement shall apply that does not violate any codes or laws.
1. Standards and Miscellaneous Codes/Requirements (Comply with latest edition or notice available unless otherwise adopted by Authority Having Jurisdiction):
 - a) Americans with Disabilities Act of 1990, as amended
 - b) ADA Standards for Accessible Design, 2010
 - c) American National Standards Institute
 - d) American Society of Heating, Refrigerating and Air Conditioning Engineers
 - e) American Society of Mechanical Engineers
 - f) American Society for Testing and Materials
 - g) Concrete Reinforcing Steel Institute
 - h) Department of Community Affairs

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- i) Electronics Industries Association/Telecommunications Industry Association
- j) Florida Building Code, 2010
- k) Florida Fire Prevention Code
- l) Institute of Electrical and Electronics Engineers
- m) Local Power Company Requirements
- n) Lightning Protection Institute
- o) Local Telephone Company Requirements
- p) National Electrical Code, 2008
- q) National Energy Conservation Policy Act
- r) National Electrical Safety Code
- s) National Electrical Manufacturers Association
- t) NFPA 1 Fire Code
- u) NFPA 101 Life Safety Code
- v) Occupational Safety and Health Act
- w) Safety Code for Elevators and Escalators
A17.1a, 2008 and A17.1b, 2009 Addenda
- x) Safety Code for Existing Elevators and Escalators
A17.3, 1996
- y) Sheet Metal and Air Conditioning Contractors
- z) Underwriters Laboratories, Inc.
- aa) Applicable Federal, State, Local Codes, Laws and Ordinances, Florida Statutes
and Referenced Codes/Standards

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 16015
ELECTRICAL SYMBOLS AND ABBREVIATIONS

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. Symbols and abbreviations specifically applicable to all Division 16 sections in addition to those in Division 1 - General Requirements and any supplemental requirements/conditions.

1.3 SYMBOLS

- A. In general the symbols used on the drawings conform to the Standard Symbols of the Institute of Electrical and Electronic Engineers with the exception of special systems or agencies as hereinafter noted.
 - Corps of Engineers.
 - Special Symbols as shown in schedules or legends.

1.4 ABBREVIATIONS

- A. The following abbreviations or initials are used.
 - A/C Air Conditioning
 - AFD Adjustable Frequency Drive
 - AC Alternating Current
 - ADD # Addendum #
 - A/E Architect/Engineer (or Engineer when Architect not applicable)
 - AFF Above Finished Floor
 - AFG Above Finished Grade
 - AHU Air Handler Unit
 - AIC Amps Interrupting Capacity
 - AL Aluminum
 - ALT Alternate
 - AMP Ampere
 - ANSI American National Standards Institute
 - AWG American Wire Gauge
 - @ At
 - B.C. Bare Copper
 - BIDS Baggage Information Display System
 - BLDG Building
 - BRKR Breaker
 - BTU British Thermal Unit
 - BTUH BTU Per Hour
 - C Conduit
 - CB Circuit Breaker
 - CBM Certified Ballast Manufacturers
 - CCTV Closed Circuit Television
 - cd Candela
 - CFM Cubic Feet per Minute
 - CH Chiller
 - CKT Circuit
 - CKT BRKR Circuit Breaker

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C/L Center Line
Clg Ceiling
Comp Compressor
Conn Connection
Cond Condenser
Cont Continuous
CRI Color Rendering Index
CT Current Transformer
CU Copper
CU Compressor Condenser Unit
CW Cold Water
DB Direct Burial
DC Direct Current
Disc Disconnect
DN Down
DPST Double Pole Single Throw
DWG Drawing
EC Electrical Contractor (or General Contractor)
ELEV Elevator
EMT Electrical Metallic Tubing
Equip Equipment
EST Estimate
FAAP Fire Alarm Annunciator Panel
FACP Fire Alarm Control Panel
FARP Fire Alarm Remote Panel
FATC Fire Alarm Terminal Cabinet
FCCP Fire Alarm Command Center Panel
FHC Fire Hose Cabinet
FIDS Flight Information Display System
FLA Full Load Amperes
FT Feet
FLR Floor
FC Footcandles
FVNR Full Voltage Non-Reversing
GAL Gallon
Galv Galvanized
GPH Gallons per Hour
GPM Gallons per Minute
GFI Ground Fault Interrupting
GRS Galvanized Rigid Steel Conduit
GND Ground
HTG Heaters
HT Height
Hz Hertz (Cycles)
HPF High Power Factor
HPS High Pressure Sodium
HP Horsepower
HR Hour
HS Heat Strip
ICTC Intercom Termination Cabinet
IMC Intermediate Metallic Conduit
Incand Incandescent
in Inches
JB Junction Box

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kVA KiloVolt Ampere
kW Kilowatts
kWH Kilowatt Hour
K Kelvin
LLD Lamp Lumen Depreciation
LED Light Emitting Diode
LIU Light Interface Unit (Fiber Optic Patch Panel)
LT Light
LTG Lighting
LTS Lights
LPF Low Power Factor
MCB Main Circuit Breaker
MLO Main Lugs Only
Maint Maintenance
MH Manhole; Metal Halide
MFG Manufacturer
max Maximum
MCM/KCMIL Thousand Circular Mils
MPH Miles Per Hour
MM Millimeter
Min Minimum
MCP Motor Circuit Protector
MTD Mounted
N Neutral
NEC National Electrical Code
NEMA National Electrical Manufacturers Association
NFPA National Fire Protection Association
NPT National Pipe Thread
NF Non Fused
NC Normally Closed
NO Normally Open
NIC Not in Contract
No. Number
OB Outlet Box
OD Outside Diameter
OL Overload
OLS Overloads
OS&Y Outside Screw and Yoke (Sprinkler)
% Percent
Ø Phase
P Pole
PL Compact Fluorescent Lamp
PT Potential Transformer
PSF Pounds per Square Foot
PSI Pounds per Square Inch
PB Pullbox
PNL Panel
PR Pair
Pri Primary
PTZ Pan, Tilt, Zoom
PVC Polyvinyl Chloride
Recept Receptacle
RPM Revolutions per Minute
RS Rapid Start

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SCA Short Circuit Amps
Sec Secondary
SHT Sheet
S/N Solid Neutral
SPST Single Pole Single Throw
SF Square Foot
SW Switch
SWBD Switchboard
Sys System
THHN; THWN Nylon Jacketed Wire
TSP Twisted Shielded Pair
TTB Telephone Terminal Board
TTC Telephone Terminal Cabinet
TV Television
TVTC Television Terminal Cabinet
TVEC Television Equip. Cabinet
TYP Typical
Temp. Temperature
UL Underwriters' Laboratories
UTP Unshielded Twisted Pair
VFD Variable Frequency Drive
VHF Very High Frequency
VHO Very High Output
V Volt
VA Volt Amperes
Vol. Volume
VV Video Visitation
W Wire
W.P. Weatherproof
XFMR Transformer
Y Wye
Yd Yard
Yr Year
3R Rainproof
4X Stainless Steel Dusttight, Watertight

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 16060
MINOR ELECTRICAL DEMOLITION FOR REMODELING

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. Section includes the requirements for electrical demolition.
- B. Provide and install all equipment, labor, material, accessories, and mounting hardware for completion of minor electrical demolition for remodeling.

1.3 REFERENCES

- A. NFPA 70 National Electrical Code
- B. Underwriters Laboratories

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 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 field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems for equipment scheduled to be removed.
- B. 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.
- C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. 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. For the full period of time the system is deactivated, a safety fireman's watch is required to be provided to enact a fire watch for areas that experience a loss of fire protection and notification coverage due to the modifications.

3.3 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

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finishes. Cut conduit flush with walls and floors, and patch surfaces.

- D. Repair adjacent construction and finishes damaged during demolition and extension work.
- E. Seal openings in walls, floors, etc. and fire stop in accordance with the accepted UL detail to maintain integrity of assembly.
- F. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate and as required to comply with the requirements of the NEC.
- G. Extend existing installations using materials and methods compatible with existing electrical installations. Extension must meet or exceed the materials/methods specified in the contract documents.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused, including but not limited to:
 - 1. 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.

END OF SECTION

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SECTION 16061
INVESTIGATION OF EXISTING ELECTRICAL SYSTEMS

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. Section includes testing and documentation of existing electrical systems.

1.3 REFERENCES

- A. IEEE Recommended Practices

1.4 DESCRIPTION

- A. Test the essential features of the following existing electrical systems:
 - 1. Alarm and bells.
 - 2. Fire detection devices, smoke detection devices.
- B. Each system shall be tested once only, and after completion of testing, results given to the Owner, Engineer and/or Owner's representative. Point out any non-operational function noticed during testing.
- C. Document the existing conditions and operation of the existing electrical systems prior to any work.
- D. Contractor is responsible for all non-working systems and their components unless non-working status is verified prior to work on system.

1.5 TIME

- A. The testing shall be held at a date to be agreed upon in writing by the Owner or his Representative.

1.6 ATTENDING PARTIES

- A. The testing shall be held in the presence of the Owner, or his Representative and Contractor.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PERFORMANCE VERIFICATION

- A. Test the operation of each of the following existing devices and associated systems:
 - 1. Fire Alarm System:
 - a) Test each heat detector and record location of each tested device and note either operational or non operational.
 - b) Test each duct mounted smoke detector with canned smoke and verify alarm activation, remote pilot light activation and damper operation. Record location of each tested device and note either operational or non operational.
 - c) Upon alarm activation verify that the fire alarm zone lights and audible/visual signals function properly. Verify that the local fire department or responding agency receives an automatic signal.
 - d) Test Fire Alarm System sufficiently to determine existing operating condition of system. Pull the pull stations, check automatic detectors. Test minimum of one

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manual device per zone, and one automatic device per zone.

- e) Upon alarm activation verify that the fire alarm zone lights and audible/visual signals function properly. Verify that the local fire department or responding agency receives an automatic signal.

3.2 INVESTIGATION/TESTING FORMS

- A. Submit Existing Facilities Investigation Form and advise Owner/Engineer of all deficiencies in system(s) prior to work. All systems will be assumed to be fully operational if Form not received by Engineer prior to work on system.
- B. Submit five copies of the Existing Facilities Investigation Form for each device tested, signed by the Contractor, Subcontractor and Owner, and submit each test result to the Owner's Authorized Representative.

Attachments:
Existing Facilities Investigation
Ground Test Information

END OF SECTION

EXISTING FACILITIES INVESTIGATION

PROJECT: _____

The existing systems on the above project have been investigated and checked to determine the existing condition of all existing electrical systems within the area(s) affected by the scope of work of this project. The investigation consisted of testing all electrical systems/devices as required by Section 16061 Investigation of Existing Electrical Systems.

All equipment was found to be operational except as noted herein (list below):

PRIME CONTRACTOR

AUTHORIZED SIGNATURE AND TITLE

DATE _____

OWNER'S AUTHORIZED REPRESENTATIVE

AUTHORIZED SIGNATURE AND TITLE

DATE _____

Note To Contractor: Upon completion of investigation and one week prior to the commencement of work, submit five copies of the completed Existing Facilities Investigation Form to the Owner's Authorized Representative, signed and dated by the Contractor. The Owner's Authorized Representative's signature and date is required to verify receipt of Form. Retain copy(ies) and submit copy of Form in each Operation and Maintenance Manual. Contractor shall submit quantities of Forms as required to present required information.

GROUND TEST INFORMATION

PROJECT NAME _____

GROUND TYPE _____

TEST BY _____

DATE OF TEST _____

GROUND LOCATION: _____

GROUND TYPE (Rod, Water pipe, etc.) _____

PRIOR TO CONNECTION TO SYSTEM

GROUND _____ (OHMS)

AFTER CONNECTION TO SYSTEM

GROUND _____ (OHMS)

WEATHER CONDITIONS (Wet/Dry) _____

SOIL CONDITIONS (Wet/Dry) _____

CONTRACTOR'S REPRESENTATIVE

DATE _____

ENGINEER'S REPRESENTATIVE

DATE _____

OWNER'S REPRESENTATIVE

DATE _____

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SECTION 16090
TESTS AND PERFORMANCE VERIFICATION OF ELECTRICAL SYSTEM

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 pertains to the furnishing of all labor, materials, equipment and services necessary to test and prove performance of the electrical system.
- B. Operate system for a three day period. Do performance verification work as required to show that the system is operating correctly in accordance with design. Supply instruments required to read data. Adjust system to operate at the required performance levels.

PART 2 - PRODUCTS (Not Applicable)

PART 3- EXECUTION

3.1 TESTS

A. System:

1. General: After installation of all conductors and before final acceptance, make required tests to determine proper functioning of all circuits. Furnish all necessary instruments required to make tests and correct any deficiencies found. Prior to energizing, circuits shall be "rung-out" to verify opens, intentional and non-intentional grounds, continuity and detect short circuits by accepted constant megger.
2. Procedure:
 - a) All wires in conduit that are shorted or unintentionally grounded shall be replaced.
 - b) Insulation resistance of all feeder conductors and all conductors AWG #1 and larger shall be tested. This is to include all new conductors and/or all existing conductors that are connected and/or extended. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps, and connections are made, except connection to source and point of final termination at distribution or utilization equipment.
 - c) Insulation resistance of conductors that are to operate at 600 volts or less shall be tested by using AVO Biddle (or accepted equal) megger at not less than 1000 volts dc. Resistance shall be measured from conductor to conduit (ground). Testing methodology shall conform to short-time or spot-reading procedural recommendations of AVO Biddle Instruments for specific megger being used. Acceptable insulation resistance of conductors rated at 600 volts shall not be less than 1 megohm.
 - d) Conductors that do not satisfy test requirements of paragraph c) above, shall be removed, replaced, and testing repeated on new cable at no additional cost to the Owner. All tests shall be performed by licensed electrician trained in the use of test instruments. Contractor shall furnish all instruments and personnel required for tests, shall tabulate readings observed and complete Conductor Insulation Resistance Test form (see Section 16098 Operation and Maintenance Manuals) and submit five copies to Engineer for acceptance. Test shall be witnessed by Owner's Representative and Engineer (if so desired). Final acceptance data is to be submitted in O & M Manual.

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- e) Test reports shall identify each feeder conductor tested, date, time, and result of test, weather conditions and range, test voltage, and serial number of the megger instrument used. Any conductor or splice that is found defective shall be promptly removed and replaced and an additional test shall be performed.
- f) Observe all safety instructions set by testing equipment manufacturer. Application of voltage testing involves risk of electric shock and sparking.

B. Grounds:

- 1. Test each raceway for raceway continuity as called for in Section 16170 Grounding and Bonding.
- 2. Test each grounding system used in the project as called for in Section 16170 Grounding and Bonding.
- 3. Submit Ground Test Information form (see Section 16098 Operation and Maintenance Manuals) for every grounding system in the project, including but not limited to, each ground rod installation; each water pipe and ground installation (test water pipe to ground and test water pipe to building service equipment), and each building steel ground connection (test building steel to ground and test building steel to building service equipment).
- 4. Grounding resistance shall be as called for in Section 16170 Grounding and Bonding.
- 5. Testing shall be 3-point method in accordance with IEEE recommended practice.
- 6. Transformer grounding.

C. Communications:

- 1. See specific sections of these Specifications for further requirements.

D. Equipment Check Out:

- 1. At completion of construction after all performance verification and testing information has been gathered, submitted, and approved, provide one copy of this information to the Authorized Manufacturer's Representative of the equipment.
 - a) Manufacturer's Authorized Representative must be trained by the manufacturer and authorized to inspect, adjust, test, and repair equipment.
- 2. Work required under this section shall include having the representative examine the performance verification information, check the equipment in the field while it is in operation, and sign a Check Out Memo for a record. (See Section 16098 Operation and Maintenance Manuals).
 - a) Check out of equipment is to include examining performance of equipment and certifying equipment has been installed per manufacturer's recommendations, that all necessary adjustments have been performed and that equipment is operating properly.
- 3. Submit one copy (for each O & M Manual) of the memo on each major item of equipment. Accepted memos shall be inserted in each O & M Manual with the performance verification information and submittal data. Memos shall be submitted and accepted before instruction to Owner or a request for final inspection.
- 4. Items requiring Check Out Memos are all major items of equipment such as (but not limited to):
 - a) Panels, distribution panels, switchboards.
 - b) Transformers.

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c) Equipment/systems installed per Sections 16700 thru 16799.

5. Do not submit Check Out Memo form at the time submittal brochures are submitted. This form shall be completed and submitted before Instruction in Operation to Owner or a request for final inspection.

END OF SECTION

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SECTION 16095
DEMONSTRATION OF COMPLETED ELECTRICAL SYSTEMS

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. Section includes the requirements for demonstration of completed electrical systems:

1.3 DESCRIPTION

- A. Demonstrate to Owner the essential features of the following electrical systems:

1. Communications Systems
 - a) Each and every system included in Sections 16700 through 16799.
2. Electrical Entrance Equipment
 - a) Circuit breakers
 - b) Fuses and fuseholders
 - c) Meters (where applicable)
3. Miscellaneous Electrical Equipment
 - a) Electrical power equipment
 - b) Motor control centers
 - c) Motor control devices
 - d) Relays
 - e) Surge suppression equipment
4. Wiring Devices
 - a) Low-voltage controls
 - b) Switches: regular, time

- B. Upon completion of testing, each system is to be demonstrated only once.

1.4 TIME

- A. The demonstration shall be held upon completion of testing of all systems at a date to be agreed upon in writing by the Owner or his representative.

1.5 ATTENDING PARTIES

- A. The demonstration shall be held by this Contractor in the presence of the Owner and the manufacturer's representative.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DEMONSTRATION

- A. Demonstrate the function and location (in the structure) of each system, and indicate its relationship to the riser diagrams and drawings.
- B. Demonstrate by "start-stop operation" how to work the controls, how to reset protective devices, how to replace fuses, and what to do in case of emergency.
- C. Performance Verification and Demonstration to Owner
 1. Submit Check Out Memo form for each item, equipment, and system. Copy to be included in each Operation and Maintenance Manual.

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END OF SECTION

CHECK OUT MEMO

Check Out Memo shall be completed and a copy provided to the Owner at the Owner's Performance Verification and Demonstration Meeting. A copy shall also be included in the specification section of each O & M Manual for the equipment checked.

Project Name _____

Type of Equipment Checked _____

Equipment Number _____

Equipment Manufacturer _____

Signature below by the manufacturer's authorized representative signifies that the equipment has been satisfactorily tested and checked out on the job by the manufacturer.

1. The attached Test and Data and Performance Verification information was used to evaluate the equipment installation and operation.
2. The equipment is properly installed, has been tested by the manufacturer's authorized representative, and is operating satisfactorily in accordance with all requirements, except for items noted below.*
3. Written operating and maintenance information has been presented and reviewed in detail with the Contractor.
4. Sufficient copies of all applicable operating and maintenance information, parts lists, lubrication checklists, and warranties have been furnished to the Contractor for insertion in the Operation and Maintenance Manuals.

CHECKED BY:

MANUFACTURER'S REPRESENTATIVE (print)

ADDRESS

TELEPHONE, FAX, E-MAIL

MANUFACTURER'S REPRESENTATIVE (signature, title)

DATE CHECKED

WITNESSED BY:

CONTRACTOR'S REPRESENTATIVE (signature, title)

***EXCEPTIONS NOTED AT TIME OF CHECK-OUT (USE ADDITIONAL PAGE IF NECESSARY)**

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SECTION 16098
OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 and Division 16 Specification Sections apply to this Section.
- B. The requirements in this section of the specifications are in addition to all requirements in sections referenced above.

1.2 SUMMARY

- A. This section includes the requirements for Operation and Maintenance Manuals (O & M Manuals) specifically applicable to Division 16 Sections, in addition to Division 1 - General Requirements and any supplemental requirements/conditions.

1.3 OPERATION AND MAINTENANCE MANUALS

- A. General: Refer to Section 01770 Closeout Procedures.
- B. O& M Manuals shall consist of a minimum of one (or if required) two hard cover view type 3-ring binder(s) sized to hold 8 1/2" x 11" sheets; one (1) for ELECTRICAL OPERATION AND MAINTENANCE (Power and Lighting) (black); one (1) for SYSTEMS OPERATION AND MAINTENANCE (Sections 16700 thru 16799) (blue). Where SYSTEMS OPERATION AND MAINTENANCE (Sections 16700 thru 16799) is not applicable, only one (1) binder is required. Refer to Division 1, general requirements for additional requirements.
 1. Each binder is to be adequately sized to comfortably hold required submittals. Minimum spline size to be 1", maximum spline size to be 3". Provide additional binders if 3" size is not sufficient to properly hold submittals.
 2. Binder cover and spline to have outer clear vinyl pockets. Provide correct designation of project in each pocket; see Binder Examples for O & M's Section 01770 Closeout Procedures at the end of this Section. Description sheet is to be white with black letters, minimum of 11" high and full width of pocket. Description is to describe project and match project drawing/project manual description. Description to include submittal type, i.e. ELECTRICAL OPERATION AND MAINTENANCE for Power and Lighting, (and if required) SYSTEMS OPERATION AND MAINTENANCE for Sections 16700 - 16799.
- C. O & M Data:
 1. Manufacturer's operation and maintenance data is required for all items as called for in the specifications. O & M Manuals shall include manufacturer's name, model number(s), characteristics, manufacturer's agent, service agent, supplier, where and/or what item(s) are used for and description (i.e. surge suppression - switchboard MDPA).
 2. Include troubleshooting instructions, list of special tools required, theory of operation, manufacturer's care and cleaning, preventative maintenance instructions, wiring diagrams, and point-to-point schematics.
- D. O & M Manuals to include:
 1. Completed forms and information per Division 1, General Requirements, and this section of the specifications.
 - a) Table of Contents
 - b) Project Addresses
 - c) Reinforced Separation Sheets tabbed with the appropriate specification reference number and typed index for each Section in the Systems Schedule
 - d) Check Out Memo
 - e) Conductor Insulation Resistance Test Memo

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- f) DC High Voltage Cable Test Report
 - g) Ground Test Information
 - h) Motor Test Information
 - i) Voltage and Amperage Readings Tabulated Data.
 - j) Progress and Record Drawing Certification
 - k) Spare Parts Certification Memo
2. Shop Drawings: Shop drawings shall be a copy of the final and accepted shop drawing submitted as required in Section 16012 "Submittals". These shall be inserted in binder in proper order.
 3. Product Data: Product data and/or Catalog sheets shall be a copy of the final and accepted submittal submitted as required in Section 16012 "Submittals". These shall be inserted in binder in proper order.
 4. Warranty/Guarantee: Provide copy of warranty/guarantee in respective location in O & M binder, (Power and Lighting) (Systems). Original warranty/guarantee is to be incorporated into separate project warranty book with warranty/guarantees provided for other sections and divisions of the specifications and submitted for Architectural/Owner acceptance.
 5. Copies of electrical panel schedules and electrical panel directories included with the corresponding specification section
 6. Wiring diagrams, schematic, etc. inserted in proper order, for:
 - a) Control devices, motor controls.
 - b) Each and every part of the Systems sections of these Specifications, 16700 thru 16799.
 7. For Section 16100 thru 16199:
 - a) Product data and/or catalog sheets on all equipment applicable to this project.
 - b) Equipment supplier list for each section's equipment.
 - c) Grounding; in addition to above provide:
 1. Test results on each ground rod.
 2. Ground Test Information Form
 8. Sections 16400 thru 16499:
 - a) Product data and/or catalog sheets on equipment applicable to this project.
 - b) Equipment supplier list for each sections equipment.
 - c) Overcurrent protective devices; in addition to above provide the following for large circuit breakers:
 1. Parts list.
 2. Operation and maintenance requirements.
 3. Wiring diagrams.
 4. Testing data.
 5. Installation/removal instructions.
 6. Check-Out Memo Form
 9. Section 16600:
 - a) Product data and/or catalog sheets on all equipment applicable to this project.
 - b) Equipment supplier list for each sections equipment.
 - c) Surge Suppression:
 1. Product data and/or catalog sheets on equipment applicable to this project.
 2. Parts list.
 3. Recommended testing and replacement procedures.
 10. Sections 16700 thru 16799
 - a) Installer's name, address, phone, etc. for each system.
 - b) Authorized representatives name, address, phone, etc. for each system.
 - c) Equipment supplier's name, address, phone, etc. for each system.
 - d) Surge Suppression.
 1. Product data and/or catalog sheets on equipment applicable to this project.

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2. Parts list.
3. Recommended testing and replacement procedures.
- e) Fire Alarm, Sound/Paging, Television, Security, Closed Circuit systems.
 1. Product data and/or catalog sheets on equipment applicable to this project.
 2. Parts list.
 3. Installation/removal instructions.
 4. Wiring diagrams of panels.
 5. Point-to-point wiring diagrams of system.
 6. Operation and maintenance requirements.
 7. Shop drawing as submitted and accepted in submittal process.
 8. Check-Out Memo Form

1.4 PROCESSING SUBMITTALS

- A. Submit a minimum of three (3) sets of O & M Manuals, two (2) sets for Owner, one (1) set for Engineer.
- B. The Contractor shall review the manuals before submitting to the A/E. No request for payment will be considered until the brochure has been reviewed and submitted for acceptance.
- C. Provide additional copies if additional copies are required in other Divisions and/or sections of these specifications.

1.5 DELAYS

- A. Contractor is responsible for delays in job project accruing directly or indirectly from late submissions or resubmissions of shop drawings, or product data.

1.6 RESUBMITTALS

- A. The A/E shall be reimbursed cost to review re-submittals subsequent to the second submittal.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

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PROJECT ADDRESSES

OWNER:

ARCHITECT:

CONSULTING ENGINEER:

Matern Professional Engineering, Inc.
130 Candace Drive
Maitland, Florida 32751
Telephone No.: (407) 740-5020
Fax No.: (407) 740-0365

GENERAL CONTRACTOR:

SUBCONTRACTOR:

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CHECK OUT MEMO FORM

This form shall be completed and a copy provided to the Owner at the Owner's Performance Verification and Demonstration meeting. A copy shall also be included in the specification section of each O & M Manual for the equipment checked.

Project Name:

Type of equipment checked:

Equipment Number:

Name of manufacturer of equipment:

Signature below by the manufacturer's authorized representative signifies that the equipment has been satisfactorily tested and checked out on the job by the manufacturer.

1. The attached Test and Data and Performance Verification information was used to evaluate the equipment installation and operation.
2. The equipment is properly installed, has been tested by the manufacturer's authorized representative, and is operating satisfactorily in accordance with all requirements, except for items noted below.*
3. Written operating and maintenance information has been presented to the Contractor, and gone over with him in detail.
4. Sufficient copies of all applicable operating and maintenance information, parts lists, lubrication checklists, and warranties have been furnished to the Contractor for insertion in the Operation and Maintenance Manuals.

Checked By: (Print or Type Name of Manufacturer's Representative)

(Address and Phone No. of Representative)

(Signature and Title of Representative)

(Date Checked)

Witnessed By: Signature and Title of Contractor Rep.)

*Exceptions Noted At Time Of Check-Out (use additional page if necessary)

CONDUCTOR INSULATION RESISTANCE TEST MEMO

PROJECT NAME: _____

CONDUCTOR FROM _____ TO

SIZE

INSULATION TYPE

INSULATION VOLTAGE RATING

DATE _____ TIME

WEATHER CONDITIONS

TEST VOLTAGE (DC)

RANGE

MEGGER INSTRUMENT/SERIAL NUMBER

TESTING METHODOLOGY

INSULATION RESISTANCE MEASUREMENT (ACCEPTABLE MEASUREMENT NOT TO BE LESS THAN (1) MEGOHM):

PHASE A TO GROUND _____

PHASE B TO GROUND _____

PHASE C TO GROUND _____

NEUTRAL TO GROUND _____

ISOLATED GROUND TO GROUND _____

CONTRACTOR'S REPRESENTATIVE:

DATE:

OWNER'S REPRESENTATIVE:

DATE:

ENGINEER'S REPRESENTATIVE:

DATE:

DC HIGH VOLTAGE CABLE TEST REPORT

Project Name: _____

Location: _____

Description: _____

Rated Voltage: _____

TEST DATA

Set Leakage @ Test Voltage _____ ma Variac _____

Pri. Voltage _____

Sphere Gap _____ Inches

Duct Temp. _____ Ambient Temp. _____ Weather _____

Cable Status _____ 1 hour prior to test

Phase or Conductor	<u>A</u>	<u>B</u>	<u>C</u>	Remarks
Starting Time	<u>MA</u>	<u>MA</u>	<u>MA</u>	

- 0
- 15 sec.
- 30 sec.
- 45 sec.
- 1 min.
- 2 min.
- 3 min.
- 4 min.
- 5 min.

Final Test Voltage _____

Time Finish: _____

KV DC after 1 min.

Test Procedure _____ No. of Terminals _____

Joints _____

Witnessed by: _____ Performed by: _____

GROUND TEST INFORMATION

PROJECT NAME: _____

GROUND TYPE: _____

TEST BY: _____

DATE OF TEST: _____

GROUND LOCATION: _____

GROUND TYPE (Rod, Water pipe, etc.):

PRIOR TO CONNECTION TO SYSTEM

GROUND: _____ (OHMS)

AFTER CONNECTION TO SYSTEM

GROUND: _____ (OHMS)

WEATHER CONDITIONS (Wet/Dry):

SOIL CONDITIONS (Wet/Dry):

CONTRACTOR'S REPRESENTATIVE:

DATE:

ENGINEER'S REPRESENTATIVE:

DATE:

OWNER'S REPRESENTATIVE:

DATE:

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MOTOR TEST INFORMATION

PROJECT NAME:
DESCRIPTION OF MOTOR:
NAME OF CHECKER:
DATE CHECKED:

(a) Name and identifying mark of motor (indicate at existing)

(b) Manufacturer

(c) Model Number

(d) Serial Number

(e) RPM

(f) Frame Size

(g) Code Letter

(h) Horsepower

(i) Nameplate Voltage and Phase

(j) Nameplate Amps

(k) Actual Voltage

(l) Actual Amps

(m) Starter Manufacturer

(n) Starter Size

(o) Heater Size, Catalog No. and Amp Rating

(p) Manufacturer of dual-element fuse

(q) Amp rating of fuse

(r) Power Factor

CONTRACTOR'S REPRESENTATIVE:

DATE:

SIGNATURE OF CHECKER:

DATE:

OWNER'S AUTHORIZED REPRESENTATIVE:

PROGRESS AND RECORD DRAWING CERTIFICATION

NAME OF PROJECT:

DIVISION NUMBER AND NAME:

This is to certify that the attached marked-up design prints were marked as the items were installed at the site during construction, and that these prints represent as accurate "As-Builts" record of the work as actually installed. One copy will be turned over to the Owner at the instruction in Operation Conference. The duplicate copy is for the Engineer's files.

Name Of General Contractor

BY: Authorized Signature And Title

Date

Name Of Subcontractor

BY: Authorized Signature And Title

Date

SPARE PARTS CERTIFICATION MEMO

This form shall be completed and a copy provided to the Owner at the Owner's Performance Verification and Demonstration meeting. A copy shall also be included in the specification section of each O & M Manual for the equipment checked.

Project Name:

Type of Spare Parts:

Specification Reference:

Quantity of Spare Parts:

Signature below by the contractor signifies that the spare parts required by the drawings and/or specifications have been turned over to the Owner.

(Name of General Contractor)

(Signature, Title, Date)

(Name of Subcontractor)

(Signature, Title, Date)

(Name of Owner)

(Signature, Title, Date)

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VOLTAGE AND AMPERAGE READINGS (TABULATED DATA)

PROJECT NAME: _____
SWITCHGEAR/PANELBOARD

FULL LOAD AMPERAGE READINGS:

DATE _____
TIME _____

PHASE A. _____
B. _____
C. _____
N. _____
GROUND _____

FULL LOAD VOLTAGE READINGS:

DATE
TIME

PHASE A TO N _____ A TO B
B TO N _____ A TO C
C TO N _____ B TO C

VOLTAGE AT THE END OF THE LONGEST BRANCH

TYPE OF LOAD

NO LOAD VOLTAGE READINGS:

DATE
TIME

PHASE A TO N _____ A TO B
B TO N _____ A TO C
C TO N _____ B TO C

_____ ENGINEERS REPRESENTATIVE
_____ OWNER'S AUTHORIZED REPRESENTATIVE
_____ CONTRACTORS REPRESENTATIVE
_____ DATE

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BINDER EXAMPLES FOR SUBMITTALS
Insert In Vinyl Pockets (Front & Spline) 3-Ring Binder

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HVAC RENOVATIONS

MPE NO. 2013-171

ELECTRICAL OPERATION AND
MAINTENANCE BROCHURE

(Size To 8-1/2" x 11")

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HVAC RENOVATIONS

MPE NO. 2013-171

SYSTEMS OPERATION AND MAINTENANCE
BROCHURE

(Size To 8-1/2" x 11")

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WAREHOUSE
HVAC
RENOVATIONS

MPE NO.2013-171

ELECTRICAL
OPERATION AND
MAINTENANCE
BROCHURE

(Size To 11")

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WAREHOUSE
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MPE NO.2013-171

SYSTEMS
OPERATION AND
MAINTENANCE
BROCHURE

(Size To 11")

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SECTION 16111
CONDUIT

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. Section includes requirements for electrical conduit.
- B. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:
 - 1. Rigid Metal Conduit (RMC) NEC 344
 - 2. Intermediate Metal Conduit (IMC) NEC 342
 - 3. Flexible Metal Conduit (FMC) NEC 348
 - 4. Liquidtight Flexible Metal Conduit (LFMC) NEC 350
 - 5. Electrical Metallic Tubing (EMT) NEC 358
 - 6. Fittings and Conduit Bodies

1.3 REFERENCES

- A. ANSI C80.1 Electrical Rigid Steel Conduit, Zinc Coated
- B. ANSI C80.3 Steel Electrical Metallic Tubing, Zinc Coated
- C. ANSI/NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- D. ANSI/NFPA 70 National Electrical Code
- E. NECA Standard Practice of Good Workmanship in Electrical Contracting
- F. NEMA RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
- G. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Conduit (EPC 40, EPC 80)
- H. NEMA TC 3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

1.5 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70. (See Drawings and this and other sections of these Specifications for additional requirements).
- B. Raceways and conduits shall begin at an acceptable enclosure and terminate only in another such enclosure except conduit/raceway stub-outs.
- C. A raceway shall be provided for all electrical power and lighting, and electrical systems unless specifically specified otherwise.

1.6 SUBMITTALS

- A. Submit catalog cut sheet showing brand of conduit to be used and showing that conduit is UL listed and labeled, and manufactured in the United States.
- B. Submit catalog cut sheet on all types of conduit bodies and fittings.
- C. Product data shall be submitted for acceptance on:

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1. Conduits.
 2. Conduit straps, hangers and fittings.
 3. Fitting entering and leaving the ground or pavement.
- D. Submit UL listed fire and smoke stopping assemblies for each applicable application.
- E. Product data shall prove compliance with Specifications, National Electrical Code, National Board of Fire Underwriters, manufacturers' specifications and written installation data.
- 1.7 PROJECT RECORD DOCUMENTS
- A. Submit record documents to accurately record actual routing of conduits larger than 1.25".
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, properly store and protect products at the site.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from sun, rain, corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.
- 1.9 PROJECT CONDITIONS
- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All conduits shall bear UL label or seal and shall be manufactured in the United States.
- B. Conduit systems and all related fittings, boxes, supports, and hangers must meet all the requirements of national, state, local and other federal codes where applicable.

2.2 MINIMUM TRADE SIZE

- A. Homeruns: 3/4" C.
- B. Underground Branches: 3/4".
- C. Aboveground Branches: 1/2".
- D. Flexible and seal-tite metallic conduit 3/4" (maximum 6' long).

2.3 RIGID METAL CONDUIT

- A. Comply with:
1. ANSI C80.1.
 2. UL 6.
 3. NEC 344.
- B. Conduit material:
1. Zinc coated or hot dipped galvanized steel.
- C. Fittings:
1. Threaded.
 2. Insulated bushings shall be used on all rigid steel conduits terminating in panels, boxes, wire gutters, or cabinets, and shall be impact resistant plastic molded in an irregular shape at the top to provide smooth insulating surface at top and inner edge. Material in these

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bushings must not melt or support flame.

3. Zinc plated or hot dipped galvanized malleable iron or steel.

D. Conduit Bodies:

1. Comply with ANSI/NEMA FB 1.
2. Threaded hubs.
3. Zinc plated or hot-dipped galvanized malleable iron.

2.4 INTERMEDIATE METAL CONDUIT

A. Comply with:

1. UL Standard 1242.
2. NEC 342.

B. Conduit material: Zinc coated steel.

C. Fittings:

1. Threaded.
2. Zinc plated malleable iron.
3. Insulated bushings on terminations.

D. Conduit bodies:

1. Comply with ANSI/NEMA FB 1.
2. Threaded hubs.
3. Zinc plated or hot-dipped galvanized malleable iron.

2.5 RIGID METAL CONDUIT PVC COATED

A. Comply with:

1. UL 6.
2. ANSI C80.1.
3. NEC 344.
4. NEMA RN1.

B. Conduit material: Hot-dipped galvanized rigid steel with external PVC coating, 40 mil thick.

C. Fittings:

1. Threaded.
2. Insulated bushings on terminations.
3. Zinc plated or hot-dipped galvanized malleable iron or steel with external PVC coating, 40 mil thick.

D. Conduit bodies:

1. Comply with:
 - a) ANSI/NEMA FB 1.
 - b) Threaded hubs.
2. Zinc plated or hot-dipped galvanized malleable iron with external PVC coating 40 mil thick.

2.6 FLEXIBLE METAL CONDUIT

A. Comply with:

1. NEC 348.
2. ANSI/UL 1.

B. Conduit material: Steel, interlocked.

C. Fittings:

1. ANSI/NEMA FB 1.
2. ANSI/UL 514B.
3. Malleable iron, zinc plated.
4. Threaded rigid and IMC conduit to flexible conduit coupling.

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5. Direct flexible conduit bearing set screw type not acceptable.

2.7 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Comply with:
 1. NEC 350.
 2. ANSI/UL 360.
- B. Conduit material:
 1. Flexible hot-dipped galvanized steel core, interlocked.
 2. Continuous copper ground built into core up to 1-1/4" size.
 3. Extruded polyvinyl gray jacket.
- C. Fittings:
 1. Threaded for IMC/rigid conduit connections.
 2. Accepted for hazardous locations where so installed.
 3. Provide sealing washer in wet/damp locations.
 4. Compression type.
 5. ANSI/NEMA FB 1.
 6. ANSI/UL 514B.
 7. Zinc plated malleable iron or steel.

2.8 ELECTRICAL METALLIC TUBING

- A. Comply with:
 1. UL 797.
 2. ANSI C80.3.
 3. NEC 358.
 4. ANSI/UL797.
- B. Conduit material: Galvanized steel tubing.
- C. Fittings:
 1. ANSI/NEMA FB 1.
 2. Set screw.
 3. Zinc plated malleable iron or steel.
 4. Concrete tight.
 5. T&B Series 5031/5030.

2.9 RIGID POLYVINYL CHLORIDE CONDUIT (Not applicable)

2.10 EXPANSION FITTINGS

- A. Expansion fittings shall be:
 1. UL listed, hot dipped galvanized inside and outside providing a 4" expansion chamber when used with rigid conduit, intermediate metal conduit and electrical metallic conduit, or:
 2. Be polyvinyl chloride and shall meet the requirements of and as specified elsewhere for non-metallic conduit and shall provide a 6" expansion chamber.
 3. Hot dipped galvanized expansion fitting shall be provided with an external braided grounding and bonding jumper with accepted clamps, UL listed for the application.
 4. Expansion fitting, UL listed for the application and in compliance with the National Electrical Code without the necessity of an external bonding jumper may be considered. Submit fitting with manufacturer's data and UL listing for acceptance prior to installation.

PART 3 - EXECUTION

3.1 LOCATION REQUIREMENTS

- A. In Slab Above or on Grade:
 1. Use coated rigid steel conduit, coated intermediate metal conduit (if accepted) or rigid non-metallic conduit.

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2. Coating of metallic conduit to be black asphaltic or PVC.
- B. Penetration of Slab:
1. Exposed Location:
 - a) Where penetrating a floor in an exposed location from underground or in slab, a black mastic coated or PVC coated galvanized rigid steel conduit shall be used.
 2. Concealed Location:
 - a) Where penetrating a floor in a location concealed in block wall and acceptable by applicable codes, rigid non-metallic conduit may be used up to first outlet box, provided outlet box is at a maximum height of 48" above finished floor.
 - b) Where penetrating a floor in location other than that above use a black mastic coated or PVC coated galvanized rigid steel conduit.
- C. Interior Dry Locations:
1. Concealed: Use rigid metal conduit, intermediate metal conduit, electrical metallic tubing. Rigid non-metallic conduit may be used inside block walls up to first outlet to a maximum of 40" AFF except where prohibited by the NEC (places of assembly, etc.).
 2. Exposed: Use rigid metal conduit or intermediate metal conduit, electrical metallic tubing. EMT may only be used where not subject to damage, which is interpreted by this specification to be above 90" AFF.
 3. Concealed or exposed flexible conduit:
 - a) Concealed flexible steel conduit or seal tight flexible steel conduit in lengths not longer than 6' in length with a ground conductor installed in the conduit or an equipment ground conductor firmly attached to the terminating fitting at the extreme end of the flex. Exposed flexible steel conduit or seal tight flexible steel conduit shall not exceed 2' in length, unless written authorization by A/E for specific conditions is granted.
- D. Interior Wet and Damp Locations:
1. Use rigid galvanized steel or intermediate metal conduit.
- E. Concrete Columns or Poured in-place Concrete Wall Locations:
1. Use rigid non-metallic conduit. Penetration shall be by accepted metal raceway (i.e. metal conduit as required elsewhere in these specifications).
- F. Locations Near 400 Hz Distribution Systems:
1. Metal ferrous conduit or support equipment is not to be installed within 6" of any 400 Hz distribution system conduit or wire. Increase distance if so required by 400 Hz system manufacturer.

3.2 ADDITIONAL REQUIREMENTS FOR RIGID STEEL CONDUIT

- A. Rigid steel conduit shall be cut and threaded with tools accepted for the purpose and by qualified personnel.
1. Accepted pipe vise.
 2. Roller/bade type cutter or band saw.
 3. Reamer capable of completely removing all ridges or burrs left by the cutter. Reaming with pliers is not acceptable.
- B. Hangers shall be installed 8' apart.
- C. Conduits stubbed through floor slabs, above grade and not contained inside walls, shall be rigid galvanized metallic conduit.

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3.3 ADDITIONAL REQUIREMENTS FOR EMT

- A. Electrical metallic tubing (thin wall) may be installed inside buildings above ground floor where not subject to mechanical injury.
- B. All cuts shall be reamed smooth and free of sharp and abrasive areas by use of an accepted reamer.

3.4 ADDITIONAL REQUIREMENTS FOR FLEXIBLE STEEL CONDUIT AND SEAL-TITE FLEXIBLE STEEL CONDUIT

- A. Shall be properly grounded.
- B. Shall be installed with accepted fittings.

3.5 SUPPORTS

- A. Arrange supports to prevent misalignment during wiring installation.
- B. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- C. Group related conduits; support using conduit rack. Construct rack using steel channel; (minimum 24" increase distance as required) provide space on each for 25 percent additional conduits.
- D. Fasten conduit supports to building structure and surfaces under provisions of Section 16190 Hangers and Supports.
- E. Do not support conduit with wire, metal banding material, or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach conduit to ceiling support wires.
- G. Conduits shall not be supported from ceiling grid supports, plumbing pipes, duct systems, heating or air conditioning pipes, or other building systems.
- H. Non-bolted conduit clamps, as manufactured Caddy Corp. are not accepted. Supporting conduit and boxes with wire is not accepted. All raceways except those from surface-mounted switches, outlet boxes or panels shall be supported with clamp fasteners with toggle bolt on hollow walls, and with lead expansion shields on masonry.

3.6 EXPANSION FITTINGS

- A. Provide expansion fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
- B. Expansion fittings shall be installed in the following cases: In each conduit run wherever it crosses an expansion joint in the concrete structure; on one side of joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion equal to at least three times the normal width of joints; in each conduit run which mechanically attached to separate structures to relieve strain caused by shift on one structure in relation to the other; in straight conduit run above ground which is more than 100' long and interval between expansion fittings in such runs shall not be greater than 100'.

3.7 GROUNDING

- A. All raceways shall have a copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC codes.
- B. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on Drawings.
- C. Grounding conductors run with exterior/ underground feeders shall be bare only.

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- D. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by accepted ground bushings.
- E. See other sections of these specifications for additional requirements.
- F. Grounding conductors (including lightning protection down conductors) run in metal conduit shall be bonded to metal conduit at both ends.

3.8 FIRE AND SMOKE STOPPING

- A. Contractor is to provide fire stopping and/or smoke stopping for all penetrations of existing (or new if applicable) fire or smoke barrier walls, chases, floors, etc. as required to maintain existing rating of floor, wall, chase, etc.
- B. Install conduit to preserve fire resistance rating of partitions and other elements.
- C. Install fireproofing material to maintain existing rating of floor, beams, etc. damaged or removed by renovation.
- D. Fire and smoke stopping material: A two-part silicone foam or a one-part putty, UL classified and FM accepted with flame spread of 0 and smoke development not to exceed 50 in accordance with ASTM E84. Material shall be suitable for penetration seals through fire-rated floors and walls when tested in accord with ASTM E119. Material shall not melt or soften at high temperatures, shall be suitable for direct outdoor and ultraviolet exposures, shall cure to give a tight compression fit, and shall not produce toxic fumes. Material, when heated, shall expand to fill and hold penetration closed where burn out of cable insulation or ATC tubing occurs.

3.9 VERTICAL RACEWAYS

- A. Cables in vertical raceways shall be supported per NEC 300-19. Provide and install supporting devices for cables, including any necessary accessible pullbox as required regardless if shown on Drawings or not. Provide and install access panels as required. Coordinate location of pull box and access panel with architect prior to installation. This includes empty raceways for future use.

3.10 GENERAL

- A. Install conduit in accordance with NECA Standard Practice of Good Workmanship in Electrical Contracting. Contractor shall layout all work prior to rough-in.
- B. Install nonmetallic conduit in accordance with manufacturer's instructions.
- C. Arrange conduit to maintain headroom and present neat appearance.
- D. Route conduit installed above accessible ceilings or exposed to view parallel or perpendicular to walls. Do not run from point to point.
- E. Route conduit in and under slab from point-to-point.
- F. Do not cross conduits in slab.
- G. Maintain adequate clearance between conduit and piping.
- H. Maintain 12" clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- I. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- J. Bring conduit to shoulder of fittings; fasten securely.
- K. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- L. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal

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conduit larger than 2" size.

- M. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- N. Provide and install pullboxes, junction boxes, fire barrier at fire rated walls etc., as required by NEC 300, whether shown on Drawings or not.
- O. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- P. Grounding and bonding of conduit under provisions of Section 16170 Grounding and Bonding .
- Q. Identify conduit under provisions of Section 16195 Identification for Electrical Systems.
- R. Install all conduits concealed from view unless specifically shown otherwise on Drawings
- S. Rigid steel box connections shall be made with double locknuts and bushings.
- T. All raceways shall be kept clear of plumbing fixtures to facilitate future repair or replacement of said fixtures without disturbing wiring. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.
- U. All raceway runs in masonry shall be installed at the same time as the masonry so that no face cutting is required, except to accommodate boxes.
- V. All raceways shall be run from outlet to outlet as shown on the Drawings, unless permission is granted to alter arrangement shown. If permission is granted arrangement shall be marked on field set of Drawings as previously specified.
- W. Spare conduit stubs shall be capped and location and use marked with concrete marker set flush with finish grade. Marker shall be 6" round x 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.
- X. All conduit stubbed above floor shall be strapped to Kindorf channel supported by conduit driven into ground or tied to steel. Spare conduit stubs shall be capped with a UL listed and accepted cap or plug for the specific intended use and identified with ink markers as to source and labeled "Spare."
- Y. All connections to motors or other vibrating equipment including dry type transformers or at other locations where required shall be made with not less than 12" of flexible steel conduit. Use angle connectors wherever necessary to relieve angle strain on flex conduit.
- Z. All connections to motors or other vibrating equipment including transformers or at other locations where required shall be made with not less than 12" of flexible liquid-tight steel conduit, with nylon insulated throat connectors and wire mesh grip fittings (manufactured by Thomas & Betts or accepted equal) at both terminations of conduit. Use angle connectors wherever necessary to relieve angle strain on flex conduit.
- AA. Provide conduit seal-offs wherever conduit crosses obvious temperature changes (i.e. from inside to outside of coolers, freezers, etc.).
- BB. Route conduit through roof openings for piping and ductwork or through suitable roof flashing or boot. Coordinate location with roofing installation specified under other sections of these Specifications.
- CC. All raceways shall be run in neat and workmanlike manner and shall be properly in accordance with latest edition of NEC with accepted conduit clamps, hanger rods and structural fasteners.
- DD. All raceway runs, whether terminated in boxes or not, shall be capped during the course of construction and until wires are pulled in, and covers are in place. No conductors shall be pulled into raceways until construction work which might damage the raceways has been completed.
- EE. Electrical raceways shall be supported independently of all other systems and supports, and shall in every case avoid proximity to other systems which might cause confusion with such systems or

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might provide a chance of electrolytic actions, contact with live parts or excessive induced heat.

END OF SECTION

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SECTION 16123
BUILDING WIRE AND CABLE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for provision and installation of building wire and cable.
- B. Provide all equipment, labor, material, accessories, and mounting hardware to properly install all conductors and cables rated 600 volts and less for a complete and operating system for the following:
 - 1. Building wire and cable.
 - 2. Wiring connectors and connections.
- C. No aluminum wiring shall be permitted.
- D. All sizes shall be given in American Wire Gauge (AWG) or in thousand circular mils (MCM/kcmil).

1.3 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code
- B. NEC 330
- C. UL 486A-486B

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

1.5 SUBMITTALS

- A. Product Data: Submit catalog cut sheet showing, type and UL listing of each type of conductor, connector and termination.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.7 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.8 COORDINATION

- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

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PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts (No exceptions).
- D. Insulation: ANSI/NFPA 70, Type THHN/THWN and XHHW.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Conductors #10 AWG or #12 AWG shall be 600 volt type THWN/THHN unless noted otherwise, rated 90 degrees C. dry, 75 degrees C wet.
- C. Conductors #8 AWG and larger shall be Type THWN-2/THHN unless noted otherwise, rated 90 degrees C, wet or dry.
- D. Use solid conductor for feeders and branch circuits 10 AWG and smaller (except for control circuits).
- E. Use conductor no smaller than 12 AWG for power and lighting circuits.
- F. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- G. All conductors shall be installed in raceway.
- H. Conductor sizes indicated on circuit homeruns or in schedules shall be installed over the entire length of the circuit, unless noted otherwise on the Drawings or in these Specifications.
- I. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).
- J. Coordinate all wire sizes with lug sizes on equipment, devices, etc. Provide/install lugs as required to match wire size.
- K. Where oversized conductors are called for (due to voltage drop, etc.) provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.

3.2 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire has been completed.

3.3 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.4 WIRING METHODS

- A. Use only building wire type (THHN/THWN for #10 and #12 and THHN/THWN-2 for #8 and larger) insulation in raceway unless noted otherwise.
- B. Wiring in vicinity of heat producing equipment; use only XHHW insulation in raceway.
- C. Conductors installed within fluorescent fixture channels shall be Type THHN or XHHW rated 90 degrees C dry. Conductors for all other light fixtures shall have temperature ratings as required to meet the UL listing of the fixture; however, in no case shall the temperature rating be less

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than 90 degrees C. Remove incorrect insulation types in new work.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16195 Identification for Electrical Systems.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.
- C. Identify neutrals with its associated circuit number(s).

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of the General Requirements of the Contract Documents and Section 16090 Tests and Performance Verification of Electrical System.
- B. Inspect wire for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.

3.7 VERTICAL RISERS

- A. Provide vertical cable riser supports per NEC 300. 19. Cable supports shall be O-Z/Gedney Type "S" or equal. These shall be located in accessible pullboxes of adequate size. Provide for adequate structural connection of cable supports to pullbox, which will transfer cable weight to building.

3.8 PULLING

- A. No wire shall be pulled until the conduit system is complete from pull point to pull point and major equipment terminating conduits have been fixed in position.
- B. Mechanical pulling devices shall not be used on conductors sized #8 and smaller. Pulling means which might damage the raceway shall not be used.
- C. Use only powdered soapstone or other pulling lubricant acceptable to the A/E. Compound or lubricant shall not cause the conductor or insulation to deteriorate.
- D. All conductors to be installed in a common raceway shall be pulled together. The manufacturer's recommended pulling tensions shall not be exceeded.
- E. Bending radius of insulated wire or cable shall not be less than the minimum recommended by the manufacturer.
- F. Where communications type conductors are installed, special requirements shall apply as outlined under that specific system detail specifications.

3.9 CONTROL AND SIGNAL CIRCUITS

- A. For control and signal circuits above 50 VAC, conductors shall be #14 AWG minimum size Type XHHW or THWN-THHN as permitted by NFPA 70 within voltage drop limits, increased to #12 AWG as necessary for proper operation.
- B. For control and signal circuits 50 VAC and below, conductors, at the Contractor's option, may be #16 AWG, 300 volt rated, PVC insulated, except where specifically noted otherwise in the Contract Documents.
- C. Conductor insulation for fire alarm systems shall be as accepted by Code Inspection Authority only. Wire acceptance by the A/E shall not supersede this final acceptance for conditions of this specific project.
- D. Install circuit conductors in conduit.

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- E. Circuit conductors to be stranded.

3.10 COLOR CODING

- A. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape or paint in all junction boxes and panels. Tape or paint shall completely cover the full length of conductor insulation within the box or panel.
- B. Unless otherwise accepted or required by A/E to match existing, color-code shall be as follows:
Neutrals: 120/208V system white; 277/480V system natural gray
Ground Wire: green, bare
Isolated Ground Wire: green with yellow stripes
120/208V: Phase A black, Phase B red, Phase C blue
277/480V: Phase A brown, Phase B orange, Phase C yellow
- C. All switchlegs, other voltage system wiring, control and interlock wiring, shall be color-coded other than those noted above.

3.11 TAPS/SPLICES/CONNECTORS/TERMINATIONS

- A. Clean conductor surfaces before installing lugs and connectors.
- B. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- C. Power conductors shall be continuous and unspliced where located within conduit. Splices shall occur within troughs, wireways, outlet boxes, or equipment enclosures where sufficient additional room is provided for all splices. No splices shall be made in in-ground pull boxes (without written acceptance of engineer).
- D. Splices in lighting and power outlet boxes, wireway, and troughs shall be kept to a minimum. Pull conductors through to equipment, terminal cabinets, and devices.
- E. No splices shall be made in junction box or outlet boxes (wire No. 8 and larger) without written acceptance of Engineer.
- F. No splices shall be made in communications outlet boxes, pull boxes or wireways (i.e., fire alarm, computer, telephone, intercom, sound system, etc.) without written acceptance of Engineer. Pull cables through to equipment cabinets, terminal cabinets and devices.
- G. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. All termination of conductors in which conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall include the Contractor to provide sleeve type vertical cable supports in vertical raceway installations provided in pullboxes at proper vertical spacings.
- H. A calibrated torque wrench shall be used for all bolt tightening.
- I. Interior Locations:
 - 1. All (non-electronic systems) copper taps and splices in No. 8 or smaller shall be fastened together by means of "spring type" connectors. All taps and splices in wire larger than No. 8 shall be made with compression type connectors and taped to provide insulation equal to wire.
- J. Exterior Locations:
 - 1. Make splices, taps and terminations above grade in splice or termination cabinets. Do not splice any cable in ground or below finished grade.
 - 2. All taps and splices shall be made with compression type connectors and covered with

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Raychem heavywall cable sleeves (type CRSM-CT, WCSM or MCK) with type "S" sealant coating with sleeve kits as per manufacturer's installation instructions or be terminated/connected to terminal strips in above grade terminal boxes suitable for use.

3. Provide and install above grade termination cabinets sized to meet applicable codes and standards, where required for splicing.

END OF SECTION

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SECTION 16131
OUTLET BOXES

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. Section includes wall and ceiling outlet boxes (and/or small junction/pullboxes).
- B. Provide and install all outlet boxes (flush or surface) complete with all accessories as required to facilitate installation of electrical system and as required by the NEC.

1.3 REFERENCES

- A. ANSI/NEMA FB 1 Fittings Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- B. ANSI/NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- C. ANSI/NFPA 70 National Electrical Code
- D. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

1.5 SUBMITTALS

- A. Submit catalog cut sheets/product data on:
 - 1. Surface cast boxes.
- B. For pullboxes and junction boxes not covered in Section 16133 Pull and Junction Boxes, submit product data showing dimensions, covers, and construction.

1.6 PROJECT CONDITIONS

- A. Verify field measurements are as shown on Drawings.
- B. Verify locations of outlets in offices and work areas prior to rough-in.
- C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All boxes and fittings shall be labeled by Underwriters Laboratories.
- B. Provide box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, outlet boxes, and corrosion-resistant knockout closures compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- C. All boxes shall be of the size and shape required by NFPA 70 for their respective locations.
- D. Boxes shall be of such form and dimensions as to be adapted to the specific use and location,

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type of device or fixtures to be used, and number and size of conductors and arrangement, size and number of conduits connecting thereto.

- E. Handy boxes shall not be used.
- F. Outlet boxes to be one-piece.
- G. 4" x 4" boxes and 4 11/16" x 4 11/16" boxes used as junction boxes shall be one piece.

2.2 SHEET METAL OUTLET BOXES ANSI/NEMA OS 1, GALVANIZED STEEL:

- A. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2" male fixture studs where required.
- B. Concrete Ceiling Boxes: Concrete type.
- C. Interior flush outlet boxes shall be galvanized steel constructed with stamped knockouts in back and sides, and threaded holes with screws for securing box coverplates or wiring devices. T&B, Steel City, Raco or accepted substitution.
- D. Ceiling outlet boxes shall be 4" octagonal or 4" square X 1-1/2" deep or larger as required for number and size of conductors and arrangement, size and number of conduits terminating at them.
- E. Switch, wall receptacle, telephone and other recessed wall outlet boxes in drywall shall be 4" square X 1-1/2" deep. For recessing in exposed masonry, provide one piece 4" square x 1-1/2" deep wall boxes with appropriate 4" square cut tile wall covers Steel City series #52-C-49/52-C-52 or accepted substitution. For recessing in furred-out block walls, provide 4" square box with required extension for block depth and required extension for drywall depth.

2.3 CAST BOXES NEMA FB 1:

- A. Interior surface outlet boxes and conduit bodies installed from 0" AFF to 90" AFF (including fire alarm device backbox) shall be the heavy cast aluminum or iron with external threaded hubs for power devices and threaded parts for low voltage devices; Appleton, Crouse Hinds or accepted substitution. Trim rings shall also be of one-piece construction.
- B. Weatherproof outlet boxes shall be constructed of corrosion-resistant cast metal suited to each application and having threaded conduit hubs, cast metal faceplate with spring-hinged waterproof cap suitably configured, gasket, and corrosion-proof fasteners.
- C. Boxes to be Type FD unless otherwise noted on drawings.
- D. Freestanding cast boxes are to be type FSY (with flange). Other cast zinc boxes are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- C. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.
- D. Install boxes to preserve fire resistance rating of partitions and other elements.
- E. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
- F. Use flush mounting outlet boxes in finished areas.

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- G. Do not install flush mounting boxes back-to-back in walls; provide minimum 6" separation. Provide minimum 24" separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Support all outlet boxes from structure with minimum of one 3/8" all-thread rod hangers. Boxes larger than 25 square inches shall be supported with two all-thread rod hangers, minimum.
- L. Do not fasten boxes to ceiling support wires.
- M. Support boxes independently of conduit.
- N. Use gang box where more than one device is mounted together. Do not use sectional box.
- O. Use gang box with plaster ring for single device outlets.
- P. Use cast outlet box in exterior locations and wet locations.
- Q. Comply with applicable portions of the NECA National Electrical Installation Standards.
- R. Install outlets in the locations shown on the drawings; however prior to rough-in, the Owner shall have the right to make slight changes in locations to reflect room furniture layouts.
- S. The Contractor shall coordinate his work with that of the General Contractor so that each electrical box is the type suitable for the wall or ceiling construction provided and suitable fireproofing is inbuilt into fire rated walls.
- T. The Contractor shall relocate electrical boxes as required so that once installed, electrical devices will be symmetrically located with respect to the room layout.
- U. All boxes shall be installed in a flush rigid manner with box lines at perpendicular and parallel angles to finished surfaces. Boxes shall be supported by appropriate hardware selected for the type of surface from which the box shall be supported. For example, provide metal screws for metal, wood screws for wood, and expansion devices for masonry or concrete.
- V. For locations exposed to weather or moisture (interior or exterior), provide weatherproof boxes and accessories.
- W. As a minimum, provide pull boxes in all raceways over 150'. The pull box shall be located near the midpoint of the raceway length.
- X. Provide knockout closures to cap unused knockout holes where blanks have been removed, and plugs for unused threaded hubs.
- Y. Provide conduit locknuts and bushings of the type and size to suit each respective use and installation.
- Z. Boxes and conduit bodies shall be located so that all electrical wiring is accessible.
- AA. Avoid using round boxes where conduit must enter box through side of box, which would result in a difficult and insecure connection with a locknut or bushing on the rounded surface.
- BB. All flush outlets shall be mounted so that covers and plates will finish flush with finished surfaces without the use of shims, mats or other devices not submitted or accepted for the purpose. Add-a-Depth rings or switch box extension rings (Steel City #SBEX) are not acceptable. Plates shall not support wiring devices. Gang switches with common plate where two or more are indicated in the same location. Wall-mounted devices of different systems (switches, thermostats, etc.) shall be coordinated for symmetry when located near each other on the same wall. Outlets on each side of walls shall have separate boxes. Through-wall type boxes shall not be permitted.

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Back-to-back mounting shall not be permitted. Trim rings shall be extended to within 1/8" of finish wall surface.

- CC. Outlet boxes mounted in metal stud walls are to be supported to studs with two screws inside of outlet box to a horizontal stud brace between vertical studs or one side of outlet box supported to stud with opposite side mounted to section of stud or device to prevent movement of outlet box after wall is finished.
- DD. All outlet boxes that do not receive devices in this Contract are to have blank plates installed matching wiring device plates.
- EE. Mount Height:
 - 1. Height of wall outlets to bottom above finished floors shall be as follows, unless specifically noted otherwise, or unless otherwise required by applicable codes including ADA. Verify with the Architectural Drawings and Shop Drawings for installing:

Switches	4'-0" AFF to top
Receptacles	1'-4" AFF to bottom
Lighting Panels	6'-6" AFF to centerline of highest breaker/fuse
 - 2. Bottoms of outlets above countertops or base cabinets shall be minimum 2" above countertop or backsplash, whichever is highest. Outlets may be raised so that bottom rests on top of concrete block course, but all outlets above counters in same area shall be at same height. It is the responsibility of this Division to secure cabinet drawings and coordinate outlet locations in relation to all cabinets as shown on Architectural Drawings, prior to rough-in, regardless of height shown on Division 16 Drawings.
 - 3. Height of wall-mounted fixtures shall be as shown on the drawings or as required by Architectural Drawings and conditions. Fixture outlet boxes shall be equipped with fixture studs when supporting fixtures.
- FF. Special Purpose Outlets:
 - 1. Locate special purpose outlets as indicated on the Drawings for the equipment served. Location and type of outlets shall be coordinated with appropriate trades involved. The securing of complete information for proper electrical roughing-in shall be included as work required under this Section of Specifications. Provide plug for each outlet.
- GG. Outlets in Fire/Smoke and Smoke Partitions/Walls:
 - 1. Electrical outlet boxes may be installed in vertical fire resistive assemblies classified as fire/smoke and smoke partitions without affecting the fire classification, provided such openings occur on one side only in each framing space and that openings do not exceed 16 square inches. All clearances between such outlet boxes and the gypsum board must be completely filled with joint compound or other accepted materials. The wall must be built around outlets of larger size so as not to interfere with the integrity of the wall rating.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box for products furnished under all Sections of these Specifications.
- B. Coordinate locations and sizes of required access doors with applicable Sections in these Specifications.
- C. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- D. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

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- E. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.3 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closure in unused box opening.

END OF SECTION

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SECTION 16133
PULL AND JUNCTION BOXES

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. Provide and install pull and junction boxes as shown on Drawings or as required by the NEC.
- B. Provide and install pull and junction boxes wherever required for a complete and operating distribution system whether shown on Drawings or not.
- C. Where outlet boxes are used for pull and/or junction boxes, they shall meet the requirements of Section 16131 Outlet Boxes.

1.3 REFERENCES

- A. ANSI/NEMA FB 1 Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- B. ANSI/NEMA OS 1 Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- C. ANSI/NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- D. ANSI/NFPA 70 National Electrical Code
- E. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

1.5 SUBMITTALS

- A. Submit actual shop drawings on all pull boxes showing.
 - 1. Covers.
 - 2. Dimensions - inside and out.
 - 3. Rating of concrete or gauge of metal.
 - 4. Manufacturer.

1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations and mounting heights of pull and junction boxes.

1.7 PROJECT CONDITIONS

- A. Verify field measurements are as shown on Drawings.
- B. Verify locations of pull and junction boxes prior to rough-in.
- C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose and to maintain required access.

PART 2 - PRODUCTS

2.1 GENERAL

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- A. Dimensions of pull and junction boxes shall meet dimensions shown on Drawings or dimensions required by NEC, whichever is largest.
- B. Pull and junction boxes shall meet all requirements of UL and NEC.
- C. Small pull boxes (i.e. 4" x 4") shall meet the requirements of these Specifications for outlet boxes as a minimum.
- D. All boxes (above ground) of 100 cubic inches or more shall be constructed of 14 gauge steel with hot dip galvanized coating.

2.2 SHEET METAL BOXES

- A. NEMA OS 1, galvanized steel.
- B. Box to be fully weatherproof and watertight where installed outside.

PART 3- EXECUTION

3.1 GENERAL

- A. Install per NEC
- B. Install electrical boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.
- F. Install boxes to preserve fire resistance rating of partitions and other elements.
- G. Align adjacent wall-mounted boxes with each other.
- H. Use flush mounting boxes in finished areas.
- I. Do not install flush mounting boxes back-to-back in walls; provide minimum 6" separation. Provide minimum 24" separation in acoustic rated walls.
- J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- K. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- L. Pull and junction boxes larger than 25 square inches shall be supported with two 3/8" all-thread rod hangers minimum.
- M. Install all labels and identification as required by the NEC and applicable sections of these Specifications.
- N. Pull and junction boxes used for systems (Sections 16700-16799) larger than 25 square inches shall be hinged cover type.
- O. Do not fasten boxes to ceiling support wires.
- P. Support boxes independently of conduit.
- Q. Large Pull Boxes:
 - 1. Boxes larger than 100 cubic inches in volume or 12" in any dimension.
 - a) Interior dry locations per NEC with screw covers.
 - 2. Other locations use hinged enclosure under provisions of Section 16160 Cabinets and Enclosures.

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- R. Boxes Installed Outdoors: All boxes installed outdoors to be NEMA 4, fully weatherproof and watertight.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations and sizes of required access doors with applicable sections in these Specifications.
- B. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

3.3 ADJUSTING

- A. Install knockout closure in unused box opening.

END OF SECTION

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SECTION 16141
WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:
 - 1. Receptacles.
 - 2. Device plates and decorative box covers.

1.3 REFERENCES

- A. NEMA WD 1 General Requirements for Wiring Devices
- B. NEMA WD 6 Wiring Devices Dimensional Specifications

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Submit product data on all types of wiring devices including plates and engraving.
- B. Manufacturer's Instructions:
 - 1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
 - 2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.7 EXTRA MATERIALS

- A. Provide a minimum of two screwdrivers of each type of tamper proof screw used on project.
- B. Turn over to Owner and submit Spare Parts Certification receipt. (See Section 16098 Operation and Maintenance Manuals).

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices shall be Specification Grade as minimum.
- B. General purpose wiring devices shall meet NEMA standard WD-1, Wiring Devices, General Purpose. Special purpose devices shall conform to the requirements of NEMA standard WD-5,

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Wiring Devices, Special Purpose.

- C. All wiring devices shall bear UL labels.
- D. All devices of one type (i.e. all snap switches, all duplex receptacles, etc.) shall be by the same manufacturer. Hazardous Location and Special Purpose Devices may not be available from the same manufacturer; this shall constitute the only exception to this requirement of single-source.
- E. Corrosion resistant devices shall be as specified for normal usage, and fabricated of yellow color melamine plastic. Where "Weatherproof" type is indicated for exterior or wet locations, provide matching self-closing cover with gasketed seals at plate/wall junctions and for cover.
- F. Provide factory packaged wiring devices having high impact strength molded plastic bodies.
- G. Except where specifically required in these Specifications, use of interchangeable type or combination switch-receptacle-pilot devices is not acceptable and shall be removed.
- H. Switches and receptacles connected to [life safety branch of the] emergency power system shall be red. Plates shall be as specified for devices connected to normal circuits, but shall be engraved reading "Emergency", see Drawings for other engraving requirements.

2.2 RECEPTACLES

A. General:

- 1. All receptacles shall be of standard NEMA configuration, as indicated on the Drawings, and shall comply with the respective ANSI C73 series standard for the NEMA configuration. Color to match plates unless specifically noted otherwise in specifications and/or on Drawings.
- 2. Duplex receptacles shall have integral UL listed self-grounding clips. Similar, single receptacles shall be provided for plug-in connections of industrial fluorescent light fixtures on the same switching circuit. Receptacle face to be impact resistant nylon.
- 3. Weatherproof duplex receptacles shall be provided in all exterior locations, and shall be ground fault circuit Interrupting (GFCI) types, with weatherproof cover plates allowing use of receptacle with cover in closed position.
- 4. Special purpose receptacles for specific equipment shall be grounding types, having the number of poles, voltage and ampere ratings, and NEMA configurations required by the equipment. For each special purpose receptacle, provide an identical mating plug equipped with cord grip, secured to cord.
- 5. Duplex receptacles shall have back and side wired screw pressure terminals.

B. Description: NEMA WD 1; heavy-duty general use receptacle.

C. Configuration: NEMA WD 6; heavy-duty, general use type as specified and indicated.

D. Convenience Receptacle: Type 5-20.

E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

F. Manufacturers:

- 1. See Drawings.

2.3 COVER PLATES

A. All wiring devices shall be provided with standard size one-piece cover plates of suitable configuration for the number and type of devices to be covered.

B. Metallic cover plates shall be used in interior spaces, except as noted below, and shall be fabricated of corrosion-resistant #302 stainless steel having a nominal thickness of .04" and a

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brushed finish. Screws securing the plates shall have flush (when installed) heads with finish to match plates. Metallic cover plates shall meet all requirements of the National Electrical Code and Federal Specifications.

- C. Where so directed by the A/E (either by Contract Documents or direction after the bid) substitute nylon plates of quality as specified below, without increase in Contract Price. Coordinate prior to securing plates for project. Where nylon cover plates are required in finished interior spaces, these shall be fabricated of either non-combustible mar-proof high impact resistant fiberglass or nylon reinforced thermosetting material or nylon, having a minimum thickness of .10", with smooth finish. Screws securing the plates shall have flush (when installed) heads of color to match plates. Nylon cover plates shall conform to Federal Specification QP-455A and all other NEC, UL and NEMA requirements. Where required by A/E nylon plates shall be fitted with nylon screws for totally nonmetallic surface installation.
- D. Cover plates for switches located in corrosive atmospheres (where vaporproof is not indicated) shall be equal to Hubbell #17CM81/#17CM82/#17CM83/#17CM84 one piece neoprene with matching presswitch.
- E. Cover plates for exterior receptacles shall be gasketed covers with hinge allowing plug and cord to be plugged in and activated with cover closed..
- F. Cover plate engraving, where required, shall be accomplished by cover plate manufacturer in accordance with instructions given on the Drawings. Metallic plates and nylon plates in ivory, beige, gray, and white shall be engraved with black fill. Red, brown, and black nylon plates shall be engraved with white fill.
- G. Unless specifically noted otherwise in Specifications or on Drawings, all outlets for telephone and other communications and data systems shall be provided with standard size one-piece cover plates having a minimum 3/4" diameter bushed hole in the center unless specifically noted otherwise in Specifications and/or on Drawings. Where telephone conductors are installed, plates shall contain telephone type, polarized plug-in receptacles.
- H. All device plates (including systems device plates and trims) located in secure areas such as cells, dayrooms, holding rooms, recreation areas, etc., shall have security wall plates (minimum 10 gauge) with minimum 12 gauge galvanized steel backplate. Plates shall have TORX counter pin reject type tamperproof screws.
- I. All device plates (including systems device plates and trims) and blank plates located in all secure areas shall be mounted with tamper proof screws, unless otherwise noted.

2.4 COLOR

- A. Wiring devices connected to normal power and located in unfinished spaces shall be grey color. Devices connected to normal power and located in finished interior spaces shall be of color selected by Architect from the following list of standard colors: ivory, beige, gray, white, brown, black.
- B. Cover plates for devices connected to normal power and located in finished interior spaces shall be of color selected by Architect from the above list of standard colors or #302 stainless steel.
- C. All devices and coverplates in paneled walls shall have finish to match paneling.
- D. Devices connected to [the life safety or critical branch of the emergency distribution system] emergency power shall be red color, except where established building standards and/or isolated ground devices require otherwise. Coordinate before purchase.
- E. Contractor shall modify any given catalog numbers as required to procure devices and plates of the proper color.

PART 3- EXECUTION

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3.1 EXAMINATION

- A. Verify conditions under provisions of Division 1 General Requirements and any other applicable supplemental requirements/conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify floor boxes are adjusted properly.
- E. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on bottom.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- F. Electrical boxes shall be cleaned and completely free of any debris, dust, etc. prior to the installation of wiring devices.
- G. Where two or more switches or receptacles are to be installed adjacent to one another, provide a multi-gang box and combination multi-gang coverplate. Provide proper NEC barriers in boxes which serve devices for both the Normal and Emergency Systems.
- H. Provide device coverplates for every device installed. Cover plates shall be installed so that they appear straight with no gaps between plate edges and the wall. Maintain vertical and horizontal to within 1/16 of an inch.
- I. In finished areas provide same type of plate for all surface mounted devices as for recessed mounted devices.
- J. In any room where new and existing construction is present, all receptacles, switches, and coverplates which are existing to remain shall be changed as required to match new work.
- K. Wiring devices shall not be installed in exposed masonry until cleaning of masonry with acids has been completed.
- L. All receptacles and switches shall be grounded by means of a ground wire from device ground screw to outlet box screw and branch circuit ground conductor. Strap alone will not constitute an acceptable ground.
- M. All wiring devices, relays, contactors, pushbuttons, selector switches, pilot lights, etc. shall be installed in approved enclosures rated for the appropriate NEMA classified environment.
- N. All devices shall be installed so that only one wire is connected to each terminal.
- O. Once construction is substantially completed, replace all damaged, burned, or scorched wiring devices.
- P. Receptacles shown to be floor mounted shall be installed in floor boxes (with coverplates) which are approved for this use.

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- Q. Connect wiring devices by wrapping conductor around screw terminal.
- R. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- S. Install protective rings and split nozzle on active flush cover service fittings.
- T. Install local room area wall switches at door locations on the lock side of the door approximately four inches from the jamb. Where locations shown on the Drawings are in question, provide written request for information to A/E prior to rough-in.

3.4 NEUTRAL CONDUCTOR CONNECTIONS

- A. Each receptacle's "in" and "out" phase and neutral conductors shall have an additional conductor for connection to device. The practice of "looping" conductors through receptacle boxes shall not be acceptable.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under other Sections of these Specifications to obtain mounting heights specified and indicated on Drawings.

3.6 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION

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SECTION 16160
CABINETS AND ENCLOSURES

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. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:
 - 1. Hinged cover enclosures.
 - 2. Cabinets.
- B. Cabinets and enclosures are to include:
 - 1. Terminal blocks.
 - 2. Mounting panel.
 - 3. Ground bus/bar.
 - 4. All accessories as required for a complete and operating system.
- C. Provide and install cabinets and enclosures as specified herein for all systems specified in Division 16 Specifications (including Sections 16700 - 16799) and Division 17 when included in Specifications.

1.3 REFERENCES AND REGULATORY REQUIREMENTS

- A. Conform to the requirements of the following:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 2. NEMA ICS 4 Terminal Blocks
 - 3. ANSI/NFPA 70 National Electrical Code
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

1.4 SUBMITTALS

- A. Submit Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- B. Submit Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under "References and Regulatory Requirements." Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- C. Submit actual shop drawings on all cabinets and enclosures showing:
 - 1. Covers.
 - 2. Dimensions - inside and out.
 - 3. Gauge of metal.
 - 4. Manufacturer.
 - 5. Terminal mounting plate, construction, etc.
 - 6. Ground bus/bar.

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1.5 EXTRA MATERIALS

- A. Provide two of each cabinet key.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unless specifically called for otherwise on Contract Drawings, provide cabinets as specified herein for terminal cabinets mounted indoors. Similarly, provide hinged cover enclosures as specified herein for terminal cabinets mounted outdoors or in locations other than NEMA 1 locations. Also provide hinged cover enclosures for locations where size required is not available in cabinet construction, or if specifically specified as enclosure in Contract Documents.
- B. Size:
1. Dimensions of cabinets and enclosures shall meet the dimensions shown on Drawings, dimensions required by NEC, or dimensions sized as required to facilitate all equipment/connections involved installation, whichever is largest.
 2. Coordinate with Sections 16700 through 16799, Section 16691 Surge Protective Devices, (if included, Division 17 of these Specifications to assure that size of equipment cabinet or enclosure will house and facilitate proper installation and access to equipment, to be installed/mounted in cabinet or enclosure.
- C. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
- D. Provide accessory feet and/or mounting brackets for free-standing equipment.
- E. Cabinets and enclosures installed outdoors shall be fully weatherproof and watertight.

2.2 HINGED COVER ENCLOSURES

- A. Construction:
1. Interior Locations: NEMA Type 1 steel (unless otherwise noted).
 2. Exterior Locations: NEMA Type 4X:
 - a) Within 10 Miles of Ocean or Gulf: Stainless steel or fiberglass.
 - b) Other Exterior Locations: Primed and phosphatized steel.
- B. Covers: Continuous hinge.
- C. Enclosure Finish:
1. NEMA 1:
 - a) Manufacturer's standard metallic gray enamel over phosphatized surfaces.
- D. Lock/Handle:
1. Provide/install key lock handle on all enclosures mounted in rooms/areas/spaces that are not electrical rooms or mechanical rooms. Enclosures installed in electrical rooms need not be and are not required to be lockable.
- E. Interior Mounting Plate:
1. Each enclosure is to have interior mounting plate/panel for mounting terminal blocks and electrical components.
 2. Plate/panel is to be metal.
- F. Ground Bus/Bar:

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1. Each enclosure housing surge suppression equipment or other equipment shall have local ground bar/bus installed. See "Local Ground Bus/Bar" below.

G. Manufacturers:

1. Hoffman.
2. Electromate Corporation.
3. Carlon for NEMA 4X.

2.3 CABINETS

A. Construction: Code gauge steel with removable endwalls.

B. Finish:

1. Boxes: Galvanized steel.
2. Fronts: Gray baked enamel.

C. Fronts:

1. Electrical or Mechanical Room Locations: Screw cover with flush handle or as noted below.
2. Other Locations: mono-flat with concealed trim clamps, concealed hinges, and flush lock lockable handle.
3. Flush or surface type as shown or called for in Contract Documents.

D. Interior Mounting Plate:

1. Each enclosure is to have interior mounting plate/panel for mounting terminal blocks and electrical components.
2. Panel/plate may be constructed of wood if painted with fire retardant paint of a flame spread rating of Class A, if it meets all applicable codes, and it is acceptable to the Authority Having Jurisdiction; otherwise plate to be metal.
3. Panel/plate shall be metal.

E. Ground Bus/Bar:

1. Each cabinet housing surge suppression equipment or other equipment shall have local ground bar/bus installed. See "Local Ground Bus/Bar" below.

F. Manufacturer:

1. Sq. "D" Class 6650 Series.

2.4 TERMINAL BLOCKS

A. Terminal Blocks: ANSI/NEMA ICS 4.

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type suitable for channel mounting, with tubular pressure screw connectors rated 300 volts.

D. Provide ground bus terminal block with each connector bonded to enclosure.

2.5 LOCAL GROUND BUS/BAR

A. Size to handle #6 through #14 AWG copper ground wire.

B. Length as required for circuits.

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- C. Manufacturer:
 - 1. Sq. "D" #PK***GTA Series.
 - 2. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install enclosures and cabinets plumb. Anchor securely to wall and structural supports at each corner.
- C. Install cabinet fronts plumb.
- D. Install per NEC and as required for proper clearance. Coordinate with panels.
- E. Provide and install terminal cabinets as shown on Drawings or as required by the NEC.
- F. Provide and install terminal cabinets wherever required for a complete and operating distribution system whether shown on Drawings or not.
- G. Install local ground bus/bar in each terminal cabinet/enclosure that houses surge protective devices or other equipment and bond to cabinet enclosure via mounting screws or #6 AWG copper ground wire.
- H. Ground local ground bus to systems ground bus/bar with minimum #6 AWG copper ground wire. Increase size if so required on Drawings.
- I. Install all labels and identification as required by the NEC and applicable sections of these Specifications.

END OF SECTION

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SECTION 16170
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes
 - 1. Equipment grounding conductors.
 - 2. Bonding.
- B. Provide all labor, materials, and equipment necessary to properly install a grounding system conductor in all new branch wiring and feeder installations, which shall be in full compliance with all applicable codes as accepted by the Authorities Having Jurisdiction. The secondary distribution system shall include a grounding conductor in all raceways in addition to the return path of the metallic conduit.
- C. In general, all electrical equipment (metallic conduit, motor frames, panelboards, etc.) shall be bonded together with a green insulated or bare copper system grounding conductor in accordance with specific rules of NEC 250, and state codes. Bonding conductor through the raceway system shall be continuous from main switch ground bus to panel ground bar of each panelboard, and from panel grounding bar of each panelboard to branch circuit equipment and devices.
- D. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors that run with feeders in PVC conduit outside of building(s) shall be bare only.
- E. Provide and install all grounding and bonding as required by the National Electrical Code (NEC) including but not limited to NEC 250.

1.3 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code
- B. NFPA 780 Standard for the Installation of Lightning Protection Systems
- C. UL 467 Grounding and Bonding Equipment

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

1.5 SUBMITTALS

- A. Submit catalog cut sheets/product data on:
 - 1. Mechanical connectors.
 - 2. Testing equipment and procedures.
- B. Product data shall prove compliance with specifications, National Electrical Code, manufacturers' specifications, and written installation data.

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1.6 PROJECT RECORD DOCUMENTS

- A. Submit record documents to accurately record actual locations of grounding electrodes.
- B. Submit test results of each ground rod. See Section 16090 Tests and Performance Verification of Electrical System.

PART 2- PRODUCTS

2.1 MECHANICAL CONNECTORS

- A. All grounding connectors shall be in accordance with UL 467 and UL listed for use with rods, conductors, reinforcing bars, etc., as appropriate.
- B. Connectors and devices used in the grounding systems shall be fabricated of copper or bronze materials, and properly applied for their intended use. Specified items of designated manufacturers indicate required criteria. Equal products may be provided if approved. All connectors and devices shall be compatible with the surfaces being bonded and shall not cause galvanic corrosion by dissimilar metals. Materials in items not listed herein shall be of equal quality to the following specified items:
 - 1. Lugs: Substantial construction, of cast copper or cast bronze, with "ground" (micro-flat) surfaces, twin clamp, two-hole tongue, equal to Burndy QQA Series or T&B equal. Lightweight and "competitive" devices shall be rejected.
 - 2. Grounding and Bonding Bushings: Malleable iron, Thomas and Betts (T&B), or equal.
 - 3. Piping Clamps: Burndy GAR-TC Series with two hole compression terminal or T&B equal.
 - 4. Grounding Screw and Pigtail: Raco No. 983 or equal.
 - 5. Building Structural Steel, Existing: Thompson 701 Series heavy duty bronze "C" clamp with two-bolt vise-grip cable clamp.
- C. Mechanical lugs or wire terminals shall be used to bond ground wires together or to junction boxes and panel cabinets and shall be manufactured by Anderson, Buchanan, Thomas and Betts Co., or Burndy.

2.2 WIRE

- A. Material: Stranded copper.
- B. Size: Size to meet NFPA 70 requirements as a minimum, increase size if called for on Drawings, in these specifications, or as required for voltage drop.
- C. Insulated THWN (or bare as noted elsewhere).

PART 3- EXECUTION

3.1 GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding electrodes conductor, bonding conductors, ground rods, etc. with all required accessories.
- C. Grounding shall meet (or exceed as required to meet these specifications) all the requirements of the NEC, the NFPA, and applicable standards of IEEE.
- D. Where there is a conflict between these specifications and the above applicable codes/standards, or between this section of these specifications and other sections, then the most stringent or excessive requirement shall govern. Where there is an omission of a code/standard requirement in these specifications then the code/standard requirements shall be complied with.
- E. Requirement in these specifications to comply with a specific code/standard article, etc. is not to

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be construed as deleting of requirements of other applicable codes/standards and their articles, etc.

3.2 GROUNDING ELECTRODE CONDUCTOR

- A. Conductor shall be sized to meet (or exceed as required to meet these Specifications and/or Drawings) the requirements of NEC 250.

3.3 EQUIPMENT GROUNDING CONDUCTORS

- A. Grounding conductors shall be provided with every circuit to meet (or exceed as required to meet these Specifications and/or Drawings) the requirements of NEC 250.
- B. At every voltage level, new portions of the electrical power distribution system shall be grounded with a dedicated copper conductor, which extends from termination back to power source in supply panelboard.
- C. 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 to meet (or exceed as required to meet these specifications and/or drawings) the requirements of NEC 250. Conductor shall be connected to the equipment grounding bus in switchboards and panelboards, to the Grounding Bus in all motor control centers, and as specified, 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.
- D. 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.
- E. All plugstrips 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.
- F. Where integral grounding conductor is specified elsewhere in bus duct construction, provide equivalent capacity conductor from supply switchboard or panelboard grounding bus to the bus duct grounding conductor. Bond integral conductor to bus duct enclosure at each tap and each termination.
- G. 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 bus with accepted 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.

3.4 TRANSFORMER GROUNDING

- A. Ground all transformers and enclosures of 120/208V and 277/480V "separately derived systems" as specified herein.
 - 1. Ground per NEC 250 and these Specifications.
 - 2. Bond neutral to transformer frame/enclosure and the equipment grounding conductors of the derived system with copper ground conductor sized per applicable table in NEC 250.
 - 3. Connect transformer neutral/ground to grounding electrode per NEC 250 with grounding electrode conductor sized per applicable table in NEC 250.
 - 4. In addition to connection to grounding electrode conductor called for above (i.e. per NEC 250) provide, install and connect supplemental grounding electrode as follows:

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- a) Where grounding required per NEC 250 is to building steel/structure, supplement this grounding with connection to nearest available effectively grounded metal water pipe.
 - b) Where grounding connection required per NEC 250 is to grounded metal water pipe, supplement this grounding with connection to building steel/structure in addition to any other available electrode specified in NEC 250.
 - c) Where supplemental grounding electrodes required above is a ground rod electrode, provide, install and connect two or more 30' ground rod electrodes at no less than 30' spacing, driven vertical to a minimum depth of 30' plus 1' below grade.
5. Where neither building steel nor water pipe grounding electrodes are available (i.e. exterior locations with no available water pipe electrode) provide two ground connections: each to two or more 30' ground rod electrodes at no less than 30' spacing, driven vertical to a minimum depth of 30' plus 1' below grade.
 6. Where transformer is mounted exterior to building, one of the two ground electrodes required shall be ground rod electrode as called for in paragraph 5. above. This ground rod electrode shall also be connected to counterpoise system (wherever counterpoise system is available).
 7. Ground to water system service pipe as required by NEC 250.
- B. Provide additional ground electrodes as required to achieve specified ground resistance.
 - C. Where two or more ground electrodes are used at any one required ground location, they shall be bonded together with a copper ground conductor, sized to meet applicable table in NEC 250, but in no case less than #2/0.
 - D. Complete installation shall exceed the minimum requirements of NEC 250.
 - E. Equipment ground conductors shall be provided in addition to above grounding. See 'Equipment Grounding Conductors.'
 - F. Provide and install ground bus bar on wall near transformer (or in associated electrical room for exterior mounted transformers). Connect to ground lug in transformer bonded to transformer enclosure/neutral with copper ground conductor sized per applicable table in NEC 250.
 - G. Multiple separately derived systems may be grounded as allowed in NEC 250.30(A)(4).

3.5 LIGHTNING PROTECTION SYSTEMS

- A. Ground per applicable section on lightning protection system, NFPA 780, and as specified herein. The most stringent requirements shall govern.
- B. Bond lightning protection system grounds to electrical service system ground, all piping entering or leaving all buildings, and counterpoise system ground where provided.
- C. See Section 16671 Lightning Protection System.

3.6 HAZARDOUS LOCATIONS

- A. Ground in hazardous locations shall be done in accordance with applicable portions of NEC 500, 501, 502, 503, 511 and 514.

3.7 MISCELLANEOUS GROUNDING CONNECTIONS

- A. Provide bonding to meet regulatory requirements.
- B. Grounding conductors shall: be so installed as to permit shortest and most direct path from equipment to ground; be installed in conduit; be bonded to conduit at both ends when conduit is metal; have connections accessible for inspection; and made with accepted solderless connectors brazed (or bolted) to the equipment or to be grounded; in NO case be a current carrying conductor; have a green jacket unless it is bare copper; be run in conduit with power and

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branch circuit conductors. The main grounding electrode conductor shall be exothermically welded to ground rods, water pipe, and building steel.

- C. All surfaces to which grounding connections are made shall be thoroughly cleaned to maximum conductive condition immediately before connections are made thereto. Metal rustproofing shall be removed at grounding contact surfaces, for 0 ohms by digital Vm. Exposed bare metal at the termination point shall be painted.
- D. All ground connections that are buried or in otherwise inaccessible locations, shall be welded exothermically. The weld shall provide a connection which shall not corrode or loosen and which shall be equal or larger in size than the conductors joined together. The connection shall have the same current carrying capacity as the largest conductor.
- E. Install ground bushings on all metal conduits entering enclosures where the continuity of grounding is broken between the conduit and enclosure (i.e. metal conduit stub-up into a motor control center enclosure or at ground bus bar). Provide an appropriately sized bond jumper from the ground bushing to the respective equipment ground bus or ground bus bar.
- F. Install ground bushings on all metal conduits where the continuity of grounding is broken between the conduit and the electrical distribution system (i.e. metal conduit stub-up from wall outlet box to ceiling space. Provide an appropriately sized bond jumper from the ground bushing to the respective equipment ground bus or ground bus bar.
- G. Each feeder metallic conduit shall be bonded at all discontinuities, including at switchboards and all subdistribution and branch circuit panels with conductors in accordance with applicable table in NEC 250 for parallel return with respective interior grounding conductor.
- H. Grounding provisions shall include double locknuts on all heavywall conduits.
- I. Bond all metal parts of pole light fixtures to ground rod at base.
- J. Install grounding bus in all existing panelboards of remodeled areas, for connection of new grounding conductors, connected to an accepted ground point.
- K. Bond together reinforcing steel and metal accessories in pool and fountain structures and bond to electrical system per NEC.
- L. Where reinforced concrete is utilized for building grounding system, 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 full length rebars which contact the connected rebar (by Division 16 Contractor). Provide size and length of rod to meet NEC requirements.

3.8 COMMUNICATIONS SYSTEMS

- A. Provide and install all grounding as required by NEC Article 800 and where available on project: Articles 810 (Radio and Television Equipment); 820 (Community Antenna Television and Radio Distribution Systems); and 830 (Network-Powered Broadband Communications Systems).
- B. Provide and install grounding electrode at point of entry of communication cables and bond to service entrance grounding electrodes per NEC 800. Install ground bus bar at point of entry of communications cable and connect electrode to ground bus. Connect communications cable metal sheath and surge protection devices to ground bar.

3.9 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 specified limits.
- B. Ground resistance measurements shall be made on each system utilized in the project. The ground resistance measurements shall include building structural steel, driven grounding system, water pipe grounding system and other accepted systems as may be applicable. Ground

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resistance measurements shall be made in normally dry weather, not less than twenty-four hours after rainfall, and with the ground under test isolated from other grounds and equipment. 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 to the Architect/Engineer as called for in Section 16090 Test and Performance Verification.
- D. Ground rod resistance test results shall be submitted to Engineer and Building Department prior to Substantial Completion. A test report certified by the Contractor shall be submitted as a close-out document for the project.

3.10 INTERFACE WITH OTHER PRODUCTS

- A. Interface with site grounding system.
- B. Interface with lightning protection system installed under Section 16671 Lightning Protection System.
- C. Interface with communications system installed under 16700 series specification sections.

3.11 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

END OF SECTION

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SECTION 16180
EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF SYSTEM

- A. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:
 - 1. Electrical connections to equipment specified under other sections.

1.2 RELATED SECTIONS

- A. Summary of Work
- B. Conduit.
- C. Building Wire and Cable.
- D. Boxes.

1.3 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.
- C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of the General Requirements of the Contract Documents and Section 16012.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.6 COORDINATION

- A. Submit under provisions of the General Requirements of the Contract Documents and Section 16010.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- E. Sequence electrical connections to coordinate with start-up schedule for equipment.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- C. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

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- D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions under provisions of Section 16061.
- B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations (including inside of coolers/freezers).
- C. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment and in cooler/freezers.
- D. Provide receptacle outlet where connection with attachment plug is required. Provide cord and cap where field-supplied attachment plug is required.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices as required.
- G. Modify equipment control wiring with terminal block jumpers as required.
- H. Provide interconnecting conduit and wiring between devices and equipment where required.
- I. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.3 EQUIPMENT CONNECTION SCHEDULE

- A. By local authority and as required for a complete and operating service.

END OF SECTION

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SECTION 16190
HANGERS AND SUPPORTS

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. Section Includes:
 - 1. Conduit and equipment supports.
 - 2. Anchors and fasteners.
- B. Furnish and install all supports, hangers and inserts required to mount fixtures, conduit, cables, pullboxes and other equipment furnished under this Division.

1.3 REFERENCES

- A. NECA National Electrical Contractors Association
- B. ANSI/NFPA 70 National Electrical Code

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA National Electrical Installation Standards.
- C. Do not fasten supports to pipes, ducts, mechanical equipment or conduit.
- D. Do not use spring steel clips and clamps.
- E. Obtain permission from A/E before using powder-actuated anchors.
- F. Obtain permission from A/E before drilling or cutting structural members.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1" off wall.

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- J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- K. All items shall be supported from the structural portion of the building, except standard ceiling-mounted lighting fixtures, and small devices may be supported from ceiling system where permitted by Ceiling Contractor, however, no sagging of the ceiling will be permitted. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels.
- L. This Contractor shall lay out and install his work in advance of the laying of floors or walls, and shall furnish and install all sleeves that may be required for openings through floors, wall, etc. Where plans call for conduit to be run exposed, this Contractor shall furnish and install all inserts and clamps for the supporting of conduit. If this Contractor does not properly install all sleeves and inserts required, he will be required to do the necessary cutting and patching later at his own expense to the satisfaction of the Architect.
- M. All conduits shall be securely fastened in place per NEC. Hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The use of perforated iron for supporting conduits will not be permitted. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by one-hole malleable straps, clamp-backs, or other accepted devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or special brackets.
- N. Where two or more conduits are run parallel or in a similar direction, they shall be grouped together and supported by means of Kindorf type trapeze hanger system (racking) consisting of concrete inserts, threaded solid rods, washers, nuts and galvanized "L" angle iron, or Unistrut cross members. These conduits shall be individually fastened to the cross member of every other trapeze hanger with galvanized cast one hole straps, clamp backs, bolted with proper size cadmium machine bolts, washers and nuts. If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolt type clamps shall be used at the end of a conduit run and at each elbow. J-bolts, or accepted clamps, shall be installed on each third intermediate trapeze hanger to fasten each conduit.
- O. Hanger assemblies shall be protected after fabrication by galvanizing. Hangers for PVC coated conduit shall be PVC coated galvanized conduit or stainless steel.
- P. On concrete or brick construction, insert anchors shall be installed with round head machine screws. In wood construction, round head screws shall be used. An electric or hand drill shall be used for drilling holes for all inserts in brick, concrete or similar construction. In brick, inserts shall be near center of brick, not near edge or in joint. Where steel members occur, same shall be drilled and tapped, and round head machine screws shall be used. All screws, bolts, washers, etc., used for supporting conduit or outlets shall be fabricated from rust-resisting metal, or accepted substitution. Fasteners similar to "TAP-CON" self tapping power driven type are acceptable. Plastic anchors are not acceptable.
- Q. Conduit supporting devices such as spring type conduit clips manufactured by Caddy Corporation may not be used.
- R. Threaded rod hangers shall be galvanized continuous thread type, minimum 3/8" diameter.
- S. Concrete/insert anchors, threaded rods, or similar fasteners installed on side or bottom of prestressed beams are not acceptable.

END OF SECTION

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SECTION 16195
IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Provide and install all equipment, labor and material for a complete identification system, including but not limited to:
 - 1. Nameplates and labels.
 - 2. Wire and cable markers.
 - 3. Conduit markers.
- B. Identify all new and existing conduits, boxes, equipment, etc. as specified herein.

1.3 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code.
- B. Americans with Disabilities Act

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2- PRODUCTS

2.1 NAMEPLATES

- A. Nameplates shall be laminated phenolic plastic, chamfered edges.
 - 1. 120/208 Volt System:
 - a) Black front and back, white core, lettering etched through outer covering, white engraved letters on black background.
 - 2. For 277/480 Volt System:
 - a) Brown with white letters.
 - 3. Emergency System:
 - a) Red with white letters.
 - 4. Emergency Power:
 - a) Red front and back, white core, lettering etched through outer covering, white engraved letters on red background.
- B. Letter Size:
 - 1. 1/8" letters for identifying individual equipment and loads.
 - 2. 1/4" letters for identifying grouped equipment and loads.
- C. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the Drawings, inscription and size of letters shall be as shown and

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shop drawing submitted for acceptance. Nameplates for panelboards, switchboards, motor control centers, disconnects and enclosed breakers shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 120/208V, 3-phase, 4-wire." In addition, provide phenolic label in panel to describe where the panel is fed from and location. For example, "Fed From MDP-1:3:5 Electrical Room #E101 Level 1." Nameplates for equipment listed below shall describe particular equipment name and associated panel/circuit, if applicable.

The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and pushbutton station nameplates for that machine.

- D. The following items shall be equipped with nameplates:
1. All motors, motor starters, motor-control centers, pushbutton stations, control panels, time switches, disconnect switches, transformers, panelboards, circuit breakers (i.e., all 2-pole, 3-pole circuit breakers), contactors or relays in separate enclosures, power receptacles where the nominal voltage between any pair of contacts is greater than 150V, wall switches controlling outlets that are not located within sight of the controlling switch, high voltage boxes and cabinets, large electrical, and electrical systems (Systems Sections 16700 through 16799), junction and pull boxes (larger than 4-11/16"), terminal cabinets, terminal boards, and equipment racks. Nameplates shall also describe the associated panel and circuit number, if applicable.
- E. All electrical system panels, transfer switches, motor control centers, disconnect switches, motor controllers, etc. shall be labeled as per branch, i.e., "Panel ABC Emergency-Life Safety Branch" (similar for emergency legally required standby branch, or emergency optional standby branch).

2.2 WIRE MARKERS

- A. Description: Cloth, tape, split sleeve or tubing type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
- C. Legend:
1. Power and Lighting Circuits: Branch circuit or feeder number indicated on Drawings including neutral conductor.
 2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.3 CONDUIT/JUNCTION BOX COLOR CODE

- A. All conduit system junction boxes (except those subject to view in public areas) shall be color coded as listed below:

<u>COLOR CODE FOR JUNCTION BOXES</u>	<u>KRYLON PAINT NUMBER</u>
System Emergency 277/480 volt	Cherry Red K02101
System Emergency 120/208 volt	Zinger Pink S01150
Fire Alarm	Popsicle Orange K02410
Normal Power 277/480 volt	Leather Brown K02501
Normal Power 120/208 volt	Glossy Black K01601
Computer/Data	Gold K01701
TV	Glossy White K01501
BAS	Cameo White K04129
Telephone	Clover Green K02012
Grounding	Fluorescent Green K03106

- B. Conduit (not subject to public view) longer than 20' shall be painted with above color paint band

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20 ft. on center. Paint band shall be 4" in length, applied around entire conduit. Where conduit is parallel and on conduit racking, the paint bands shall be evenly aligned. Paint shall be neatly applied and uniform. Paint boxes and raceways prior to installation, or tape conduits and surrounding surfaces to avoid overspray. Paint overspray shall be removed.

- C. Junction boxes and conduits located in public areas (areas that can be seen by the public) shall be painted to match surface to which it is attached. Provide written request to A/E for interpretation of those public areas which may be in question.

2.4 CONDUIT/JUNCTION BOX MARKER

- A. All new and existing junction boxes/cover plates for power, lighting and systems (except those installed in public areas) shall adequately describe its associated panel and circuit reference number(s) within (i.e. ELRW-2, 4, 6), or systems within (i.e. fire alarm, intercom, etc.). Identification shall be neatly written by means of black permanent marker. Paint one-half of cover plate with appropriate color above, and one-half with associated panel/circuit or system as described above. Junction box cover plates located in public areas shall be identified with small phenolic labels securely attached. Label colors to be determined by A/E. Large pull/junction boxes (8" x 8" or larger) shall be color identified by painting the corners of box cover plate with specified colors at 45 degree angles; phenolic labels as specified herein.
- B. Identify conduit not installed in public areas with corresponding panel/circuit numbers or corresponding system type as described above. Spacing: 20 ft. on center adjacent to color identification bands.

PART 3- EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

- A. Install nameplate parallel to equipment lines.
- B. Secure nameplate to equipment front using stainless steel pop rivets.
- C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- D. Nameplates installed inside on dead front cover shall be self-adhesive tape. Do not drill or install screws in dead front.
- E. Identify new and existing conduit, junction boxes, and outlet boxes using field painting.
- F. Identify new underground conduit using underground warning tape. Install a minimum of one tape per trench at 6" below finished grade. For trenches exceeding 24" in width, provide one tape per 24" of trench width spaced evenly over trench width.
- G. Install wire markers at all new connections and terminations, and at existing connections and terminations modified or altered.

END OF SECTION

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SECTION 16441
ENCLOSED DISCONNECT SWITCHES

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. Provide all labor, materials, and equipment necessary to properly install switches as shown on the Drawings and as required by codes.
- B. Coordinate with Division 15 Contractor and Specifications as to who is to provide disconnect switches for mechanical equipment. Provide all disconnect switches not being provided by Division 15 Contractor.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver switches in factory wrapped packaging to the site. Handle switches carefully to prevent damage. Store in a clean, dry space protected from dirt, water, and physical damage. Do not install damaged switches.

1.4 QUALITY ASSURANCE

- A. The manufacturer of switches shall be the same as that of the panelboards.

1.5 SUBMITTALS

- A. Submit catalog cut sheet on each type of disconnect switch to be used on this project. Submit catalog cut sheet on enclosure locks to be used on this project.

PART 2 - PRODUCTS

2.1 CONSTRUCTION

- A. Switches shall be 600V heavy duty types with visible, quick-make, quick-break blades.
- B. Units for 2-speed motors shall be 6-pole in a single enclosure. Use of two 3-pole units will not be acceptable.
- C. Provide ground bus, and where required a solid neutral bus.
- D. Switches shall be fusible or nonfusible as denoted on the Drawings or as required by the equipment served from the switch. Fusible switches shall have rejection type fuse holders.
- E. Terminal lugs shall be rated for 75 degrees Centigrade.
- F. Enclosures, unless otherwise noted, shall be NEMA 1 for indoor locations. All switches mounted outdoors including those noted to be NEMA 3R on drawings shall be heavy duty type 4X, watertight, corrosion resistant.
- G. The enclosure shall be interlocked with the switch handle such that the enclosure door or cover cannot be opened with the switch in the "ON" position. The switch handle shall be capable of being padlocked in the "OFF" position but not in the "ON" position.
- H. Finish for NEMA I units shall be standard baked gray enamel finish over a rust inhibiting phosphate primer.
- I. Each disconnect switch shall be provided with a Homac #ELB-2 or similar enclosure lock. Homac #ELB-2 is available from Graybar Electric.
- J. Disconnect switches installed between any variable speed drive type of unit (VFD, AFD, USD,

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etc.) and its respective motor(s), shall have auxiliary break before break (open) interlock control contact.

- K. Disconnect switches installed to disconnect HVAC equipment are to be fusible type with fuses as recommended by HVAC manufacturer.

2.2 RATING

- A. The size, number of poles, and fusing for each switch shall be as denoted on the Drawings. As a minimum, no less than one pole for each ungrounded conductor shall be provided. Switches shall be rated 250 VAC or 600 VAC as required by the circuit to which it is connected.
- B. Switches serving motors with more than one set of windings shall have the number of poles necessary to disconnect all conductors to all windings in a single switch. Switches serving motor loads shall be horsepower rated of sufficient size to handle the load.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Molded Case Circuit Breakers: NEMA AB1, plug-on type for 250V or less, bolt-on type for over 250V, thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Breakers shall be HID rated. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- B. Thermal-magnetic, molded case, with inverse time-current overload and instantaneous magnetic tripping, unless otherwise shown. Breakers shall be calibrated for 40 degrees C or shall be ambient compensating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all switches in accordance with the manufacturer's written instructions, NECA National Electrical Installation Standards, the applicable requirements of the NEC, and recognized industry practice.
- B. All switches shall be firmly anchored to walls and supporting structures (where used) using appropriate installation. Switches shall be installed with the turning axis of their handles approximately 5'-0" above finished floor unless otherwise indicated. Provide rigid steel (galvanized for exterior use) mounting stands, brackets, plates, hardware, and accessories for a complete installation.
- C. Switches shall be mounted in accessible locations chosen where the passageway to the switch is not likely to become obstructed. Where a switch serves as the disconnecting means for a load, the switch shall be located as close as practical to the load with the switch handle within sight of the load.
- D. Provide and install lugs on disconnect switch as required to accept conductors called for on Drawings.
- E. Disconnect switches shall not be mounted on equipment, unless specifically noted or required and meet all applicable codes, etc. If switches are noted or required to be mounted on equipment they shall have vibrator clips on fuses and be connected to conduit system with liquid tight flexible conduit.
- F. Provide and install enclosure lock on each disconnect switch. Enclosure lock bolt shall be tightened firmly but not tight enough to break bolt.
- G. Coordinate all requirements for controls between variable speed drive units and its respective motor with drive specification, manufacturer, provider and installer. Provide auxiliary contacts, relays, etc. as required.

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- H. Install all labels and identification as required by the NEC and applicable sections of these specifications.

END OF SECTION

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SECTION 16471 - PANELBOARDS

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. Provide all labor, materials and equipment necessary to properly and completely install panelboards as scheduled on the drawings and as required by this section.

1.3 REFERENCES

- A. NECA National Electrical Installation Standards
- B. NEMA PB 1 Panelboards
- C. NEMA PB 1.1 General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- D. NFPA 70 National Electrical Code
- E. UL 50 Enclosures for Electrical Equipment
- F. UL 67 Panelboards
- G. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with NECA National Electrical Installation Standards.
- B. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years experience.

1.6 SUBMITTALS

- A. Product data shall be submitted on:
 - 1. Panel
 - 2. Cabinet
 - 3. Bus
 - 4. Dimensions
 - 5. Construction
- B. Shop drawings shall be submitted for every panel on this project. 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.

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11. Series AIC rating with upstream breakers.

1.7 PROJECT RECORD DOCUMENTS

A. Submit record documents to record actual locations of products; indicate actual branch circuit arrangement.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit Maintenance Data: Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as instructed by manufacturer.

1.10 MAINTENANCE MATERIALS

A. Provide two of each panelboard key.

1.11 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle panelboards and enclosures carefully to prevent damage.

B. Store equipment indoors and protect from weather.

C. Deliver tubs and internal assemblies sufficiently in advance of installation period as necessary to prevent delay of work. This time shall be established by a CPM provided by the Contractor and accepted by the supervising authorities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Square D.

B. Manufacturers (including accepted substitutions) must provide equipment equal to or superior than the basis of design used on this project.

1. Panels or circuit breakers with an AIC rating less than that shown on the Drawings will not be approved.

2. Where basis of design panelboard can accept a certain type, frame, and/or AIC rated breaker, the accepted substitution manufacturer must also be able to accept all equal breaker type, frame, and/or AIC rating.

2.2 GENERAL

A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1, circuit breaker type, dead front UL 67.

B. Panelboard Bus: Copper ratings as indicated. Provide aluminum ground bus in each panelboard. Provide isolated full size neutral bus where neutral is applicable. Provide non-linear load panelboards as specified on drawings. Non-linear panelboards shall have 200 percent rated neutral busbar.

C. Short Circuit Rating:

1. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards. Bus shall be braced for minimum capacity equal to or greater than the lowest breaker symmetrical interrupting capacity. Minimum short circuit rating shall be increased to meet the following requirements:

a) Individual CB AIC rating shown on panel schedules indicate lowest AIC rating allowed for individual circuit breaker in panel.

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- b) Panel Series AIC rating shown is the required rating of panel and its circuit breakers based on series rating of individual panel circuit breakers with panel main circuit breaker or upstream feeder breaker.
 - c) Circuit breaker types are not shown or called for. The Contractor must provide breakers in panel or feeder breakers in upstream breakers to comply with the required AIC ratings given, including providing current limiting breakers where required to achieve all ratings given.
2. Short Circuit Rating Label:
- a) Panelboards shall be labeled with a UL short-circuit rating.
- D. Enclosure:
- 1. Enclosures shall be at least 20" wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
 - 2. Enclosures shall be provided with blank ends.
 - 3. Where indicated on the drawings, branch circuit panelboards shall be column width type.
 - 4. Regulatory requirements:
 - a) NEMA PB 1, Type 1, Type 3R, or Type 4X as indicated on Drawings. Use only Type 3R or Type 4X for units to be installed outdoors. Use only Type 4X in interior wet locations and designated wash-down areas. For the purposes of this specification, a wash-down area is defined as any area that is directly washed or rinsed with any form of water hose.
 - 5. Cabinet Box: 6" deep, 20" wide minimum, constructed of code gauge steel, galvanized or bonderized to prevent rust.
- E. Cabinet Front: Flush or surface (as indicated on Drawings) cabinet front with concealed trim clamps, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard baked enamel finish for interior panels. Exterior panels to be painted with rust inhibit primer painted over on all surfaces with epoxy paint.
- F. Panels and breakers shall be rated for voltage and class of service to which applied.
- G. Spaces:
- 1. Space provisions or spaces for future breakers shall be located at the bottom of the panel and be fully bussed complete with all necessary mounting hardware less the breaker.
- H. Provide lugs as required for conductors being connected to panelboard lugs, circuit breakers, etc.

2.3 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).

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- C. Provide lugs as required for conductors being connected to panelboard lugs, circuit breakers, etc.
- D. Main circuit breaker is not to be mounted as branch breaker or subfeed breaker.

2.4 CIRCUIT BREAKERS

A. General

- 1. Molded Case Circuit Breakers: Plug-in type for 250V or less, bolt-on type for over 250V, thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- 2. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

B. Main Breakers:

- 1. Main breakers shall be individually mounted separate from branch breakers.
- 2. Covered by a metal plate, except for operating handle.
- 3. Connection from the load's side to the panel bus shall be bus bar. Insulated wire not permitted.

C. Branch Breakers:

- 1. Thermal-magnetic, molded case, with inverse time-current overload and instantaneous magnetic tripping, unless otherwise shown. Breakers shall be calibrated for 40 degrees C or shall be ambient compensating.
- 2. Quick-make, quick-break, with tripped indication clearly shown by breaker handle taking a position between ON and OFF.
- 3. Multi-pole breakers shall have common internal trip. No handle ties between single pole breakers are acceptable for this project.
- 4. Multi-wire branch circuit breakers shall have multi-pole breakers as required by the NEC. Handle ties between breaker handles are not acceptable.
- 5. Single pole 15 and 20 ampere circuit breakers shall be rated for switching duty and shall be labeled as "SWD."
- 6. AIC rating shall be as called for under "2.2 General."
- 7. Ground Fault Circuit Interrupters (GFCI):
 - a) Provide UL Class (5 milliamp sensitivity) ground fault circuit protection on 120 VAC branch circuits for exterior location receptacles and for interior locations where required by NEC. (These may not be indicated on Panel Schedule.) This protection shall be an integral part of the branch circuit breaker, which also provides overload, and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. Provide separate neutral for circuits on GFCI breakers whether indicated on drawings or otherwise.
- 8. Breakers feeding heating and air-conditioning equipment shall be rated HACR type breaker.
- 9. Breakers feeding high intensity discharge lamps systems shall be HID rated.

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- D. All breakers are to have lugs sized to match conductors called for on drawings.

2.5 SERVICE ENTRANCE EQUIPMENT

- A. Panelboards used as service entrance equipment shall be listed and labeled by UL for use as service equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1. Install all panelboards and panelboard enclosures in accordance with the manufacturer's written instructions, NECA Standard of Installation, the applicable requirements of the National Electrical Code, and recognized industry practices.
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 16190 Hangers and Supports.
- C. Height: 6' to top of panelboard; install panelboards taller than 6' with bottom no more than 4" above housekeeping curb.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Mount a typewritten directory showing the actual circuit numbers, type of load and room names on inside of door. Room names shall be actual names or numbers used, not necessarily shown on the drawings. Progress drawings shall show same arrangements as the directory. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 16195 Identification for Electrical Systems.
- G. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 4 empty 1". Identify each as "SPARE."
- H. Proper working clearances shall be maintained at every panelboard location. The working space in front of a panelboard shall be as a minimum, 30" wide extending 3', 3.5', or 4' (per NEC 110.26) out perpendicular to the panelboard.
- I. All enclosures shall be firmly anchored to walls and supporting structures (where used) using appropriate hardware. Provide supporting (unistrut type) channels on walls constructed of gypsum board or where otherwise necessary to provide a mechanically secure and permanent installation. Enclosures shall be installed so that the top is 6'-6" above finished floor. Where the size of the enclosure is such that the top cannot be installed at 6'-6", the top of the enclosure shall be kept as low as possible.
- J. Clean the interior of each panelboard before installing conductors. At all times, keep the interior trim and exterior surfaces of the panelboard free of rust and debris. Repaint finishes if necessary.
- K. Coordinate all raceways and conductors with their respective panelboards so that all connections and conductors routing present an orderly appearance. Conductors in the panelboards shall be laced and arranged in orderly manner.
- L. Collect all keys upon delivery of panelboard. Store keys on one ring to be kept by project superintendent. Forward key ring with keys to Owner upon substantial completion.
- M. Provide a separate neutral conductor for each GFI breaker. These shall not be combined to serve more than one circuit, even when on different phases. Increase plan indications of conductors for neutral wires required as necessary.

3.2 IDENTIFICATION

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- A. Refer to Section 16195 Identification for Electrical Systems for products and content.
- B. Provide engraved plastic nameplates under the provisions of Section Electrical Identification.
- C. Nameplate shall state panel name and voltage of this panel, name of panel that feeds this respective panel, and UL short-circuit rating of this panel.
- D. Provide labels and identification as required by the NEC.
- E. All circuit identifications and directories shall be checked to verify accuracy of the description of the load and/or equipment being fed

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.
- D. Feeder conductors shall be checked by accepted means to establish the absence of shorts to ground, insulation value, etc., and the result recorded and submitted to the Engineer.
- E. All circuits shall be operated to establish a good working order and checked for shorts.
- F. All panel directory circuit numbers shall be checked to verify accuracy of the number.
- G. Where and when requested by Engineer provide:
 - 1. Inspection of equipment by authorized equipment manufacturer technician complete with submittal of statement of findings by technician, and providing any adjustments deemed necessary for a complete and operating system.
 - 2. Ground, voltage, and/or load readings complete with submittal on legible form with applicable data.

END OF SECTION

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SECTION 16721
ADDRESSABLE FIRE ALARM-DETECTION SYSTEM (EXTENSION OF EXISTING)

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. The work described herein and on the drawings consists of all labor, materials, equipment, and services necessary and required to provide and test an extension of the existing automatic fire detection and alarm system. Any material not specifically mentioned in this specification or not shown on the drawings but required for proper performance and operation shall be provided.
- B. The drawings and specifications herein comply to the best of the Engineer's knowledge with all applicable codes at the time of design. However, it is this Contractor's responsibility to coordinate/verify (prior to bid) the requirements of the Authority Having Jurisdiction over this project and bring any discrepancies to the Engineer's attention at least ten days prior to bid. No changes in contract cost will be acceptable, after the bid, for work and/or equipment required to comply with the authority having jurisdiction.
- C. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications. All wiring and/or cabling shall be in conduit. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer's recommendations. Provide and install firestopping where penetrations are made through rated walls and floors.
- D. The Contractor shall provide and install the fire alarm system (including all equipment, wiring, etc.) in accordance with the manufacturer's recommendations.
 - 1. Installation of devices shall be in accordance with the manufacturer's requirements as well as the requirements of the Contract Documents. Recommendations by the manufacturer for the proper installation of the fire alarm system and its equipment shall not preclude the requirement for the Contractor to comply with the requirements of the Contract Documents.
 - 2. Termination of fire alarm circuits shall be in accordance with the manufacturer's recommendations, applicable requirements of the National Electrical Code (NFPA 70), ADA, other applicable Codes and the Contract Documents.
 - 3. Voice evacuation audio circuits (25V or 70V) shall be run in separate raceways from fire alarm data loops and other system circuits where the potential exists for interference or adverse effect upon the proper operation of the any fire alarm equipment, circuit or the system as a whole.
 - 4. The fire alarm installer shall be responsible for ensuring that prior to bidding the project the Electrical Contractor understands the raceway requirements for the project. Claims by the

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Contractor after award of the project in regard to additional raceway required either by the fire alarm system manufacturer's recommendations for proper installation of the system and its associated equipment, or for compliance with the requirements of the Contract Documents shall not be allowed.

5. The Contractor shall be responsible for providing personnel necessary to accomplish either a fire watch and/or a security watch in unprotected areas during times when the fire alarm system is off-line.
 - a) Where the fire alarm system is inactive in any area due to the work of this project, the contractor shall, as a minimum, provide personnel necessary to observe the status of each fire alarm control panel in the affected area.
 - b) When security functions provided by the fire alarm system are off-line in any area or partial area, the Contractor shall, as a minimum, provide one person at each AOA door until the system is operational. during those times where the off-line time is accidental, the contractor shall station personnel within five minutes of the system going off-line.
- E. This specification describes a fully addressable, common fire alarm system with remote power supplies.
 1. All components shall be connected via the Signaling Line Circuit (SLC) to the FACP.
 2. The installation includes the phasing in of new equipment, and/or conduits and temporary wiring, if required, for the existing system in areas of demolition, and then removal of the existing system.
 3. Any existing conduit that is in place, in good condition and meets this specification may be reused.
 4. All new components must be electrically compatible with the existing FACP and must be interconnected by means of suitable wiring circuits to form a complete functional system when the project is completed.
 5. Existing system must remain active at all times. Provide Fire Watch if system is taken off line at any location as required by applicable codes and the local Authority Having Jurisdiction.
- F. The Owner shall be responsible for any retrofits, installation and design required by the local AHJ to comply with the requirements of the 2010 Florida Fire Prevention Code Section 11.10. This code requirement can only be determined after the construction of the building and may or may not be required by the local AHJ in the area of this project.

1.3 DESCRIPTION

- A. The Contractor shall furnish and install an addressable fire alarm system extension to match the existing system. All devices shall be addressable. Control shall be microprocessor based and field-programmable. All electronics shall be solid state.
- B. Provide all materials, work, labor, etc. as required to modify (including any programming, battery capacity, etc.) the existing to comply with the operation, etc. noted in these Contract Documents.
- C. The system extension shall include but not be limited to:
 1. Main Fire Alarm Control Panel (FACP) including all required power supplies
 2. Fire Alarm Annunciator Panel (FAAP)
 3. Fire Alarm Shutdown
 4. Smoke Detectors

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5. Duct Detectors
 6. Remote Fire Alarm Control Panels (Network Nodes)
 7. Surge Suppression
 8. Programming
 9. Grounding
 10. Firestopping
 11. Wire and Cable Labeling
 12. Electrical power required to comply with all functions and operations called for in this section of the specifications.
 13. Conduit, wire, wire fittings, terminal cabinets with plywood and terminal strips, and all accessories required to provide a complete operating system.
- D. The Contractor shall furnish and install all equipment (raceways, wire/cable, circuit breakers, modules, relays, etc.) necessary, and as required by applicable code, to accomplish incidental functions of the fire alarm system including but not limited to the following:
1. Monitoring of sprinkler system and/or fire protection system flow and tamper switches
 2. Monitoring of sprinkler system and/or fire protection system valve supervisory switches
 3. Monitoring of post indicator valve (PIV) switches
 4. HVAC system control and/or shutdown
 5. Ventilation system (supply fans, exhaust fans, fan terminal boxes, etc.) control and/or shutdown
 6. Smoke control system control and/or shutdown
 7. Control of fire, smoke, and/or combination fire/smoke dampers
 8. Control of fire and/or smoke doors, dampers, shutters, etc.
- E. The system shall operate as a non-coded, continuous ringing system which will sound all audible devices and activate all visual devices until it is manually silenced. When system is silenced by silence switch in control panel, audible alarm is to silence, but visual alarm devices are to continue to operate.
- F. The system shall be wired as a ClassA or ClassB to match existing system for all circuits.
- G. The system is to be a complete analog addressable system.
- H. All portions of fire alarm system shall be installed in conduit. Conduit and boxes to be installed by electrical contractor.
- I. The fire alarm system shall not share a raceway, junction box, enclosure, manhole or device with any other system.
- J. Contractor to advise Owner of requirements for monitoring the fire alarm system by Owner's monitoring company and provide all electrical required for remote monitoring.
- K. Provide and install wiring, equipment, etc. for connection to devices furnished under other divisions of the work.
- L. Provide and install wiring, equipment, etc. as required to deactivate power in the elevator rooms by heat detectors via shunt trip breakers and arm sprinkler pre-action system.
- M. Provide and install wiring, equipment, etc. as required to deactivate power to computer power panels and air conditioning equipment by automatic or manual devices as shown on plans.

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- N. Although they may not be indicated on the fire alarm system diagram and/or drawings, all required control and interlock wiring between the fire alarm system and building equipment shall be provided hereunder, Controls are required to/for/from:
 - 1. Fire/smoke air and duct detectors
 - 2. Fire, smoke and/or combination fire/smoke dampers
 - 3. Supply/return fans, exhaust fans, and/or fan terminal boxes (FTB)
 - 4. Automatic fire extinguishing systems
 - 5. Smoke evacuation equipment
- O. Provide wiring for post indicator valve alarms, in each instance in which these are provided under work of other trades, connected to fire alarm system.
- P. Provide and install all relays (electric-electric, electric-pneumatic, and/or pneumatic-electric) as required for a complete and operational fire alarm system, complying with all applicable codes and all requirements, and coordinated with all divisions of these specifications.
- Q. Provide terminal cabinets sized to house terminal strips and surge suppression equipment.
- R. Surge Suppression
 - 1. The Contractor shall have equipment installed on the ac voltage supply and other lines taking care to arrest damaging electrical transient and spikes, which can cause damage to the microprocessor components of the system. Central office telephone lines shall have equipment installed to arrest high voltages from electrical and/or lightning from entering the system and causing damage.
 - 2. Provide and install all materials, labor and auxiliaries required to furnish and install complete surge suppression for the protection of building fire alarm system from the effects of induced transient voltage surge and lightning discharge as indicated on drawings or specified in this section.
 - 3. Provide surge suppression equipment at the following locations:
 - a) On each conductor pair and cable sheath entering or leaving a building.
 - b) On each conductor associated with fire protection (sprinkler) system fire alarm connections.

1.4 STANDARDS, CODES, REFERENCES, AND REGULATORY REQUIREMENTS

- A. Reference Section 16014.
- B. The equipment and installation shall comply with the current or applicable provisions of the following standards:
 - 1. ANSI S3.41 American National Standard Audible Emergency Evacuation Signal
 - 2. National Fire Protection Association Standards:
 - a) NFPA 70 National Electrical Code (including but not limited to Article 760, Fire Alarm Systems)
 - b) NFPA 72 National Fire Alarm Code
 - c) NFPA 101 Life Safety Code
 - d) NFPA 90A Installation of Air Conditioning and Ventilating Systems
 - 3. Underwriters Laboratories Inc. The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

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- a) UL 864 (Category UOJZ) APOU Control Units and Accessories for Fire Alarm Systems. All Control Equipment shall be listed under UL category UOJZ.
 - b) UL 268 Smoke Detectors for Fire Alarm Systems
 - c) UL 268A Smoke Detectors for Duct Application
 - d) UL 217 Smoke Detectors Single and Multiple Station Smoke Alarms
 - e) UL 521 Heat Detectors for Fire Protective Signaling Systems
 - f) UL 228 Door Closers With or Without Integral Smoke Detectors
 - g) UL 464 Audible Signal Appliances
 - h) UL 1638 Visual Signaling Appliances
 - i) UL 1481 Power Supplies for Fire-Protective Signaling Systems
 - j) UL 1480 Speakers
 - k) UL 1424 Cables for Power-Limited Fire-Alarm Circuits
 - l) UL 1971 Signaling Devices for the Hearing Impaired
 - m) UL 1449 3rd Edition - Standard for Safety Surge Protective Devices
 - n) UL 497, UL 497A, UL 497B
4. All fire alarm equipment, including accessories to the system and including all wires and cable unless otherwise noted, shall be listed by the Underwriters' Laboratories product directory called Fire Protection Equipment and/or the Electrical Construction Materials List.
 5. Each item of the fire alarm system shall be listed and classified by UL and FM as suitable for purpose specified and indicated.
 6. The system controls shall be UL listed for Power Limited Applications per NEC. All circuits must be marked in accordance with NEC.
 7. All equipment supplied as part of the Fire Alarm System shall be provided by a single manufacturer and shall comprise a complete UL Listed Fire Alarm System.
 8. IEEE: The fire alarm system includes solid state electronic components. Therefore, the equipment manufacturer shall provide certification that all such equipment is internally protected from, or can withstand, power line surge voltages and currents as specified in Table 1, Location Category A High Exposure of ANSI/IEEE Standard C62.41-1991.
- C. The equipment and installation shall comply with the current or applicable provisions of the following codes and laws:
1. Americans with Disabilities Act (ADA): The fire alarm system shall comply with ADA, Public Law 101-336, 1990. The system shall comply with ADA Accessibility Guidelines (ADAAG).
 2. Federal Register - Rules and Regulations - Non-discrimination on the basis of Disability by Public Accommodations and in Commercial Facilities.
 3. Local and State Building Codes.
 - a) Florida Administrative Code. All applicable chapters including but not limited to:
 1. Chapter 69A Rules, including but not limited to:
 - (a) Ch 69A-3 Fire Prevention - General Provisions
 - (b) Ch 69A-43 (Florida Handicap Code - Lodging)

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- (c) Ch 69A-46 Fire Protection System Contractors and Systems
 - (d) Ch 69A-47 Uniform Fire Safety Standards for Elevators
 - (e) Ch 69A-48 Fire Safety Standards for the Fire Alarm Systems
 - 2. Florida Building Code, Chapter 423, State Requirement for Education Facilities
 - 3. Florida Administrative Codes 33-8 (Jails)
 - b) Florida Department of Insurance:
 - 1. Insurance Code: The fire alarm system and installation thereof shall comply with the State of Florida Department of Insurance rules. The requirements of the Florida State Department of Insurance shall be as promulgated by the Division of State Fire Marshal.
 - 2. Fire Alarm Rules: The fire alarm system and installation thereof shall comply with the Fire Safety Rules promulgated by the Florida State Fire Marshal.
 - c) City of Orlando
 - d) Orange County
 - e) Authority Having Jurisdiction:
 - 1. General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
 - 2. Fire Department: Orange County
 - 3. Building Official: City of Orlando
 - 4. State of Florida: Division of State Fire Marshal.
- D. Surge Suppression
- 1. Equipment Certification: When available by any one manufacturer, all surge suppression equipment shall be listed by Underwriters Laboratories, shall bear the UL seal and be marked in accordance with referenced standard. Such surge suppression equipment shall be UL listed and labeled for intended use.
 - 2. Comply with all standards and guides as listed under "References" above.
- E. Systems not capable of complete network interface operations as described in this specification shall supply a complete local area or wide area network with CRT/terminals at each location and shall obtain UL site certification and acceptance prior to the completion date. Certification shall not delay final system acceptance.

1.5 RELATED SECTIONS

- A. All applicable sections of Division 0, Division 1, and Division 16.
- B. Applicable sections of these specifications with regard to, but not limited to:
 - 1. Extinguishing systems
 - 2. Ductwork accessories: smoke dampers
 - 3. Building control systems

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 10 years experience and with service facilities within 50 miles of Project.
- B. Manufacturer: Company specializing in manufacturing the products specified in this section with

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minimum 10 years experience and with service facilities capable of providing a maximum response time of 2 hours.

C. Installer:

1. Company specializing in installing the products specified in this section with minimum 10 years experience.
2. The Installer shall be currently licensed as a Florida Certified Alarm System Contractor I (EF).
3. The installing Contractor shall be a direct sales division of, or the authorized and designated distributor for, a fire alarm system manufacturer.
4. Installing Contractor shall maintain a local staff of specialists, including a Fire Alarm Planning Superintendent, for planning, installation, and service.
5. The Installing Contractor shall maintain an office with capability to provide emergency service 7 days a week, 24 hour days, with a maximum response time of 2 hours. The Installing Contractor shall have been actively engaged in the business of selling, installing and servicing fire alarm systems for at least 10 consecutive years going back from date of bid.

D. Surge Suppression

1. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electronics/communications systems equipment.
2. The surge suppressor manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor.
3. Verify proper clearances, space, etc. is available for surge suppressor.

E. Coordination/Project Conditions

1. Verify proper grounding is in place.
2. In installations where the electrical contractor does not provide a counterpoise system in conjunction with the underground raceway system, the fire alarm contractor shall provide a coupling conductor within the fire alarm underground raceway system to run along side fire alarm conductors. Coupling conductors shall be sized according to applicable codes and standards.

F. The work specified herein is an extension of the existing system and as such all equipment shall match existing. In the event that the existing equipment is no longer available other equipment will be considered for acceptance provided the following is submitted in writing by the system installer to the Engineer (See Division 1 requirements and Section 16013 on Substitutions):

1. Certified letter from the manufacturer specifically stating the following:
 - a) Part numbers and descriptions of each item that is no longer manufactured.
 - b) Manufacturer name (if not the same as the original manufacturer), part numbers and descriptions of items that are certified by the manufacturer to be compatible with the existing system.
 - c) A detailed listing of specific differences, including both advantages and disadvantages, between the original item and the proposed substitution.
2. Contractor qualifications (as listed above).
3. Complete lists, descriptions and drawings of materials to be used.

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4. A complete drawing showing conduit, conduit sizes, backboxes, number of wires and wire sizes.
5. A complete riser diagram of Fire Alarm System.

1.7 SUBMITTALS

- A. Submit in accordance with Sections 16010 and 16012.
- B. In addition to requirements of 16010 and 16012, the contractor shall submit:
 1. Narrative of operation of System as provided. (Submittal will not be reviewed by the A/E without this narrative.)
 2. Manufacturer's data on all products, including but not limited to:
 - a) Catalog cut sheets.
 - b) Roughing-in diagrams.
 - c) Installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
 - d) Operation and maintenance manuals.
 - e) Typical wiring diagrams and risers.
 - f) The contractor shall submit test reports, manufacturers' specifications and any other information necessary to determine compliance with material and equipment specifications described herein.
 3. Submit floor plans to locate all devices. Wiring diagrams shall include wire and raceway sizes, fire alarm control panels, communication panels, Fire Fighter's HVAC override panel, riser wiring and associated raceway sizes, wiring details, connections and terminal identification. All devices shall be identified by the same applied identification symbol as shown on the contract documents.
 4. Submit all load calculations and cable/wire sizing for each branch of the individual fire alarm field circuits. Wire sizing calculations to prove maximum three percent (3%) voltage drop at all ac voltages and maximum eight percent (8%) voltage drop at all dc voltages.
 5. Battery sizing calculations.
 6. Submit a detailed step by step testing procedure for a component by component system functional checkout and test.
 7. Point to point wiring diagrams and block diagrams of system to be installed. Point to point wiring diagrams may be submitted at time of operation and maintenance manuals in lieu of in submittal brochure. Block diagrams shall be required with submittals.
 8. Riser diagrams and floor plans showing conduit runs and number of wires. All devices shall be identified by the same applied identification symbol as shown on the drawings.
 9. Surge Suppression
 - a) Surge protective data for 120 volt power source, power circuit, outside signaling circuit, and exterior incoming circuits from other buildings (if any), and outgoing circuits to other buildings (if any).
 - b) Submit Product Data for each type of suppressor:
 1. Dimensions
 2. Means of mounting

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3. Compliance with UL Standards referenced
 4. Compliance with IEEE Standards referenced
 5. Design type (Hybrid, MOV)
 6. Size of wire leads
 7. Warranty
 8. Performance data showing compliance with performance as specified herein.
 9. Complete schematic data on each suppressor type indicating component values, part number, conductor sizes, etc.
 10. Manufacturer's certified test data on each suppressor type.
 11. Test data from an independent test laboratory.
10. Name, qualifications, etc. of company providing and installing system.
 11. Qualifications of installer. Submit proof installer meets specified requirements.
 12. Proof of UL Listing. Indicate the UL listing, the UL classification, and NEC insulation type used for each type of wire to be used in installation of fire alarm and communications system.
 13. Manufacturer's drawings showing all dimensions (height, width, and depth) for all cabinets used to house system components. Provide catalog pages, mounting details and specification sheets for all fire alarm system components and rough-in boxes.
 14. Submit Florida Registered Firm certificate number.
 15. Submit Florida Fire Alarm Contractor's license number.
 16. Submit Fire Alarm Technician(s) Manufacturer's certification.
 17. Detail of Fire Department override control panel layout.
 18. Detailed drawing of the Fire Alarm Control Panels layout indicating the exact arrangement of all zones, including expansion zones.
 19. Coordination Drawing: Coordination CAD drawing of building Fire Command room and equipment layout as shown on drawings, with all panel and rack footprints, using actual manufacturer's dimensions, indicating proper clearances.
 20. Network:
 - a) Complete description data indicating UL listing for all network components.
 - b) Complete sequence of operation of all functions of the network.
 - c) A list of every network node address.
 - d) A list of every address of every device connected to a network node that is provided for purposes of alarm initiation, status monitoring, supervised notification appliance circuits, and auxiliary control.
 - e) Complete network wiring diagrams for all components and interfaces to equipment supplied by others.
 21. All drawings required herein shall be on AutoCAD 2007 or higher.
 22. Where required by Authority Having Jurisdiction submit signed and sealed documents as required by Authority Having Jurisdiction. Where Authority Having Jurisdiction requires shop drawings to be signed and sealed by a Registered Engineer, Contractor is required to submit same and include in his bid all costs associated with having a Registered Engineer

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other than the design Engineer of Record perform signing and sealing.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit in accordance with Sections 16010 and 16098.
- B. In addition to the requirements of 16010 and 16098, the contractor shall submit:
 - 1. Updated and revised contract documents to record actual locations (as-installed) of all equipment, devices, initiating devices, signaling appliances, and end-of-line devices.
 - 2. Record actual type, size, and routing of cables installed.
 - 3. Record all cable identifications.
 - 4. Drawings required herein are in addition to those required under "OPERATION AND MAINTENANCE DATA".
 - 5. All drawings required herein to be on AutoCAD 2007 or higher.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit in accordance with Sections 16010 and 16098.
- B. In addition to the requirements of 16010 and 16098, the contractor's O & M Manuals shall include:
 - 1. A complete as-installed equipment list, listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item.
 - 2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codings (point-to-point wiring diagrams). System performance measurements shall be documented as noted elsewhere in this specification.
 - 3. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.
 - 4. Repair parts list for each and every major equipment item furnished.
 - 5. Service manuals for each and every major equipment item furnished.
 - 6. Manufacturer's warranties and operating instructions for each and every equipment item furnished. Include a copy of the certificate of warranty, signed by both parties.
 - 7. Technical Systems Operations Manual, custom-written by the Contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately.
 - 8. Surge Suppression
 - a) O & M data to include:
 - 1. All accepted shop drawings, product data, and/or cutsheets.
 - 2. Installation, connection, and maintenance information on each type of surge suppression.
 - 3. Procedure and/or time table for recommended periodic inspection of devices to determine continued usefulness.
 - 9. Complete equipment rack layouts showing locations of all rack mounted equipment items.
 - 10. CAD floor plans, prepared at a scale of not less than 1/16" = 1'-0" showing detectors,

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speaker locations and orientation, rack locations, and all other related device locations.

11. The Contractor/Installer shall videotape the entire training session(s), and submit the video tape with the Operational Manual.
- C. Drawings required herein are in addition to those required under "PROJECT RECORD DOCUMENTS".
1. All drawings required herein shall be on AutoCAD 2007 or higher.

1.10 WARRANTY

- A. The contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from date of acceptance by owner, repair or replace any equipment found to be defective.
1. No charges shall be made by the installer for any labor, equipment, or transportation during this period to maintain functions.
 2. Respond to trouble call within twenty-four (24) hours after receipt of such a call.
- B. The contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for one (1) year from date of final acceptance of the system.
- C. Surge Suppression
1. All surge suppression devices shall be warranted free from defects in materials and workmanship for a period of five (5) years.
 2. Any suppressor, which shows evidence of failure or incorrect operation during the warranty period, shall be repaired or replaced by the manufacturer and installer at no cost to the owner.
 3. Equipment that is damaged by surges during warrantee period shall be replaced at no expense to Owner.

1.11 ADDITIONAL DEVICES FOR JURISDICTIONAL COMPLIANCE

- A. Prior to bid, Contractor shall review plans and specifications carefully for compliance with all codes, and in particular the ADA requirements and NFPA 72. Contractor shall include in bid price any devices required to provide a fully compliant system. Said additional devices shall be shown on shop drawings submitted by Contractor.
- B. In addition to the above-mentioned devices, Contractor shall include in his bid price the cost of installing twenty additional audible/visual notification devices (over and above those shown on drawings, required by specifications, or determined by system installed to be required) whose location/need may not become apparent until just prior to substantial completion date. At least two weeks prior to substantial completion system shall be fully operational. After system is operational, Owner's safety representative and the system installer shall review the placement of and coverage provided by visual and audible signals throughout the facility for compliance with all codes, and in particular the ADA requirements and NFPA 72. System installer shall provide the additional devices at locations where the Architect/Engineer requests for complete coverage. The additional devices shall be installed and fully operational prior to date of Substantial Completion.
- C. After the project has had its first annual safety inspection, the system installer shall install within one week's notice any additional audible/visual signals that have been determined to be required during said inspection from the balance of the twenty additional devices noted above. There shall be no cost for these added devices provided the total does not exceed the balance remaining of the twenty devices noted above. The final balance of the twenty additional devices included in bid price shall be turned over to the Owner as spare material after any fire alarm issues identified during the first annual safety inspection are resolved.

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1.12 MAINTENANCE SERVICE

- A. Furnish service and maintenance of fire alarm system for one (1) year from date of Substantial Completion.
 - 1. No charge shall be made by the installer and/or contractor for any labor, equipment, or transportation during this period to maintain functions.
 - 2. Respond to trouble call within twenty-four (24) hours after receipt of such call.

1.13 EXTRA MATERIALS

- A. Provide six (6) keys of each type.
- B. Provide three (3) of each type of automatic smoke detector without base.
- C. Provide three (3) of each type of surge suppression device.

1.14 OWNER'S INSTRUCTION:

- A. Provide instruction to the Owner's designated personnel upon completion of the system installation. Instruction shall include a functional training session on fire alarm control panel operation and instruction on peripheral device operation, including what are normal indications and alarm indications of each type of new/added device. Videotape all training sessions and deliver (4) copies of tapes to Owner (for use in future training).

1.15 SYSTEM OPERATION

- A. System operation shall meet the operation requirements of all codes and regulatory requirements.
- B. Upon activation of the Fire Alarm System by a manual station, smoke detector, or any other new or existing automatic device, (except AHU smoke duct detector) the following shall take place:
 - 1. Energize all alarm signaling devices.
 - 2. Sound all audible alarms and flash visual signals throughout the campus. (See Item 9 below)
 - 3. Alert local fire department or proprietary system.
 - 4. Cause alarm to be displayed on the annunciator section of the control panel.
 - 5. Cause alarm to be displayed on remote annunciator
 - 6. Close all doors or fire shutters, held open by automatic release devices throughout the facility, or by zone (coordinate with architect and door hardware supplier, provide all electrical required).
 - 7. Unlock all electrically locked time-out room doors (coordinate with the architect and door hardware supplier, provide all electrical required).
 - 8. Shut down all air handlers, exhaust fans supplying or exhausting air, and fan terminal boxes (FTB).
 - 9. Shut down of air handling unit by a local smoke duct detector shall not activate audible alarms or flash visual signals, but shall provide a supervisory indication at the fire alarm control panel/fire alarm annunciator.
 - 10. Shut all fire and/or smoke dampers in ducts associated with the air handling units and exhaust fans which are shut down.
 - 11. Transmit signals to the building elevator control panel to initiate return to the main floor or alternate floor.

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12. Transmit signals to the building automation system to tell system that the fire alarm system has taken control of respective mechanical system.
 13. Send a signal to all dimming and lighting relay/control systems. Fire alarm signal shall initiate dimming system controls to drive all dimmed circuits to immediate full-on output. Fire alarm signal shall initiate lighting relay/control system to turn on all emergency lighting circuits.
 14. Send a signal to all non-fire alarm sound reinforcement systems (i.e. Cafeteria, Gymnasium, Multi-Purpose Room, Theater, etc.). Fire alarm signals shall override all other sound systems. Alarm notification signals shall take precedence over all other signals. Operation of other sound systems shall resume after fire alarm system clears alarm.
- C. System operation shall meet the operation requirements of all codes and regulatory requirements.
- D. Upon activation of the Fire Alarm System by a manual station the following shall take place:
1. Energize all alarm signaling devices.
 2. Sound all audible alarms and flash visual signals throughout the building.
 3. Alert local fire department or proprietary system.
 4. Cause alarm to be displayed on the annunciator section of the control panel.
 5. Cause alarm to be displayed on remote annunciator
 6. Close all doors, held open by automatic release devices throughout the facility, or by zone (coordinate with Architect and door hardware supplier, provide all electrical required).
 7. Unlock all electrically locked doors (coordinate with architect and door hardware supplier, provide all electrical required).
- E. Upon activation of the Fire Alarm System by any smoke detector, any sprinkler flow alarm switch or other automatic detection device, the following shall take place in addition to the above:
1. Shut down all air handlers and exhaust fans supplying or exhausting air in at least the zone where the alarm is initiated.
 2. Shut all smoke dampers in ducts associated with the air handling units and exhaust fans, which are shut down, in at least the zone where the alarm is initiated. (Coordinate with mechanical contractor and provide all electrical as required).
 3. Transmit signals to building elevator control panel to initiate return to main floor or alternate floor.
 4. Transmit signals to building automation system to tell system that the fire alarm system has taken control of respective mechanical system.
 5. Send a signal to all dimming and lighting relay/control systems. Fire alarm signal shall initiate dimming system controls to drive all dimmed circuits to immediate full-on output. Fire alarm signal shall initiate lighting relay/control system to turn on all emergency lighting circuits.
 6. Send a signal to all non-fire alarm sound reinforcement systems. Fire alarm signals shall override all other sound systems. Alarm notification signals shall take precedence over all other signals. Operation of other sound systems shall resume after fire alarm system clears alarm.
- F. Elevator: Smoke detectors associated with elevator lobbies, hoistways and machine rooms shall be types accepted by the Florida State Fire Marshall under FAC Chapter 69A.47 Uniform Fire Safety Standards for Elevators. Elevator recall shall be initiated ONLY by elevator lobby,

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hoistways and machine room smoke detectors. In addition to those functions outlined in "A" above, elevator detector(s) shall initiate the following functions.

1. The operation of any one elevator lobby, hoistways, or machine room product of combustion detectors associated with a single bank of elevators shall signal the elevator controls to commence required procedures for that bank of elevators. Refer to Division 14 for required procedures, floor(s) of recall, and alternate floor(s) of recall.
 2. The operation of any elevator machine room product of combustion detector that is part of this Fire Alarm System shall signal the elevator controls to commence required procedures for that bank of elevators. Refer to Division 14 for required procedures.
 3. The activation of the smoke detector(s) in a machine room, lobby or hoistway shall cause a suitable warning light to flash. The light is to be located adjacent to the "Phase One" recall switch or elevator hall button at the designated and alternate fire department access level.
 4. Fire alarm system shall monitor shunt trip voltage per NFPA 72.
- G. System supervisory faults, such as shorts, opens, and grounds in conductors, operating power failure, or faults within supervised devices, shall place the system in the trouble mode, which causes the following system operations:
1. Visual and audible trouble signal indicated be zone at the fire alarm control panel.
 2. Visual and audible trouble signal indicated at remote annunciator panel.
 3. Trouble signal transmitted to central station.
 4. Manual acknowledgement function at fire alarm control panel shall silence audible trouble signal; visual signal shall be displayed until initiating failure or circuit trouble is cleared.
- H. Alarm Reset: The system shall remain in the alarm mode until manually reset with a key accessible reset function. The system shall reset only if the initiating circuits are cleared.
- I. Lamp Test: manual lamp test function causes alarm indication at each lamp on the fire alarm control panel and the remote annunciator.
- J. When the fire alarm system is activated as a drill, all incidental functions shall be exercised including notification of the fire department.
- K. Where required by codes or Authority Having Jurisdiction:
1. When system is silenced by silence switch in control panel, audible alarm is to silence but visual alarm devices are to continue to operate.
- L. The fire sprinkler valve tamper switch, when closed, shall annunciate a supervision signal at the fire alarm control panel and annunciator panels, if any. This supervision signal shall not cause a general alarm.
- M. Operation of auxiliary contacts in control panel to shut all smoke dampers in ducts associated with air handling units and exhaust fans which are shut down. (These shall not be controlled from detector unit contacts.)

1.16 ZONING

- A. Alarm Zones.
1. Regardless of the number of zones shown on drawings, the minimum alarm zones required are:
 - a) One per building, per floor for pull stations.
 - b) One per building, per floor for automatic devices.

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- c) One for each duct smoke detector.
 - d) Zones as required by NFPA and FBC.
- B. Notification Zones.
- 1. Regardless of the number of zones shown on drawings the minimum notification zones (horns and strobe lights) required are:
 - a) One (or more) circuit(s) for administration building
 - b) One (or more) circuit(s) for exterior horns
 - c) One (or more) circuit(s) for remainder of campus.
 - 2. Breakdown circuits as required for load and distances involved.

PART 2- PRODUCTS

2.1 GENERAL EQUIPMENT AND MATERIAL REQUIREMENTS

- A. All equipment shall be new and unused. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on the contract drawings shall be the best suited for the intended use and shall be provided by a single manufacturer.
- B. Provide all equipment to match existing equipment required to perform all functions and/or features included in this section of the specifications although not specifically noted or specified herein.
- C. Modify/rework existing system and reprogram existing system as required for extension to new devices and/or as required for proper operation of system with new devices, adding new zone modules, adding surge suppression, adding power supply and battery capacity to meet regulatory requirements with new devices, etc.

2.2 RACEWAYS

- A. General:
 - 1. All raceways (conduit, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within Division 16 of these specifications.
 - 2. All raceways (conduit, wireways, pull boxes, outlet boxes, etc.) shall comply with all requirements of the manufacturer of the fire alarm system.
- B. Conduit: Comply with Section 16111 except as noted below:
 - 1. Pull Cords: Install pull cords in all raceway runs that are installed without cable.
 - 2. Size: Minimum size shall be 3/4" conduit.
- C. Boxes:
 - 1. All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable section of these specifications.
 - 2. Boxes shall be sized as required by the fire alarm system manufacturer and NEC for cables and/or device installed.

2.3 TERMINATION CABINETS

- A. Terminal cabinets are to comply with applicable sections of these specifications.

2.4 "SYSTEMS" AND "LOCAL" GROUND BUS

- A. Bus to comply with applicable sections of these specifications.

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2.5 POWER SUPPLY

- A. Provide additional power supplies with battery backup for all equipment as required for a proper and operating fire alarm system with new equipment connected.
- B. Power supplies shall supply sufficient power to sound all signals, flash all visual devices, and operate all required functions simultaneously, and shall operate on a single phase 120V ac source.
- C. The entire fire alarm system with new devices shall be provided with a continuous back-up power source (batteries) for uninterruptible service during normal/generator power switchover. The batteries shall provide operating and supervisory power for a minimum period of 24 hours, and shall be capable of operating all alarm devices for a duration of 15 minutes at the end of the 24 hour period. The standby battery system shall be supervised for both overcharging and low battery. The power supply shall include a properly sized automatic battery charger.
- D. The power supply for the panel and all fire alarm peripheral shall be integral to the control panel. The power supply shall provide all control panel and peripheral power needs as well as 3.0 amperes of unregulated 24V dc power for external audio-visual devices. The audio-visual power may be increased as needed by adding additional modular expansion power suppliers. All power supplies shall be designed to meet UL and NFPA requirements for power-limited operation on all external signaling lines, including initiating circuits and indicating circuits.
- E. The same manufacturer as the fire alarm control panel (FACP) shall provide all power supplies. Power supplies provided by manufacturers other than the manufacturer of the fire alarm control panel (FACP) shall not be acceptable.
- F. Circuit breakers, or other over-current protection on all power outputs.
- G. Input power shall be 120V ac, 60 Hz. The power supply shall provide internal batteries and charger. Internal battery capacity shall be as required.
- H. The battery pack shall provide maximum normal operating and supervisory power for:
 - 1. 24 hours per NFPA 72
 - 2. 60 hours per NFPA 72.
 - 3. Provide low maintenance gel cell type batteries with sufficient ampere-hour rating to meet the above NFPA Standard and to operate all alarm signals for a duration of 15 minutes at the end of the required period of time.
- I. Wall Mount Equipment Enclosure
 - 1. The control panel, and all associated equipment, shall be housed in an enclosure designed for mounting directly to a wall or vertical surface. The back box and door shall be constructed of 16 gauge steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.
 - 2. The enclosure(s) shall be of sufficient size to house all equipment required for this project. All equipment shall be mounted in the enclosure(s) as designed by the manufacturer. Provide enclosures in quantities as required to provide a complete, UL Listed fire alarm system.

2.6 DUCT MOUNTED SMOKE DETECTOR

- A. The Duct Mounted Smoke Detector for the fire and smoke detection system shall be a high velocity rated Analog addressable series smoke detector intended for use with ventilation and conditioning ducts.
- B. The detector shall provide detection of combustion gases and smoke in air conditioning ducts in

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compliance with NFPA 90A. The detector shall be UL-listed specifically for the use in air handling systems.

- C. The detector shall operate at air velocities ranging from 300 feet per minute to 4000 feet per minute without requiring compensation for operation at specific air velocities. Sampling tubes of proper length shall be provided and installed to match duct width at the installed location.
- D. Whether shown on drawings or not, a remote alarm indicator/test station shall be provided for each duct mounted smoke detector to annunciate smoke detector operation remotely. Mount unit in ceiling or wall near respective remote smoke detectors (in an occupied space).

2.7 ADDRESSABLE MODULE

- A. Analog addressable device shall be furnished as required to monitor fire alarm or supervisory initiating devices or control auxiliary functions. Each module shall contain address switches to assign a unique input point for programming or control by the system.

2.8 RELAYS

- A. Relays required for control (i.e. air handler shutdown, supply fan shutdown, exhaust fan shutdown, fan terminal box shutdown, door lock release, fire shutter release, smoke damper closure, fire damper closure, smoke/fire damper closure, or any other interface required by these specifications or applicable codes) shall be UL listed relays suitable for use in fire alarm systems.
- B. Per NFPA, relays used for control of other systems shall be located within three feet (3') of the device to be controlled.
- C. Relays shall be analog addressable devices powered and controlled from the fire alarm system. Each relay shall contain address switches to assign a unique input point for programming or control by the system.
- D. Each relay shall provide at least one set of Form "C" dry relay contacts.

2.9 AUDIBLE NOTIFICATION DEVICES

- A. Audible notification devices shall be wall mounted at each location designated on the drawings and/or as specified herein.
- B. The audible notification device shall include screw terminals for in-out field wiring. The device shall surface mount to a standard 4" sq. x 2 -1/8" backbox.
- C. The audible notification devices shall be UL listed for fire protective service and shall provide 24V dc inputs and sound output of not less than 75 dBA at 10 feet or more than 120 dBA at the minimum hearing distance from the audible appliance.
 - 1. The audible notification device shall be compliant with ANSI S3.41 for signal character conformance.
- D. Audible notification devices located on the exterior of a building, or in a damp or wet location, shall be a weatherproof version and rated, by the manufacturer, for use in wet locations.

2.10 AUDIBLE/VISUAL NOTIFICATION DEVICES

- A. Audible/visual notification devices shall be wall mounted at each location designated on the drawings and/or as specified herein.
- B. The audible/visual notification device shall include screw terminals for in-out field wiring. The device shall surface mount to a standard 4" sq. x 2 -1/8" backbox.
- C. The audible portion of the audible/visual notification devices shall be UL listed for fire protective service and shall provide 24V dc inputs and sound output of not less than 75 dBA at 10 feet or more than 120 dBA at the minimum hearing distance from the audible appliance.
 - 1. The audible portion of the audible/visual notification device shall be compliant with ANSI

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S3.41 for signal character conformance.

- D. The audible portion of audible/visual notification devices located on the exterior of a building, or in a damp or wet location, shall be a weatherproof version and rated, by the manufacturer, for use in wet locations.
- E. The visual portion of the audible/visual notification devices shall comply with the Americans with Disabilities Act which includes the following:
 - 1. The lamp shall be a xenon strobe type or equivalent.
 - 2. The color shall be clear or nominal white (i.e. unfiltered or clear filtered white light).
 - 3. The maximum pulse duration shall be two-tenths of one second (0.2 sec) with a maximum duty cycle of 40 percent. The pulse duration is defined as the time interval between initial and final points of 10 percent of maximum signal.
 - 4. The intensity shall be a minimum of 75 candela. The use of visual devices rated at 15/75, 15 or 30 candela shall not be acceptable. Field selectable devices may be utilized provided the device is set at 75 candela or higher and the setting of the device selector switch is visible when the device is installed.
 - 5. The flash rate shall be a minimum of 1 Hz and a maximum of 3 Hz.
 - 6. More than two visible notification appliances in the same room or adjacent space within the field of view must flash in synchronization. This requirement shall not preclude synchronization of appliances that are not within the same field of view.

2.11 SURGE SUPPRESSION

- A. Non-Addressable Initiation Devices:
 - 1. Plug-in replacement modular design with associated female wiring connector.
 - 2. UL 497B listed and labeled.
 - 3. Multi-stage hybrid protection circuit.
 - 4. Fail short/fail safe.
 - 5. Surge Capacity: 10KA with 8 x 20 μ s waveform, 500A per line with 10 x 700 μ s waveform.
 - 6. Clamp Voltage: 150% of circuit peak operating voltage with 100 amp 10 x 700 μ s waveform.
 - 7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
 - 8. Capacitance: 1500 pf.
 - 9. Manufacturer:
 - a) EDCO #PC642C series with #PCBIB base.
- B. Addressable Initiation Devices and Data Loops:
 - 1. Plug-in replacement modular design with associated female wiring connector.
 - 2. UL 497B listed and labeled.
 - 3. Multi-stage hybrid protection circuit.
 - 4. Fail short/fail safe.
 - 5. Surge Capacity: 10KA with 8 x 20 μ s waveform, 500A per line with 10 x 700 μ s waveform.

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6. Clamp Voltage: 150% of circuit peak operating voltage with 100 amp 10 x 700 μ s waveform.
 7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
 8. Capacitance: 50 pf.
 9. Manufacturer:
 - a) EDCO #PC642C-LC series with #PCBIB base.
- C. Power Circuit (120 volt):
1. UL 1449 listed.
 2. 15 amp, 120V rated.
 3. Suppressors shall be tested per IEEE, C62.41-1991 for Categories A and B.
 4. Normal mode (L-N), and common mode (L+N-G) protection.
 5. Internal fusing.
 6. Hybrid design.
 7. Indicators for normal operation and failure indication.
 8. Enclosure:
 - a) Fire retardant high impact, phenolic or plastic housing or metal enclosure.
 9. Clamping voltage UL 1449, Line to Neutral, Category B Impulse At (3KA, 8 x 20 μ s): 385V @ 120V.
 10. Maximum Surge Capacity: 20,000 amps.
 11. Maximum Continuous Operating Voltage: 115% of line voltage.
 12. Provide hardwire connection or add 15 amp receptacle device to hardwired devices to match equipment being protected and maintain UL listing.
 13. Provide additional 15 amp in-line fusing as required to comply with UL and the N.E.C. when connected to a 20 amp, 120V circuit.
 14. Manufacturers:
 - a) Leviton #51020-WM (hardwired).
 - b) EDCO #HSP-121BL2.

2.12 CABLE

- A. Contractor shall provide and install cable as required by the manufacturer, as specified elsewhere in these specifications, and to provide a complete, fully operational, UL Listed fire alarm system.
- B. Fire alarm system cables installed in exterior and/or underground raceways shall comply with the applicable sections of NEC Article 800.

2.13 WATERFLOW DETECTOR

- A. Waterflow switch to be supplied and installed by the mechanical contractor and wired in to fire alarm system by Systems Contractor. Zone as shown on zone schedule.

2.14 SPRINKLER SUPERVISORY SWITCHES

- A. Supervisory Switch to be supplied and installed by mechanical contractor and wired in to fire alarm system by Systems Contractor. Zone as shown on zone schedule.

2.15 PRESSURIZATION

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- A. Upon alarm from the fire alarm system, the fire alarm control panel shall activate pressurization fans for both stairwells and the elevator shaft. Systems Contractor shall provide control relay, 24V dc coil, one per fan, to accomplish this action. Smoke dampers on the roof shall be closed in order for pressurization to be accomplished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications. All wiring and/or cabling shall be in conduit. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer's recommendations. Provide and install firestopping where penetrations are made through rated walls and floors.
- B. Make final connections between new or modified components and the existing fire detection and alarm system.
- C. Provide any programming required at the fire alarm control panels, remote panels or fireworks computers. This includes programming in support of outages, planned or unplanned, of the system.
- D. Test and certify the completed system in accordance with all regulatory requirements.
- E. Update the system as-built drawings, CAD files and bitmaps.
- F. Locate, install, and test fire alarm and detection systems in accordance with the equipment manufacturer's written instructions, and the latest editions of the NFPA, the National Electrical Contractor's Association publication "Standard of Installation" and all applicable codes and standards referenced in this specification.
- G. Modify/rework existing system as required for extension to new devices and/or as required for proper operation of entire system, adding new zone modules, surge suppression, power supply and battery capacity or new devices to meet regulatory requirements.
- H. Rework/modify/reprogram existing fire alarm control panel and remote control panels to accept and reflect all changes made by alterations as specified.
- I. Modify/update the existing fire alarm as-built (mylars and blue line) drawings and CAD files to reflect modifications, additions, etc., made by this project. Provide blue line sets of changes for approved and company with all additional requirements as outlined in specifications.
- J. Provide all work required for a complete system including complete system testing and checkout. All components shall be properly mounted and wired. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.
- K. Provide wiring, cabling, raceways, and electrical boxes in accordance with manufacturer's written instructions.
- L. Components shall be electrically "burned-in" by operating the component at full power for a period as recommended by the manufacturer.
- M. Installation shall be done in a neat workmanlike fashion by a firm regularly engaged in fire alarm

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installation and service.

- N. The installation and inspection of all fire detection and fire alarm devices and systems shall be performed by, or under the direct on-site supervision of, a licensed fire alarm technician or a fire alarm planning superintendent who shall certify the work upon completion of the activity. The certifying licensee shall be present for the final test prior to certification.
- O. Installation plans and wiring diagrams shall bear the signature and license number of the licensed Fire Alarm Planning Superintendent, the date of installation and the name, address, and certificate of registration number of the registered firm.
- P. After completion of the installation of the system, the licensee shall complete a NFPA installation certificate. The installation certificate format shall be furnished by the State Fire Marshal. When an installation certificate form has been completed, legible copies shall be distributed as directed by the State Fire Marshal.
- Q. After an installation has been complete, affix a Fire Alarm Tag to the control panel. The Fire Alarm Tag is in addition to the installation certificate. Protect the Fire Alarm Tag from vandalism by applying pressure sensitive label; do not use a "tie on" tag. It shall be as required in the Fire Safety Rules as promulgated by the Florida State Fire Marshal.
- R. Power supplies are to be loaded to a maximum of 75% of their capacity. Provide additional power supplies where required to comply with this maximum loading requirement.
- S. As-built plans and wiring diagrams shall bear the signature and license number of the licensed fire alarm planning superintendent, the date of installation and the name, address, and certificate-of-registration number of the registered firm.
- T. All components shall be completely wired. System shall be fully operable when main power service has failed and the Emergency Standby Generator has assumed emergency system loads. This shall require that any devices, which required 120 volt power shall receive, supply from an emergency 120 volt source.
- U. Installation of detectors:
 - 1. All ceiling mounted detectors shall be installed in accordance with the requirements of NFPA 72.
 - 2. All concealed detectors shall be provided with a remote indicating lamp and test switch installed in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.
 - 3. Duct detectors shall be installed in accordance with NFPA 90A. All brackets and hardware shall be provided as required to install detector housing in correct position. All detector housings shall be sealed as required to prevent air leakage between duct and housing. Sampling tubes of proper length shall be provided and installed to match duct width at the installed location.

3.2 RACEWAYS AND BOXES

- A. Provide dedicated raceway with applicable boxes for all fire alarm wiring in accordance with applicable sections of these specifications.
- B. All initiating, indicating and auxiliary control devices shall be mounted on UL listed outlet boxes.
- C. Provide supporting devices per Section 16190.
- D. Identify raceways and boxes per Section 16195.

3.3 WIRE/CABLE

- A. Conductor: 98% conductivity, solid copper or stranded copper. If stranded conductors are used,

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then a compression lug shall be installed at every end. Wrapping twisted strands at terminal block screw is not acceptable. As an acceptable equivalent, stranded conductors without crimp-on lugs may be terminated into terminal strips of box-lug connectors.

- B. Insulation: A type accepted by NEC for the application. Individual conductors shall be Type THHN/THWN. All cable shall be UL listed for fire-protective signaling application. Communication, Class 3 or Multi-Purpose cables shall not be substituted for FP cable types.
- C. Size: All conductors shall be sized as prescribed by the system manufacturer, with following minimums:
 - 1. Multiplex Signaling Line Circuit: AWG #14, shielded twisted pair cable.
 - 2. Initiating Circuits, Hard-Wired Devices: AWG #14, THHN/THWN conductors.
 - 3. Notification Circuits: AWG #14, THHN/THWN conductors.
 - 4. Initiating Circuits, Addressable Devices: AWG #14, shielded twisted pair cable.
 - 5. Provide larger conductors where required to maintain voltage drop or signal strength within acceptable limits.
- D. The above wire sizes shall be increased to size as required to comply with authority having jurisdiction or as required for voltage drop, load, etc.
- E. Color Coded:
 - 1. Wiring shall be color coded as required to match existing system.
 - 2. Permanent wire materials shall be used to identify all splices and terminations for each circuit at all junction boxes, outlet boxes, and terminations.
- F. UL:
 - 1. General: Fire-protective signaling cable shall be UL listed as non-power limited or power limited as needed to match the output of the fire alarm equipment.
 - 2. Non-Power Limited: Fire protective signaling circuits classified as non-power limited shall use cable listed under UL Electrical Construction Materials Directory. Category HNHT, "NON-POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". all such cable shall have fire resistance, listing and markings as described in NEC 760.176. Minimum cable marking shall be NPLF.
 - 3. Power Limited: Fire protective signaling circuits classified as power limited shall use cable listed under UL Category HNIR, "POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". All such circuits shall be durably marked where plainly visible at terminations to indicate that it is a power-limited fire protective signaling circuit. Refer to paragraph titled "Fire Resistance of Cables" for additional requirements.
 - 4. Fire Resistance of Cables: Power-limited fire-protective signaling circuit cables shall be UL listed as described in NEC 760.179. All such cable shall bear a cable marking that includes a Type designation as given in NEC Table 760.179(I). Provide Type FPL.
- G. Connections of Installation Wiring:
 - 1. Connections to Equipment: In accordance with NFPA for monitoring integrity and with the equipment manufacturer's instructions.
 - 2. Connections of installation wiring to alarm initiating devices and alarm indicating appliances shall be monitored for integrity.
 - 3. Interconnecting means shall be arranged so that a single break or single ground fault will not cause an alarm signal.

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4. Apply a compression lug, similar to T&B Sta-Kon Terminal, to all stranded conductors at terminations or use box-lug terminal strips.
5. There shall be no wire splices. All wiring shall be continuous, uncut between devices and terminal blocks.

H. Rated Enclosures:

1. All vertical fire alarm wiring traversing more than one level shall be routed in rated enclosures. In addition, all horizontal wiring serving devices location on floors other than where wiring originates shall be routed in 2-inch concrete encasement, suitable rated building construction, or 2-hour wrap application enclosure accepted by local authority having jurisdiction.

3.4 END-OF-LINE DEVICE

- A. Mount end-of-line device box with last device or separate box adjacent to last device in circuit.

3.5 AUXILIARY CONTROL RELAYS

- A. An auxiliary fire alarm relay used to control an emergency control device, e.g. motor controller for HVAC system fan or elevator controller shall be located within 3 ft. of the emergency control device.
- B. The installation wiring between the system panel and the auxiliary fire alarm relay shall be monitored for integrity.
- C. Auxiliary control relays shall be listed for use with fire alarm systems.
- D. All ceiling mounted detectors shall be installed in accordance with the requirements of NFPA 72.
- E. All concealed detectors shall be provided with a remote indicating lamp installed in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.
- F. Label each device with point number.

3.6 INSTALLATION OF DUCT DETECTORS

- A. Comply with all applicable codes and standards including but not limited to:
 1. NEMA Guide for Proper Use of Smoke Detectors in Duct Applications
 2. Full requirements of detector UL listing.
 3. NFPA 90.
 4. Refer to Part 1 – General for additional standards.
- B. Location: To permit proper sampling of the air within a duct, locate supply air duct detectors downstream from fans, filters, humidifiers, and heating/cooling elements (if codes permit). Locate supply or return air duct detectors at least six duct widths (diameters) from any opening, detector, bend, or branch connection. When physical parameters or codes make it impossible to meet the six width requirement, locate the detector as far as possible from the obstacle.
- C. All brackets and hardware shall be provided as required to install detector housing in correct position. All detector housings shall be sealed as required to prevent air leakage between duct and housing.
- D. All concealed detectors shall be provided with a remote indicating lamp installation in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.

3.7 STAIRWAY PRESSURIZATION

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- A. Upon alarm from the fire alarm system, the fire alarm control panel shall activate pressurization fans for both stairwells and the elevator shaft. Provide control relay, 24V dc coil, one per fan, to accomplish this action. Also, the applicable smoke dampers on the roof shall close in order for pressurization to be accomplished.

3.8 MAIN FIRE ALARM CONTROL PANEL AND ASSOCIATED EQUIPMENT

- A. Install all programming and software changes to existing fire alarm control panel to provide a complete and operational extension of the existing system as specified.
- B. All functions/operations/performance specified are to match the same functions/operations/performance of the existing fire alarm system.
- C. All color graphic AutoCAD bit maps shall be updated and tested.

3.9 CABLE IDENTIFICATION

- A. Provide and install permanent cable markers on all cables/wire lines, telephone lines, etc. at terminal strips, terminal cabinets and at main equipment.

3.10 SURGE PROTECTION

A. General

- 1. Provide, install and connect new surge suppression equipment as specified herein, including protection of equipment power source, cable/wire entering or leaving building housing, main fire alarm system equipment, ground lugs, #6 copper ground wire in 3/4" c. to existing main building service ground.
- 2. Extreme care shall be taken by contractor to assure a properly surge protected system.
- 3. Surge protection equipment must be selected by contractor to match the equipment being protected including wire sizes, operating volts, amps, and circuit impedance.
- 4. Installation of surge protection equipment and its grounding must be per manufacturer's recommendations to assure short and proper ground paths.

B. Equipment Selection

- 1. Contractor to coordinate with suppliers and installers of all equipment being protected and provide surge suppression equipment which meets these specifications on respective equipment, wires, etc.

C. Equipment Installation

- 1. Install surge suppression equipment per manufacturers recommendation at each wire terminal as noted under Part 1.
- 2. Install surge suppression equipment terminal cabinets, etc. as required to facilitate installation of surge protection equipment and terminal points. Increase size of terminal cabinets (from that shown on drawings) to size required to facilitate installation of surge suppression equipment and terminal blocks.
- 3. Locate surge suppression equipment in terminal cabinet nearest main equipment cabinet (FACP).
- 4. Coordinate with Section 16691 contractor to assure that surge suppression for 120V ac power circuit and surge suppression required by this section are all installed in same terminal cabinet and bonded together.

D. Ground Installation

- 1. Ground Bus Connections.
 - a) Provide "local" ground bus in each terminal cabinet housing surge protection

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- equipment (with lugs, etc. as required).
- b) Bond "local" ground bus to terminal cabinet with minimum #6 copper wire.
 - c) Connect terminal cabinet "local" ground bus to "systems" ground bus installed per 16170 with minimum #6 copper insulated wire (unless otherwise noted) in conduit.
 - d) Note that "systems" ground bar is also to be used for power transformation ground (480V to 208V) where applicable.
2. Surge suppression equipment grounding.
- a) Connect each surge suppressor to local ground bus in terminal cabinet with wire sized as recommended by manufacturer. Where "M" block type terminations/surge suppressors are used, bond ground rail to local ground bar with wire as recommended by manufacturer.
 - b) Coordinate with Section 16691 contractor to assure that 120V ac power source/supply surge suppressor is also grounded to same local ground bus as surge suppressors provided in this section for same system (i.e. fire alarm, intercom, television, etc.).
3. Conductors.
- a) Conductors shall meet requirements of Section 16123. Minimum size to be #12 THWN.
 - b) Bends in excess of 90 degrees in any grounding conductor shall not be permitted. A radius of 6 inches or greater shall be maintained on all bends.
 - c) Do not bundle unprotected conductors with protected conductors.
 - d) Conductors shall be kept as short as possible.
 - e) Conductors shall be secured at 12" intervals with an accepted copper clamp.
 - f) Grounding conductors shall be properly connected to the building service ground by accepted clamps.
4. Grounding Connectors
- a) Connectors, splicers, and other fittings used to interconnect grounding conductors, bond to equipment or grounding bars, shall be accepted by NEC or UL for the purpose.
 - b) All connectors and fittings shall be of the Nicopress crimp or compression set screw type.
 - c) Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electro-galvanic action.
5. Telephone Circuits
- a) Systems utilizing telephone company pairs as a transmission medium shall be provided with a suppressor conforming to device in Part 2 of this specification.
 - b) Suppressors shall be installed at each point where interface is made to telephone company pairs.
 - c) In cases where a modem or other device is used to interface with the telephone circuit the following procedure shall apply:
 1. Where the modem or coupling device is furnished by the telephone company the suppressors shall be installed on the system side of the modem or coupling device.

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2. Where the modem or coupling device is furnished by the system contractor, the suppressor shall be installed on the telephone line side of the modem or coupling device.

3.11 EXISTING CONDITIONS

- A. Existing fire alarm control panel and all associated electrical is to be removed, complete.
- B. All existing fire alarm wiring and conduit is to be removed complete.
- C. Contractor shall investigate existing conditions prior to bid.

3.12 CONDUIT/BOX IDENTIFICATION

- A. Contractor shall identify fire alarm conduit and boxes with red paint in exposed locations. Identify conduit in concealed locations with 4" mark of red paint every 4'-0" OC.

3.13 DEMONSTRATION

- A. When system is complete it shall be demonstrated to owner's representative who shall be given complete instructions, spare parts, manuals and maintenance information.

3.14 SYSTEM TESTING

- A. Prior to certification of the fire alarm system the contractor shall accomplish a complete test of the fire alarm system in accordance with NFPA 72, Chapter 10, paragraph 10.4 Testing.
- B. Perform a complete, functional, component by component test of the entire fire alarm and detection system. Provide a detailed step by step testing procedure, which is unique to this project, reflecting the type of system and the number and location of all components.
- C. Demonstrate the proper operation of each component as follows:
 1. Ionization, photoelectric, and duct smoke detectors: activate the detector with a "false smoke" product which has been specifically formulated for testing smoke detection systems.
 2. Heat detectors: activate the detector by utilizing the detector check button.
 3. Pull Stations: activate the station by operating the station in its normal mode.
 4. Audible and Visual Alarms: verify proper operation when the system is put into the alarm mode.
 5. Sprinkler Flow Switches: open the sprinkler system's inspection test valve. Verify that the flow switch sends an alarm signal within the allowed time corresponding to the switch's time delay setting.
 6. Fire Alarm Panels: functionally check-out and test the panel per the manufacturer's written instructions. Demonstrate the proper operation of each modular component. Demonstrate automatic power change to batteries and back to building power upon a drop in voltage below the voltage threshold as specified by the panel manufacturer.
- D. Demonstrate the supervisory function at each device loop circuit, and at all single component wiring runs such as for the sprinkler valve supervisory switches.

3.15 CERTIFICATION

- A. After completion of the installation of the system, the licensee shall complete a NFPA Inspection and Testing form. The Inspection and Testing form format shall be as indicated in NFPA 72, Chapter 10, Figure 10.6.2.3 Inspection and Testing form. When an Inspection and Testing form has been completed, legible copies shall be distributed as directed by the Authority Having Jurisdiction.
- B. After an installation has been complete, affix a Fire Alarm Tag to the control panel. The Fire

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Alarm Tag is in addition to the Inspection and Testing form. Protect the Fire Alarm Tag from vandalism by applying pressure sensitive label; do not use a "tie-on" tag. It shall be as required in the Fire Safety Rules.

3.16 FINAL DRAWINGS

- A. As-built drawings shall be given to the Owner's representative, at time of instruction, in addition to those to be supplied as general requirements of the job.

3.17 AUTHORITY HAVING JURISDICTION

- A. The drawings and specifications herein comply to the best of the Engineer's knowledge with all applicable codes at time of design. However, it is this contractor's responsibility to coordinate/verify (prior to bid) the requirements of the authority having jurisdiction over this project and bring any discrepancies to the Engineer's attention at least seven days prior to bid. No changes in contract cost will be acceptable after the bid for work/equipment required to comply with the Authority Having Jurisdiction.

END OF SECTION