



**ORANGE COUNTY CONVENTION CENTER
WEST BUILDING – DOCK 7
SERVER ROOM AHU ADDITION
BID DOCUMENTS**

**FOR
ORANGE COUNTY
CAPITAL PLANNING & CONSTRUCTION GROUP
ORANGE COUNTY CONVENTION CENTER
P.O. BOX 691509
ORLANDO, FLORIDA 32869-1509**

**BY
MATERN PROFESSIONAL ENGINEERING, INC.
130 CANDACE DRIVE
MAITLAND, FLORIDA 32751**

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**ORANGE COUNTY CONVENTION CENTER
WEST BUILDING – DOCK 7
SERVER ROOM HVAC REPLACEMENT
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

- 1. Addition of the new AHU-3-16A serving the Dock 7 Server Room within the West Building. AHU is located on the Level 3 Mechanical Mezzanine behind Hall C.
- 2. All new supply and return ductwork from the new AHU to serve the server room. Diffusers and grilles shall be appropriately located to create a hot aisle/cold aisle for the electronic equipment in the room.
- 3. Capacity of AHU-3-16A will be minimum 20 tons.

1.04 CONTRACTOR RESPONSIBILITIES

- A. The contractor shall have all submittals approved by the Engineer and accepted by the Owner prior to the start of active construction.
- B. The contractor shall have all equipment and material onsite prior to the start of active construction.
- C. 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
- D. The contractor shall field verify existing conditions of construction prior to start of active construction.
- E. 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.
- F. The contractor is responsible for moving equipment if necessary to perform the work

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included in the contract. The contractor is responsible for placing the equipment back in its original location. The contractor is responsible for any damages to equipment, etc., which occur during construction. The contractor shall provide protection for equipment and any other items that may be subject to damage during the construction periods.

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

1.05 WORK SEQUENCE

- A. The facility shall remain occupied and operational while work is in progress. Normal business hours are defined as 8am to 5pm. Material and equipment deliveries will be during normal business hours. All work shall be performed during occupied and unoccupied hours, during the week and on weekends. All work is to be coordinated with the Owner.

1.06 CONTRACTOR USE OF PREMISES

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

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operations. Take all precautions necessary to protect the building and it's 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.
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 pollution control requirements.
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. Smoking is not allowed inside the building.
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.

1.07 SECURITY AND IDENTIFICATION

- A. 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.
- B. Background Checks for the contractor's staff must be approved by Orange County's

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Security team prior to working in any County facility. Contractors are responsible for obtaining the necessary forms for background checks for work at the Convention Center. All contractor's staff background checks will be sent to Crystal.Rurut@occc.net for approval.

- C. 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***
- D. The Convention Center will inform the contractor of their Background Check results. Upon Background Check approval, the contractor's staff shall arrange an appointment with the Convention Center 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.
- E. Contractor's employees will not be allowed in Orange County facilities without completed and approved background investigations.
- F. Work hours will be scheduled around business activity. Work is required to be scheduled around no show activity in section of the building project work is scheduled. Contractor will be required to mobilize more than once to accommodate Convention Center show schedules.

1.08 OWNER OCCUPANCY

- A. Owner Occupancy: The Owner will be occupying the building during construction. Normal occupancy hours are 7 AM to 6 PM Monday through Friday, however, it varies with show activity. The contractor is to coordinate with the Owner for areas in the building that work can be performed.

1.09 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.

1.10 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. 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

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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 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.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01027

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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

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.

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- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Schedules
 - 2. Installation and removal of temporary facilities
 - 3. Delivery and processing of submittals
 - 4. Progress meetings
 - 5. Project close-out activities
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
 - 1. Salvage materials and equipment (if any) involved in performance of, but not actually incorporated in, the Work.
- E. Lack of coordination as specified in this and other sections of the contract documents are in grounds for assessment of back charges and/or termination in order to remediate the situation.

1.04 SUBMITTALS

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

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 GENERAL INSTALLATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
- C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
- D. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.
- E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to Project Manager for final decision.
- F. Recheck measurements and dimensions, before starting each installation.
- G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- H. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the 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,

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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

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 PRE-CONSTRUCTION CONFERENCE

- A. Schedule a pre-construction conference and organizational meeting at the project site or other convenient location no later than 20 days after execution of the agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attends: The 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

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14. Security
15. Housekeeping
16. Working hours

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

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

1.04 PRE-INSTALLATION CONFERENCE

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

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
 - a. Contract Documents
 - b. Options
 - c. Related Change Orders
 - d. Purchases
 - e. Deliveries
 - f. Shop Drawings, Product Data and Quality Control Samples
 - g. Possible conflicts
 - h. Compatibility problems
 - i. Time schedules
 - j. Weather limitations
 - k. Manufacturer's recommendations
 - l. Comparability of materials
 - m. Acceptability of substrates
 - n. Temporary facilities
 - o. Space and access limitations
 - p. Governing regulations
 - q. Safety
 - r. Inspection and testing requirements
 - s. Required performance results
 - t. Recording requirements
 - u. Protection
2. Record significant discussions and agreements and disagreements of each conference along with and approved schedule. Distribute the record of the meeting to everyone concerned promptly including the Owner and

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.
- 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

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- 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.

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.
- 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

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

1.07 SHOP DRAWINGS

- A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered a Shop Drawings and will be rejected.
- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
1. All required dimensions
 2. Identification of products and materials included
 3. Compliance with specified standards
 4. Notation of coordination requirements
 5. Notation of dimensions established by field measurement
 6. Sheet Size: Except for templates, patterns and similar full-size Drawings on sheets at least 8" x 11" but no larger than 24" x 36".
 7. Number of Copies: Submit one (1) electronic copy of each submittal to the County's Representative, unless copies are required for operation and maintenance manuals. Submit one (1) electronic copy where copies are required for operation and maintenance manuals. Engineer will retain 1 electronic copy. Mark up and retain one returned electronic copy as a Project Record Drawing.
 8. Submit one (1) hard copy once approved for legal seal stamping if needed at jobsite. Coordinate with Engineer and County's Representative.
 9. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connections with construction.
- C. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.
1. Preparation of coordination Drawings is specified in section Project Coordination and may include components previously shown in detail on Shop Drawings or Product Data.

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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
PRODUCT 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.

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2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitution, and the following information, as appropriate:
 - a. Product Data, including Drawings, and descriptions of products, fabrication and installation procedures.
 - b. Samples, where applicable or requested.
 - c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
 - d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 - e. A statement indicating the substitution's effect on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - f. Cost information, including a proposal of the net change, if any in the Contract Sum.
 - g. Certification by the Contractor that the Substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
3. Engineer's Action: Within two weeks of receipt of the request for substitution, the Engineer will request additional information or documentation necessary for evaluation of the request if needed. Within two (2) weeks of receipt of the request, or one week of receipt of the additional information or documentation, which ever is later, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the project specified by name. Decision on the use of a product substitution or its rejection by the Engineer is considered final. Acceptance will be in the form of a Change Order.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

- A. Conditions: The Contractor's substitution request will be received and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise request will be returned without action except to record noncompliance with these requirements.
 1. Extensive revisions to Contract Documents are not required.
 2. Proposed changes are in keeping with the general intent of Contract Documents.
 3. The request is timely, fully documented and properly submitted.
 4. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method

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cannot be provided as a result of failure to pursue the work promptly or coordinate activities properly.

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

END OF SECTION 01631

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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

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the work. Immediately prior to the date or dates of substantial completion, complete miscellaneous record and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Project Manager for the Owner's records.

- G. Maintenance Manuals: Organize operating and maintenance data into four (4) suitable sets of manageable size and electronically as PDFs on one (1) CD-ROM compact disc. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:
1. Emergency instructions
 2. Spare parts list
 3. Copies of warranties
 4. Wiring diagrams
 5. Recommended turn-around cycles
 6. Inspection procedures
 7. Shop Drawings and Product Data
 8. Fixture lamping schedule

PART 2 PRODUCTS (Not 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

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3.02 PROJECT CLOSE-OUT MANUALS AT SUBSTANTIAL COMPLETION

- A. Submit Project Close-out Manuals prior to issuance of final application for payment. Provide one (1) hardcopy.
- B. Bind in commercial quality 8 ½" x 11" three ring binder, indexed with hardback, cleanable, plastic covers.
- C. Label cover of each binder with typed title PROJECT CLOSE-OUT MANUAL, with title of project; name, address, and telephone number of Contractor and name of responsible Principal.
- D. Provide table of contents: Neatly typed, in the following sequence:
 - 1. Final Certificate of Occupancy
 - 2. Warranty Service Subcontractors Identification List
 - 3. Final Lien Waivers and Releases
 - 4. Warranties and Guarantees
 - 5. Systems Operations and Maintenance Instruction
 - 6. Manufacturer's Certificates and Certifications
 - 7. Maintenance Service Contracts
 - 8. Spare Parts Inventory List
 - 9. Special Systems Operating Permits or Approvals
 - 10. Asbestos free materials notarized statement
- E. Provide all documents for each section listed. List individual documents in each section in the Table of Contents, in the sequence of the Table of Contents of the Project Manual.
- F. Identify each document listed in the Table of Contents with the number and title of the specification section in which specified, and the name of the product or work item.
- G. Separate each section with index to sheets that are keyed to the Table of Contents listing.
- H. Warranty Service Subcontractors List shall identify subcontractor supplier, and manufacturer for each warranty with name, address and emergency telephone number.
- I. Electronic Close-out DVD: At the completion of the project, submit one copy of a DVD with entire project close out information below in PDF format. All letter, legal and brochure size sheets shall be portrait and the As-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

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of dust).

- 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

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3.1 RELOCATION AND REMOVAL

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

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remain. When removing nails by claw hammer, place a small piece of wood under the hammer head to keep claws at right angle to the nail and prevent damage to the surface.

3.7 DISPOSAL

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

3.8 CLEANING

- A. Clean surfaces as described in specifications.

3.9 CONCRETE

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

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3.12 PATCHING

- A. Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish.
- B. Where patching occurs on rated partition or fireproofed structure repair to match existing UL rated system to match code required hourly rating for assembly.

3.13 FIRESTOPPING AND DRAFT STOPPING

- A. Fire stop existing holes at all 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

SECTION 07921 - JOINT SEALANTS

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. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Latex joint sealants.
 - 4. Acoustical joint sealants.

1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required, provide samples with joint sealants in 1/2"-wide joints formed between two (2) 6"-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- E. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.
- G. Warranties: Special warranties specified in this Section.

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1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results for "Product Test Reports" paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the Notice to Proceed with the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated, as documented according to ASTM E548.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.

1.4 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 °F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two (2) years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.
- C. Multi-Component, Non-Sag, Neutral-Curing Silicone Sealant:
 - 1. Products:
 - a. Dow Corning Corporation; 756 H.P.
 - b. Other approved equivalent.
 - 2. Type and Grade: M (multi-component) and P (pourable)
 - 3. Class: 50
 - 4. Use Related to Exposure: NT (non-traffic)
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O
 - a. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, and ceramic tile.
- D. Single-Component, Neutral-Curing Silicone Sealant:
 - 1. Products:
 - a. Dow Corning Corporation; 799
 - b. GE Silicones; UltraGlaze SSG4000
 - c. GE Silicones; UltraGlaze SSG4000AC
 - d. Polymeric Systems, Inc.; PSI-631
 - e. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus

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- f. Tremco; Proglaze SG
 - g. Tremco; Spectrem 2
 - h. Tremco; Tremsil 600
- 2. Type and Grade: S (single-component) and NS (non-sag)
 - 3. Class: 25
 - 4. Use Related to Exposure: NT (non-traffic)
 - 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O
 - a. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and ceramic tile.

2.3 JOINT-SEALANT BACKING

- A. Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330. Provide any type approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, non-absorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 °F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Non-Porous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent non-porous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

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3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Masonry.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean non-porous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Non-porous joint substrates include the following:
 - a. Metal.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or joint-sealant-substrate tests prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

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- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-Sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.
- G. Installation of Preformed Tapes: Install according to manufacturer's written instructions.
- H. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
 - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 - 2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8". Hold edge of sealant bead 1/4" inside masking tape.

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3. Within ten (10) minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. EXAMINATION / INSPECTION

1. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
2. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - b. Whether sealants-filled joint cavities and are free from voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
3. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

- B. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements. Costs for retests and resultant required work will be paid for by Contractor.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

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3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07921

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SECTION 09220
NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Metal partition and ceiling framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 09250 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A 641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009.
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2009a.
- D. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2008.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2006.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2009a.
- G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- I. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- J. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

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- K. Factory Mutual for fire-rated assemblies.
- L. Underwriters Laboratories for fire-rated materials and products classification.
- M. NFPA for fire rated assemblies.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
 - 2. Describe method for securing framing to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and other special project-specific conditions.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

1.06 PRODUCT HANDLING

- A. Remove items delivered in broken, damaged, rusted, or unlabeled condition from site immediately.
- B. Protect metal materials from dampness.
- C. Store metal materials indoors, off floor.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:

1. Clarkwestern Dietrich Building Systems LLC; Product: www.clarkdeitrich.com.
2. California Expanded Metal Company (CEMCO): www.cemcosteel.com.
3. Dietrich Metal Framing: www.dietrichindustries.com.
4. Scafco Steel Stud Manufacturing Company: www.scafco.com.
5. Dale/Incor Industries.

2.02 FRAMING MATERIALS

A. Fire Rated Assemblies: Comply with applicable code and as indicated on drawings.

B. Non-Load bearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of metal framing of L/240 at gypsum board wall finishes, and L/360 at ceilings, soffits and plaster or other brittle finishes, for the most stringent dead load, live load, or lateral load stipulated by governing code.

1. Studs: C shaped with flat oroomed webs with knurled faces. Unless specifically indicated otherwise, provide not smaller than 4 inch, nor lighter than 20 gauge pre-punched studs for all vertical members and continuous, not lighter than 20 gauge un-punched tracks at top and bottom of studs. Provide heavier gauge and/or larger members where specifically indicated on Drawings or required by governing code.
2. Runners: U shaped, sized match studs.
3. Ceiling Channels: C shaped.
4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
5. Provide G60 galvanizing for all metal framing members in accordance with ASTM C 653.

C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition. "Flex" and similar type tracks subject to metal fatigue failure are not acceptable.

1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.

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2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating.
 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems as indicated on drawings and of fire rating and movement required.
 4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet (3660 mm).
 5. Provide minimum 2 inch deep leg.
- E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
- F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
1. Use channel type as follows:
 - a. Suspended ceiling: Main runners and cross furring for cement plaster finishes; main runners only for veneer plaster base and gypsum board finishes.
 - b. Vertical framing.
 - c. Furring, bracing and anchors.
 2. Hat type: Use for cross furring for veneer plaster base and gypsum board, and wall furring.
 3. Resilient, "zee" and other types: Use where indicated on Drawings, or required to achieve the design intent expressed in the Drawings.
- G. Fasteners: ASTM C1002 self-piercing tapping screws.
- H. Sheet Metal Backing: Minimum 20 gauge, 4 inch (____ mm) wide, galvanized.
- I. Anchorage Devices: Power actuated at concrete floors and curbs greater than 6 inches wide. At concrete curbs less than 6 inches wide provide 5/16 inch diameter bolts in 3/8 inch expansion sleeves--do not use power actuated anchors.
- J. Wire: Zinc-coated, soft-annealed low carbon steel conforming to ASTM A 641.
1. Areas of use:
 - a. Suspension system: Minimum 8 gauge.
 - b. Tie wire for metal framing systems: Minimum 18 gauge.
- M. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

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2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.
- C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Comply with requirements of ASTM C 754, and as noted herein.
- B. Erect studs plumb and true and suspended framing level. Install all fastenings, anchorages, and accessories as indicated on accepted shop drawings, and as required for proper system completion.
- C. Extend partition framing to structure in all locations, unless specifically indicated otherwise on Drawings.
- D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- E. For stud tracks on concrete floors and curbs greater than 6 inches wide, secure power actuated anchors with minimum 7/8 inch penetration into concrete. At stud tracks on concrete curbs less than 6 inches wide, secure bolts with minimum 1-3/4 inch penetration into concrete.
- F. Align and secure top and bottom runners at 24 inches (600 mm) on center maximum, and within 6 inches of ends of each track segment.
- G. At partitions indicated with an acoustic rating:
 - 1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.

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2. Place two beads of acoustic sealant between runners and substrate , studs and adjacent construction.
 3. Place two beads of acoustic sealant between studs and adjacent vertical surfaces.
- H. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- I. Unless indicated otherwise on Drawings, install studs vertically at 16 inches (400 mm) on center, except at mortar-set ceramic tile walls, space studs at 12 inches on center.
- J. Align stud web openings horizontally.
- K. Secure studs to tracks using stud shoes at both top and bottom, wire tied to studs or with two No. 10 screws at each stud flange to flange. Do not weld.
- L. Stud splicing is not permissible.
- M. Fabricate corners and intersections using a minimum of three studs. At corner conditions with angles of other than 90 degrees, provide continuous corner pieces brake-formed to the proper corner angle with legs which extend to cover the width of the face flanges of the studs.
- N. Double stud at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings. Extend from floor to underside of structure above. Attach jack studs to runners within head of frame and track at ceiling framing.
1. Provide header (runner track), using a mitered head splice, at head of openings and fasten to adjacent vertical studs with screws or welding.
- O. Brace stud framing system rigid, using 3/4 inch channels placed horizontally at not more than 4 feet 6 inches apart vertically and within 12 inches of deep leg top track. Wire tie or weld at each stud. Provide additional bracing or stiffening in accordance with referenced standards to prevent excessive bending or rotation of studs where collateral facing materials are not subsequently applied.
- P. Brace all chase wall partitions. Brace unfinished stud side horizontally at 4 feet maximum on center using stud or runner tracks with brace web screwed to stud web or welded.
- Q. Coordinate erection of studs with requirements of door frames, window frames, and fireproofing; install supports and attachments.
- R. Locate stud within 2 inches maximum from all abutting partitions, partition corners, and other construction.
- S. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

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- T. Blocking: Use steel channels secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, opening frames, and items indicated on Drawing, or requiring blocking.
- U. Use sheet metal backing for reinforcement of items indicated on Drawings or requiring backing. Install horizontally and screw or weld in place between wall studs to provide surface area required for attachment of furniture, equipment and other ceiling and wall-hung accessories.
- V. Provide spaced double studs where plaster control joints occur.
- W. Provide an additional cut-to-length stud extending from opening frame header to ceiling runner at gypsum board and gypsum lath vertical joints over opening frame.
- X. Attachment of Suspension Wires to Structural Elements:
 - 1. Metal Decks: Verify that sufficient suspension wires have been previously installed in metal deck. Provide additional suspension wire attachments as required, using steel drill screws and steel angle "ceiling" clips. Use of "molly" type or similar anchors is not permitted.
 - 2. Concrete Slabs (except insulating/lightweight concrete fills): Verify that sufficient suspension wires have been previously installed in concrete. Provide additional suspension wire attachments as required, using drilled expansion anchors and steel angle "ceiling" clips. Use of power-activated fasteners is not permitted.
 - 3. Wood Framing: Install formed loop through drilled hole or nail to wood member in accordance with ASTM C 1002. Use of screw eyes or staples is not permitted.

3.03 METAL FURRING

- A. Direct Attachment to Masonry and Concrete:
 - 1. Attach furring members either vertically or horizontally.
 - 2. Install horizontal furring not more than 4 inches from floor and ceiling.
 - 3. Secure furring members with screw fasteners through flanges.
 - 4. Space as specified for metal stud framing.
- B. Braced Type Attachment to Masonry and Concrete:
 - 1. Attach adjustable wall furring brackets as follows:
 - a. 48 inches on center vertically, 6 inches maximum from floor and ceiling.
 - b. 36 inches on center horizontally, 4 inches maximum from columns or other abutting construction.
 - c. Attach brackets at perimeter of openings.

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- d. Fasten each bracket through hole closest to serrated edges.
 2. Lay channels on furring brackets so that channel flanges engage serrated edges of bracket.
 - a. Plumb each channel and place in true alignment.
 - b. Wire-tie channels to each bracket with a double strand of 16 gauge or triple strand of 18 gauge wire.
 - c. Bend each excess bracket length down and inward toward wall.
 3. Position cross furring channels with flanges against channels. Wire-tie at each intersection with channel with a double strand of 16 gauge wire. Space as specified for metal stud framing.
- C. Free Standing Vertical Furring: As specified for metal studs.

3.04 CEILING AND SOFFIT FRAMING and FURRING

- A. Comply with requirements of ASTM C754.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated, maximum 6 inches from each end.
- E. Space main carrying channels runners at maximum 72 inch (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely. Saddle-tie with suspension wire with three twists of wire around itself.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, spaced in accordance with requirements for specified metal lath and maximum 16 inches on center for gypsum board finish; not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely. Saddle tie to main runners with two loops of 18 gauge or single loop of 16 gauge tie wire. Lap ends minimum 8 inches and wire tie near each end of overlap.
- H. Coordinate openings in ceilings with other trades. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with additional framing and lateral channel bracing. Extend bracing minimum 24 inches (600 mm) past each opening. Support framing from floor or roof structure above. Do not attach framing to lighting or ductwork.

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- I. Laterally brace suspension system, in accordance with governing code.

- J. Exterior soffit uplift support: Unless indicated otherwise on Drawings, provide soffit uplift support against wind pressures by adding vertical, back-to-back minimum 1-1/2 inch steel framing channels tied or welded together, secured to soffit framing grid and securely attached to structure above. Provide minimum of one support for each 16 sq. feet of soffit area for horizontal projections which exceed 3 feet from face of building.

3.05 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).

- B. Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION

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SECTION 09260
GYPSUM WALLBOARD

PART 1 - GENERAL

1.1 DESCRIPTION

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

1.2 QUALITY ASSURANCE

- A. Fire Resistance Ratings: Provide assemblies that have been tested, approved and listed by Underwriter's Laboratories, Inc., Factory Mutual or other testing agency acceptable to local authorities and code.
- B. ASTM Standards: Comply with applicable requirements of the following:
1. ASTM C 36 Gypsum Wallboard.
 2. ASTM C 475 Joint Compound and Joint Tape for Finishing Gypsum Board.
 3. ASTM C 514 Nails for the Application of Gypsum Board.
 4. ASTM C 630 Water-Resistant Gypsum Backing Board.
 5. ASTM C 645 Non-Load (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Application of Gypsum Board.
 6. ASTM C 665 Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 7. ASTM C 754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum (Wallboard, Backing Board or Water-Resistant Backing Board).
 8. ASTM C 840 Application and Finishing of Gypsum Board.
 9. ASTM C 954 Steel Drill Screws for Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.112 inch Thickness.
 10. ASTM C 955 Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging for Screw Application of Gypsum Board and Metal Plaster Bases.
 11. ASTM C 1002 Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
 12. ASTM C 1007 Installation of Load-Bearing (Transverse and Axial) Steel Studs and Related Accessories.

1.3 SUBMITTALS

- A. Submit manufacturer's product data, specifications and installation instructions for each product, system and component.

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- B. Submit shop drawings for details not in manufacturer's data. Include drawings locating ceiling and 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.

1.4 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

2.1 SUSPENDED CEILING FRAMING AND FURRING

- A. Comply with ASTM C 754 and manufacturer's recommendations.
- B. Ceiling Suspension Main Runners: ASTM C 754, 1½-inch steel channels, 0.475 lb. per ft., cold-rolled, galvanized.
 - 1. Hanger Wire: ASTM C 754 galvanized, soft annealed steel wire, sized in accordance with Table 5, ASTM C 754.
 - 2. Hanger Anchorage Devices: Size for 3 x calculated loads, except size direct-pull concrete inserts for 5 x calculated loads.
 - 3. Steel Furring: ASTM C 645; 25 gage, hat-shaped, galvanized.
- C. Direct Hung Suspension System: In lieu of suspended main runner channels and hat-shaped furring, a direct hung system of tees or channel studs may be provided. Members shall be prepared to receive screw attached gypsum board and system shall have structural strength and rigidity equal to the suspended main runner system.

2.2 STEEL STUD FRAMING AND FURRING

- A. Steel Studs: Conform to ASTM C 645; 25-gage minimum at interior locations 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 5 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.
- C. Steel Furring: ASTM C 645; 25-gage, hat-shaped, galvanized.
- D. Steel Furring Resilient: ASTM C 645, 25-gage, manufacturer's standard design to

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reduce sound transmission.

- E. Fasteners for Steel: ASTM C 954; size recommended by gypsum board manufacturer.

2.3 GYPSUM WALLBOARD

- A. Regular Gypsum Wallboard: ASTM C 36, regular type with tapered long edges.

- 1. Sheet Size: Maximum length available by 4'-0" wide.

- 2. Thickness:

- A. 5/8" Type "X" fire rated on all new partitions

- 3. Use sag-resistant type for ceiling surfaces.

- B. Fire Retardant Gypsum Wallboard: ASTM C 36, Type X, provide where fire rated construction is indicated.

- 1. Size: 4-foot wide sheets by maximum length available.

- 2. Thickness: Shall be 5/8-inch.

- C. Gypsum Backing Board and Coreboard: ASTM C 442, Type X, coreboard with moisture-resistant paper facings in thickness indicated for system required for rated assembly.

- D. Gypsum Sheathing Board: ASTM C 79, Type X, water resistant core and surface paper. Provide for all exterior walls. Sheet size: Maximum length available for intended use by 4'-0" wide by 1/2-inch thick.

- E. Water Resistant Gypsum Wallboard: ASTM C 630, 5/8-inch thick, USG "W/R Sheetrock", National Gypsum "MR Board" or approved equivalent, having core of gypsum and asphalt composition, surfaced with chemically treated multi-layered paper. Provide Type X water-resistant for fire-rated partitions.

2.4 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, 1 1/4" x 1 1/4".

- 3. Control Joints: USG No. 093.

2.5 JOINT TREATMENT MATERIALS

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- A. Comply with ASTM C 475.
- B. Joint Tape: U.S. Gypsum Perf-A-Tape and U.S. Gypsum Imperial type P or S. for water-resistant wallboard 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.

2.6 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.

2.7 ACOUSTICAL SEALANT

- A. Non-drying, non-hardening, non-skinning, non-staining, gunnable synthetic rubber sealant.

PART 3 - EXECUTION

3.1 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 "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

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with furring and other support as indicated.

3.2 INSTALLING CEILING FRAMING

- A. Space ceiling suspension main runners not more than 4'-0" o.c., and space hangers at not more than 4'-0" o.c. along runners unless shown otherwise. Coordinate ceiling framing with structure. Provide additional hangers and runners to support electrical, mechanical and other work indicated and required.
- B. Space ceiling furring members 16-inches o.c., except as otherwise indicated on drawings.
- C. Attach furring members to main ceiling runners and to other structural supports as indicated and in accordance with ASTM C 754 and manufacturer's directions.

3.3 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.

3.4 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.

3.5 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 VI; Application of Gypsum Board with Adhesives to Interior Masonry and Concrete Walls.
 - 4. System VIII; Application of Gypsum Board to Steel Framing and Furring.
 - 5. System XIII; Control (Expansion) Joints.

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6. System XIV; Foil-Backed Gypsum Board.

B. Space Fasteners in wallboard in accordance with ASTM C 840.

C. Lead Lined Gypsum Wallboard: Use lead shielded fasteners at manufacturer's recommended spacing but not less than 8-inches on center at edges and 12-inches on center in field of pattern.

3.6 INSTALLATION TRIM ACCESSORIES

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

3.8 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.

3.9 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

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SECTION 09900
PAINTING

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 the work specified in this Section.

1.2 DESCRIPTION OF WORK

- A. Extent of painting Work shown on Drawings and as herein specified. The Owner requires sole source responsibility for cleaning and preparation of all surfaces prior to priming and painting.
- B. The Work includes painting and finishing of interior and exterior exposed items and surfaces throughout project, except as otherwise indicated. Surface preparation and priming shall be included in the bid.
- C. Paint architectural structural exposed steel to match existing.
- D. Touch up paint existing metal wall panels, trim and flashing to match existing paint and color.
- E. "Paint" as used herein, means all coating systems materials, including primers, emulsions, enamels, stains, sealants and fillers, and other applied materials, whether used as primer, intermediate or finish coats and the preparation of the surfaces prior to the application of the coat systems.
- F. Paint exposed surfaces, whether or not colors are designated in "schedules", except where natural finish of material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint same as adjacent similar material or areas. If color or finish is not designated, Architect will select these standard colors on the schedule for material systems specified.
- G. The following categories of Work are not included as part of field-applied finish Work, or are included in other sections of these specifications:
 - 1. Shop priming: This is only for new materials, unless otherwise specified, shop priming of ferrous metal items is included under various sections for new structural steel, new miscellaneous metal, new hollow metal work, and similar items.
 - 2. Mechanical and electrical work: Painting of mechanical and electrical work in unoccupied and concealed space is not required.
 - 3. Pre-finished items: Unless otherwise indicated, do not include painting when factory-finishing is specified.

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4. Concealed surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas.
5. Finished metal surfaces: Metal surfaces of anodized aluminum and similar finished materials will not require finish painting, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information, including paint label analysis and application instructions for each material proposed for use.
- B. Do not order any materials until final color selection has been accepted by the Owner.

1.4 DELIVERY AND STORAGE

- A. Deliver materials to job site in original, new, and un-opened packages and containers bearing manufacturer's name and label, and the following information:
 1. Name and title of materials.
 2. Manufacturer's name.
 3. Color name and number.

PART 2 - PRODUCTS

2.1 COLORS AND FINISHES

- A. Manufacturer listed is for color only and the basis for matching color selection to other paint manufacturers specifically called out for a surface. All colors to be selected by the Architect, or as indicated on drawings and specifications.
 1. Interior drywall and block walls: Color to match existing.
 3. Exposed steel structure: Paint color to match color of existing wall panel.

2.2 MATERIAL QUALITY

- A. Provide best quality grade of various types of coatings as regularly manufactured by PRATT & LAMBERT; DULUX PAINTS; PITTSBURGH PAINTS; GLIDDEN; SHERWIN WILLIAMS; DURON. Materials not displaying manufacturer's identification as a standard best-grade product will not be acceptable.
- B. Provide undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer and use only within recommended limits.
- C. Paint Systems: Provide the following paint systems for various substrate as indicated:

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- 2.3 Exterior Paint Systems: Manufacturer listed name and system establishes baseline for quality standard for the paint system required. Other paint manufacturer's products may be submitted for review by the Architect. The Contractor will submit all information to the Architect to determine whether proposed substitution meets the baseline quality requirements.
- 2.4 Interior Paint Systems: Manufacturer listed name and system establishes baseline for quality standard for the paint system required. Other paint manufacturer's products may be submitted for review by the Architect. The Contractor will submit all information to the Architect to determine whether proposed substitution meets the baseline quality requirements.
- A. Exposed Steel Structure: Pratt & Lambert, Spec #41.1, gloss finish, alkyd type, one (1) coat Effecto Primer plus two (2) coats Effecto, or accepted equal.
- B. Interior Drywall Surfaces: Pratt & Lambert, Spec #114.4, semi-gloss finish, latex enamel type, two (2) coats Alcolate, or accepted equal.
- D. Interior CMU Surfaces: Pratt & Lambert, Spec #118.4, satin finish, latex type, one (1) coat primafill plus two (2) coats Aqua Satin Enamel, or accepted equal.
- E. Exposed Stainless Steel:: Pratt & Lambert, Spec #41.1, gloss finish, alkyd type, one (1) coat Effecto Primer plus two (2) coats Effecto, or accepted equal.
- F. Exposed Steel: Pratt & Lambert, Spec #41.1, gloss finish, alkyd type, one (1) coat Effecto Primer plus two (2) coats Effecto, or accepted equal.
- G. Steel Primer: Federal Specification TT-P-636D, color and finish to match existing.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Applicator must examine areas and conditions under which painting work is to be applied, and notify Contractor in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.
- B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
- C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, un-cured masonry joints repaired, and un-cured concrete allow manufacturer's recommendation for cure or as listed on the drawings and these specification or any conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION

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- A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions as herein specified and shown on drawings for each particular substrate condition.
- B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted, or provide surface applied protection prior to surface preparation and painting operations. Remove, if necessary for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
- C. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.
- D. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block, and cement plaster to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

3.3 TEST & SURFACE PREPARATION

- A. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content or alkalinity exceeds that permitted in manufacturer's printed directions and recommendations. Submit two (2) copies of alkalinity test and recommendation for Owner and Architect record.
- B. Determine paint origin on existing metal panels. Notify Architect if paint is not original factory-applied paint.
- C. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop coated of oil, grease, dirt, loose mill scale, and other foreign substances as noted on Drawings.
- D. Touch-up shop applied prime coats wherever damaged or bare where required by other sections of these specifications. Clean and touch-up with same type of shop primer.
- E. Galvanized Surfaces: Clean free of oil and surface contaminants. Treat surfaces for painting and priming follow paint manufacturer recommendations for treatment and priming of galvanized surfaces.

3.4 MATERIALS PREPARATION

- A. Mix and prepare painting materials in accordance with manufacturer's directions. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign material, and residue.

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- B. Stir materials before application to produce a mixture of uniform density and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.5 APPLICATION

- A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Apply additional coats when undercoats stain or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- C. Paint surfaces behind moveable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture similar exposed surfaces.
- D. Finish exterior doors on tops, bottoms, and side edges same as exterior faces, unless otherwise indicated. Sand lightly between each succeeding enamel or varnish coat. Omit first coat (primer) on metal surfaces that have been shop-primed and touch-up painted, unless otherwise indicated.
- E. Scheduling Painting: Apply first coat material to surfaces that have been cleaned, pre-treated, or otherwise prepared for painting by painter as soon as practicable after preparation and before subsequent surface deterioration.
- F. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- G. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.
- H. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to those items exposed and on the exterior of the building. Use paint primer and paint type that is compatible with the material being painted.
- I. Prime Coats: Apply prime coat of material that is required to be painted or finished, and that has not been primer coated by others.
- J. Recoat primed and sealed surfaces, where there is evidence of suction spots or unsealed areas of first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

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- K. Pigmented (Opaque) Finishes: Completely cover to provide an opaque smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

3.6 CLEAN-UP AND PROTECTION

- A. Clean-Up: During progress of Work, remove from site discarded paint materials, rubbish, cans, and rags at end of each work day. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- B. Protection: Protect work and equipment of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect. Protect all existing exterior landscaping or other adjacent property from damage from paint and the Work.
- C. Cover floors of spaces scheduled for exposed concrete finish or other floor sealers with temporary protective cover.
- D. Cover existing materials and finishes and protect from damage.
- E. Provide "wet paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations. At the completion of work of other trades, touch-up, and restore all damaged or defaced painted surfaces.

END OF SECTION 09900

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SECTION 15010
MECHANICAL GENERAL PROVISIONS

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. 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.
- S. Guarantee of Work.

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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
3. 2010 The Florida Accessibility Code for Building Construction

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4. 2008 National Electric Code (NEC)
 5. 2010 The Florida Building Code – Mechanical
 6. 2010 The Florida Building Code - Plumbing
 7. 2010 Florida Fire Prevention Code (FFPC)
 8. 2007 State Requirements for Educational Facilities (SREF)
 9. 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

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divisions to assure a complete, functioning system or systems.

I. Submittals:

1. In addition to all other submittal requirements elsewhere in the contract documents, the contractor shall comply with the following.
2. Submittal for acceptance is required only on those items specifically requested in the specification section that applies.
3. For products and equipment that do not require a submittal for acceptance, submit a separate letter for each specification section certifying that all products and equipment will be provided in compliance with the contract documents.
4. Provide submittal data in accordance with the General Conditions and/or as listed below.
5. Designate in the construction schedule, or in a separate coordinated schedule, the dates for submission and the dates that the submittals will be needed in order to meet construction schedule. This schedule shall be submitted prior to or in conjunction with the first submittal. Processing of submittals may be delayed pending the receipt of this schedule at the reviewer's discretion.
6. Submittal data shall be presented in a clear and thorough manner and referenced to the specification section.
 - a. Where applicable, data shall be identified by reference to sheet and detail, schedule or room numbers, equipment or unit number as shown on Contract Drawings.
7. Prepare performance and product data as follows:
 - a. Clearly mark each copy to identify pertinent products or models, delete non-pertinent data.
 - b. Show performance characteristic and capacities.
 - c. Show dimensions and clearances required.
 - d. Show wiring or piping diagrams and controls.
 - e. Clearly list any deviation in the submittals from the requirements of the contract documents.
 - f. Include installation requirements.
8. Manufacturer's standard schematic drawings and diagrams:
 - a. Modify drawings and diagrams to delete information not applicable to the work of this project.
 - b. Supplement standard information to provide information specifically applicable to the work of this project.
9. 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 mechanical 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 15 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 by a duly authorized agent of the manufacturer.

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10. Letter of Certification: Where a submittal is not required, provide letter certifying that the work will be completed in strict accordance of the specified requirements. In the event the contractor wishes to alter the requirements of the specification for whatever reason, this should be clearly explained in this letter noting that this alteration may require additional submittal requirements.
11. Schedules: Where schedules are called for, submit schedule indicating which products will be used and to what extent by system, location, size, etc.
12. Where samples are requested, samples shall be of sufficient size and quantity to clearly illustrate:
 - a. Functional characteristics of the product, with integral related parts and attachment devices.
 - b. Full range of color, texture and pattern.
 - c. Where a mock-up is specified, erect at the Project site, in a location acceptable to the Owner's Representative. Size or area shall be that specified or as agreed upon during pre-construction or other job site meetings.
 - d. Where mock-up is not a permanent part of the installation, remove mock-ups at conclusion of work or when acceptable to the Owner's Representative.
13. The Contractor shall:
 - a. Review Shop Drawings, Product Data and Samples prior to submission.
 - b. Determine and verify:
 - 1) Field measurements.
 - 2) Field construction criteria.
 - 3) Catalog numbers and similar data.
 - 4) Conformance with specifications.
 - 5) All submittals have been properly interfaced with the requirements of this and other divisions of work so as to assure a complete, functioning system in accordance with the contract documents.
 - 6) Provide ¼" drawings of ALL mechanical rooms, with dimensions clearly indicating equipment maintenance clearances and electrical NEC required clearances. NO mechanical room walls shall be built until the engineer and the owner have approved the shop drawings for the mechanical equipment and clearances.
 - c. Coordinate each submittal with requirements of the work and of the Contract Documents.
 - d. Clearly identify any deviations in the submittals from requirements of the Contract Documents. Any deviations not specifically disclosed in the submittal shall be solely at the risk of the Contractor, and shall be subject to discovery at any time. Any undisclosed deviations shall be corrected by the Contractor to comply with the requirements of the Contract Documents at no cost to the Owner regardless of the action code accorded the submittal by the Owner's Representative.
 - e. Do not release equipment for shipment, begin fabrication or work on any items requiring submittals for acceptance until all submittals are returned with the Owner's Representative acceptance.
 - f. Make submittals promptly, and in such sequence as to cause no delay in

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the work or in the work of any other contractor.

14. Number of Submittals: Comply with the General Conditions.
15. Submittals shall contain:
 - a. The date of submission and the dates of any previous submissions.
 - b. The Project title and number.
 - c. Contract identification.
 - d. The names and phone numbers including personal contact of:
 - 1) Contractor.
 - 2) Supplier.
 - 3) Manufacturer.
 - e. Identification of the product, with the specification section number and contract document description clearly indicated.
 - f. Field dimensions, clearly identified as such.
 - g. Relation to adjacent or critical features of the work or materials.
 - h. Applicable standards.
 - i. Identification of deviations from Contract Documents.
 - j. Identification of revisions on re-submittals.
 - k. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 - l. Each submittal shall be limited to a single specification section. Submittals shall not be grouped with other sections in common binders or under common control sheets except as defined in paragraph m. below. Each submittal shall have a cover/control sheet containing the information listed above (a thru k) and have a minimum of 8" x 3" clear space for the general contractors, engineers and architects review stamp.
 - m. The first group of submittals shall be sent in 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:
 - 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 project in each pocket. Description sheets are 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.
 - n. Submittals not complying with these requirements may be returned with no action taken at the reviewer's discretion.
16. Re-submittals shall contain:
 - a. The date of re-submission and the dates of all previous submissions.
 - b. A copy of the Engineer's comments from the previous submittal.
 - c. An itemized response to each of the Engineer's comments specifically outlining the changes or corrections being made. As an example; this

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could be either noting the page(s) of the previous submission that are affected and what changes have been made or noting specific additional information being provided.

- d. Submittals not complying with these requirements may be returned with no action taken at the reviewers discretion.

17. The Owner's Representative will:

- a. Review submittals promptly and where special attention is requested, review in accordance with the schedule required.
- b. Review the submittal for general compliance with the contract documents. The contractor is responsible for quantities, dimensions, placement of the product, coordination with all other trades occupying the space, maintain service clearance, function and compliance with the written installation instructions.
- c. Determine the appropriate action for the submittal. Action codes will be as follows:

<u>Action</u>	<u>Description</u>
No exceptions noted.	No exceptions taken.
Make corrections noted.	Resubmittal not required. Make corrections to exceptions noted.
Revise and resubmit.	Make corrections to exceptions noted and resubmit.
Rejected	Not in compliance with contract documents. Resubmit
Submit Specific Item	Resubmit item as specified.
Review not required	Not required for review. No action taken. Copy retained for reference.

- d. Turn around time will generally be within 14 calendar days on properly prepared submittals unless otherwise noted in Division 1.
- e. Review comments will generally be on a separate attached sheet.

18. Resubmission requirements for "as specified" products.

- a. Make any corrections or changes in the submittals required by the Owner's Representative and resubmit until accepted.
- b. A submittal shall only be reviewed a maximum of 3 times. If upon the second resubmission an accepted action cannot be rendered (No Exceptions Noted or Make Corrections as Noted), the contractor shall supply the basis of design product and bear all costs incurred by the Owner's Representative during the review process until an accepted submittal is achieved.

19. The Contractor shall maintain one copy of all accepted submittal data including letters of compliance in a job site file.

J. Product Requirements, Equals and Substitutions:

- 1. In addition to all other requirements for submittals, equals and substitutions elsewhere in the contract documents, the contractor shall comply with the following.
- 2. Product Requirements:

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- a. The specifications sections under Article 2.1 "ACCEPTABLE MANUFACTURER", lists suppliers found acceptable for this project. The names listed are manufacturers who meet the minimum acceptable standards that this project dictates. The list is furnished as a guide. Even though a manufacturer is named, he must still provide the type and quality of equipment specified as well as equipment that will fit within the allotted space and within the design weight allowance, etc. Being named does not imply permission for that manufacturer to provide an alternative product or design. Other manufacturers not named will be considered to be equal providing they furnish a product of the type and quality specified.
- b. In certain cases, foundations and/or structural supports or electrical requirements for equipment specified in this Division are provided under other divisions of the specifications. Where an alternate acceptable manufacturer's product is provided, this contractor shall coordinate the revised requirements and include an allowance for any cost differential.
- c. If the list, under Article 2.1 "ACCEPTABLE MANUFACTURERS" names only one manufacturer followed by "No Substitutions" that product shall be supplied.

3. Substitutions.

- a. A substitution is defined as any product not meeting the requirements as outlined in PART 2 - PRODUCTS. A different design accomplishing the same result will be considered a substitution. The same design requiring a larger motor, or more space or a structural change to accommodate larger weight, etc., will be considered a substitution. If a manufacturer who is not listed as an "ACCEPTABLE MANUFACTURER" wants to have his product considered as an equal or as a substitution, he shall submit details to the Owner's Representative 10 days in advance of bid date and a decision will be rendered. If necessary, a clarification will be issued in the form of an Addendum. No substitution requests shall be considered after the Bid.
- b. Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including.
 - 1) Comparison of the qualities of the proposed substitution with that specified in tabulated format.
 - 2) Changes required in other elements of the work because of the substitution.
 - 3) Effect on the construction schedule.
 - 4) Cost, extra credit or statement of no change in contract price.
 - 5) Any required license fees or royalties.
 - 6) Availability of maintenance service, and source of replacement materials.
- c. The Owner's Representative shall be the judge of the acceptability of the proposed substitution.
- d. A request for a substitution constitutes that the Contractor:
 - 1) Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
 - 2) Will provide the same warranties for the substitution as for the product specified.
 - 3) Will coordinate the installation of the substitution into the work, and make such other changes as may be required to make the

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- work complete in all respects.
 - 4) Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
 - 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 Owner's Representative 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.
4. Owner's Representative will review requests for substitutions with reasonable promptness, and will issue an addendum or notify Contractor, in writing, of the decision to accept or reject the requested substitution.
5. The Owner's Representative will review substitution submittals for compliance a maximum of two times. If the submittal or substituted product does not comply with the contract documents on the second submittal, the submittal and product will be rejected and the specified product will be required.
6. The contractor may request further review of the substitution after the second submittal rejection if the contractor agrees in writing to accept responsibility for the cost of additional review time and expenses by the Owner's Representative.
7. In the event a substitution is rejected, supply the products which constituted the basis of design at no change in the contract price.
- 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.

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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:

1. Quantity: Four (4) sets
2. Format: Adequately sized for contents, minimum 1" and maximum 3" spline size, hard cover, view type, 8-1/2" x 11 loose leaf binders. Binder covers to have outer clear vinyl pocket on front cover and spline. Provide correct project designation and contents description in each pocket. Use as many as required. Do not overload binders.
3. Content:
 - a. Cover sheet.
 - b. Table of contents (as follows):
 - 1) Description of systems.
 - 2) Design parameters.
 - 3) Section 15010 - Mechanical General Provisions
thru
 - 4) Section 15950 – Sequence of Operations
 - c. Point by Point System Check-out: Provide tabulated results indicating compliance with contract document requirements.
5. Detailed Preparation Requirements:
 - a. The cover sheet shall list: project name, location, architect, structure engineer, mechanical engineer and electrical engineering firm name with address, telephone number and project managers name for this project.
 - b. Each major heading in the table of contents shall have a large distinctive, clearly marked, non-erasable, plastic encased tab.
 - c. The description of systems will be provided by the design engineer for insertion at the time of review and turn-over to owner. This description of systems will be an updated version of the narrative included in Section 15010 - Mechanical General Provisions and will be an overview of the entire system. It will be the basis for the starting of the owners instruction program.
 - d. Each section shall have the following sub-tabs. Sub-tabs shall be similar to the main tabs but of a different color.
 - 1) Specifications: The specification shall be copied and inserted

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- complete with all addenda.
- 2) Submittal: This section shall include all accepted submittal data. If submittal was not required, include technical data as specified.
 - 3) Installation Instructions: If the product, such as pipe, etc., does not have any written installation instructions, include a statement "Manufacturer's Written Installation Instructions not Available - Product Installed in Accordance with Specifications and Good Practice".
 - 4) Operation and Maintenance Instructions: These shall be the written manufacturer's data edited to omit reference to products or data not applicable to this installation.
 - 5) Parts List: These shall be edited to omit reference to items not applying to this installation.
 - 6) Equipment Supplier: This section shall include the name, address and telephone number of the manufacturer's agent and/or service agency supplying or installing and starting up of the equipment.
 - 7) System Description: This section shall include that portion of the overall description included in the beginning of the manual as it applies to each sub-section. In sections such as pipe, valves and fittings, a statement shall be included "Not Applicable to this Section." Data for this section will be added by the design engineer when the manuals are submitted for review and forwarded to the owner.
 - 8) Controls Description: This will be included in each section covering controlled equipment. It will include the description from the approved temperature control submission, complete with schematic diagram showing piping arrangement and control location on 8-1/2" x 11" or 11" x 17" sheet. This data shall be provided by the temperature controls contractor in a form suitable for insertion by the mechanical contractor and for review by the design engineer.
 - 9) Special Operating Instructions: This section shall include condensed instructions for start-up, shut-down, emergency operation, safety precautions and troubleshooting suggestions. Where control is clearly covered in controls description, it is not to be duplicated here.
 - 10) Preventative Maintenance Instructions: This section shall include excerpts from the manufacturer's written instructions on weekly, monthly, quarterly, annually, etc. This summary shall be prepared by the mechanical contractor with help from the equipment supplier. It will be reviewed by the engineer prior to turning over to the owner.
- e. Section 15051 - Adjusting, Balancing and System Testing shall contain the following sections:
- 1) Specifications.
 - 2) Submittal.
 - 3) TAB Data.

This shall be the final TAB data. It will probably have to be added after the owner has received his training and the O&M manuals. Payment for TAB work will be withheld until the data is received and accepted, and the TAB instructed session is complete. The contractor shall provide a separate binder complete as detailed in this article as part of the set.

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The engineer will be responsible for incorporating this data into the O&M manuals.

6. Submittal Requirement:

- a. The O&M manuals shall be submitted at the 30% completion stage, which shall be defined as that time in the project when the major pieces of equipment have been set in place ready for connection to piping and duct systems.
- b. In order to ensure that this is done and to give a reasonable time for compliance, any progress payments for mechanical work past the 60% completion stage, defined as piping and ductwork installed and tested but not insulated, will be held up until this submittal requirement is met.

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.
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.

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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.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 15010

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SECTION 15020
HVAC 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 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. Provisions of Division 7 for Waterproofing and Flashing and 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. Painting.
- F. Placing of equipment.

1.3 RELATED WORK

- A. DIVISION 9 - FINISHES (Access Doors - Painting).
- B. DIVISION 7 - THERMAL AND MOISTURE PROTECTION (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

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acceptance is not required.

1. Access doors.
2. Piping and equipment identification.
3. Fire and smoke stopping material.

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.

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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 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

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- 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 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.
- C. 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.
- D. Electrical Requirements: Product description not applicable to this Section.
- E. Painting: Product specified in Division 9 - FINISHES.
- 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. Furnish access doors for installation under Division 9 - FINISHES.
 - 2. 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.
 - 3. 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".
 - 4. Access doors shall be provided where indicated and if not indicated, where required.
 - 5. Access doors shall be installed so as to allow full door swing.
 - 6. Where full swing and access is not possible, removable doors shall be provided.
 - 7. 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

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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 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 3/4 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.

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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 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. Painting:

1. All equipment shall be furnished with a factory- applied galvanized, prime paint, or finish paint finish. Touch-up damaged surfaces of equipment immediately.
2. Paint for galvanized surfaces shall be in accordance with ASTM A780 using zinc rich compound.
3. Paint wooden mounting backboards with two coats of gray enamel prior to making attachments to the board.
4. For quality control refer to DIVISION 9 - FINISHES.
5. Remove all dirt, rust, scale, grease, pipe dope, solder flux, and welding slag from all surfaces to be painted.
6. Paint immediately, under this Division, all damaged galvanized surfaces. Paint galvanized metal surfaces behind grilles with two coats of flat black paint.
7. Apply rust inhibitive primer to ferrous surfaces of shop fabricated steel supports.
8. Paint immediately under this division all field and shop welded joints in piping or equipment supports with 2 coats of grey metal primer.

F. 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.

END OF SECTION 15050

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SECTION 15051
ADJUSTING, BALANCING AND SYSTEM TESTING

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. 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 chilled water systems.
 - 1. With 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.

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.
- D. Constant Volume Systems:
 - 1. Adjust each fan to deliver the specified quantity of air at the specified temperatures to all areas of the building served by the air system. Where the installed drive cannot be adjusted to obtain the required flow, advise the contractor so that the necessary drive change can be made. Adjust speed, in direct proportion to actual vs. required cfm. Exercise caution because amps vary with the cube of speed.
 - 2. Determine air volume in ducts by use of pitot tube, and inclined manometer. Plug all holes in duct.
 - 3. Determine air quantity through air grilles or diffusers by use of flow hood with direct readout meter calibrated in CFM. If use of flow hood is not possible, use velometer nozzle as recommended by air device manufacturer. Calculate air quantity based on air device area factors provided by the air device manufacturer.
 - 4. Compare duct traverse to accumulated air flow at diffusers. If the two do not reconcile, examine system for leaks and, report to contractor so that he can

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repair and repeat.

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.

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.

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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.
 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.

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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. 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 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.
- D. 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.
- E. 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.

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- 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.

3.8 OPERATING TESTS

- A. Operate systems to demonstrate that systems have been properly adjusted and balanced, and to demonstrate that the systems' performance conforms with the intent of the specifications and drawings.
- B. The balancing contractor shall make available to the Owner's operating personnel a Certified Test and Balance Engineer for a minimum of 16 hours, two working days, not necessarily consecutive, with all necessary equipment to demonstrate that all systems operate as intended and that the balancing reports are accurate.
- C. This demonstration will occur after the balancing contractor has submitted his reports to confirm that all systems or portions of the systems that coincide with the building's occupancy schedule, are adjusted and balanced.
- D. Conduct tests with natural building heating and/or cooling loads for a minimum 4 hours duration.

END OF SECTION 15051

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SECTION 15055
MOTORS

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. 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

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- 15056 – Motor Starters.
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 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. 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 26.
- 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:

<u>Voltage to Ground</u>	<u>Minimum Clearance Distance</u>
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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 15058
CONTROL WIRING

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. Provisions of Section 16010 - Electrical General Provisions, shall be made an integral part of this section.

1.2 WORK INCLUDED

- A. Building Control System Wiring.
- B. Interior & Exterior Lighting Control Wiring

1.3 DEFINITIONS

- A. Control Wiring: All wiring, high or low voltage other than power wiring, required for the proper operation of the mechanical systems.
- B. Power Wiring: All line voltage wiring to the mechanical equipment. Line voltage which also serves as a control circuit, such as a line voltage thermostat, or involves interlocking with a damper, shall be considered control wiring.

1.4 QUALITY ASSURANCE

- A. All work will be in accordance with the requirements of the National Electrical Code.

1.5 SUBMITTALS

- A. Submittals are not required.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. All material used in the completion of the wiring under this section will comply with the requirements of Division 16 Electrical and Section 15900 - Building Control System.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cooperate completely with the contractor for Division 16.
- B. Provide all conduit, wire and accessories necessary to complete the control wiring as specified under WORK INCLUDED.
- C. Because of variations in requirements from manufacturer to manufacturer, all details may

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not be included in the Contract Documents. This sub-contractor must obtain approved coordinated wiring diagrams before proceeding with the control wiring.

- D. All control wiring shall be properly installed in an approved raceway system or when allowed, run exposed in concealed spaces. All control wiring run in exposed areas shall be in an approved raceway unless otherwise noted.
- E. Control wire run exposed shall be neatly bundled and routed parallel and/or perpendicular to building structure or equipment casing. Routing of wire shall be so that it does not interfere, chafe or obstruct service or maintenance of the equipment served.
- F. Exposed control wire shall be properly secured and/or supported within equipment enclosures. Cable shall be secured on no greater than 18" centers.
- G. All openings made for the passing of control wire shall be properly bushed to prevent chafing. Hole size shall be suitable for the quantity of wires or tubing passing through while allowing for ease of pulling and future expansion. Oversized holes beyond these requirements are not allowed.
- H. Holes made within air handling equipment which may allow the transfer or bypassing of air shall be properly sealed after wire is pulled. Expanding foam sealant and proper backing material will be acceptable. Seal shall be suitable for maximum unit operating pressures.
- I. Attachments of control devices, raceway and cable supports shall be made with proper attachments. Self-drilling screws which result in exposed end will not be acceptable. Bolts and nuts shall be used with bolt head exposed to view. All fasteners located where exposed to weather or moisture shall be stainless steel or cadmium plated.
- J. Any opening, holes or cuts in equipment enclosures or building structure not used shall be neatly sealed. On equipment, the seal or patch shall be of similar material sealed and painted to match.
- K. The control contractor shall clean all unused or scrap material from the equipment enclosure.
- L. All control wire shall be identified by proper cable identification methods. Verify how cables shall be labeled with the Owner's Representative prior to the start of work. All termination shall be labeled and labels clearly visible.
- M. All control devices, cabinets, equipment and raceways shall be labeled. Verify how the hardware shall be labeled with the Owner's Representative prior to the start of work.
- N. Splices in control wire are not allowed unless the length of run is too great to allow for a continuous run. When splices become necessary, they shall be solder connected with heat shrink tubing. When raceway is used, all splices shall be in junction boxes.
- O. Control devices (i.e., flow switches), connected to cold equipment where the possibility of condensation may occur shall be vaporproof type. The connecting conduit shall be properly sealed with spray type foam after the wires are pulled through. If this is not possible, a weatherproof junction box shall be close mounted to the device to allow for proper moisture sealing. Conduit connections shall be sealed with a silicon type caulk/sealant.
- P. All control devices or wiring located exposed to weather or moisture shall be in an approved raceway system. This system shall be properly supported and sealed to

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prohibit moisture convection or transfer. Provide flexible conduit similar to seal tight for connection to all equipment. EMT and set screw fittings are not acceptable. All exterior raceway shall be IMC (Intermediate Metallic Conduit) or better with threaded fittings.

- Q. Where a disconnect switch is mounted between an adjustable frequency drive and the motor, the disconnect must have a late make, early break auxiliary contact. This contact shall be wired into the AFD control circuit so that the control circuit is disconnected before the power circuit it broken.
- R. BCS Contractor to fully review the electrical drawings for interlock wiring required for exterior and interior lighting control. BCS contractor to coordinate with the electrical contractor all relays, contactors, programming and wiring required.

END OF SECTION 15058

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SECTION 15060
PIPE AND PIPE FITTINGS

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. Chilled Water (CHS/CHR) Piping.
- B. A/C Unit Condensate Drain (CD) Piping.

1.3 DEFINITIONS

- A. Pipe sizes given in this document are nominal.

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. All other metallic piping - ASME/ANSI B31.1
- 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.

1.6 SUBMITTALS

- A. All submittals shall be made in accordance with Section 15010 - Mechanical General Provisions.

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- B. Submit a list identifying the specific type of material that will be used for each piping system. Include pipe, fittings, valves, hangers and supports. Include the designation of the publication applicable for each type of material and method.
- C. 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. 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. Submit certified welding inspection reports as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Chilled Water (CHS/CHR) Piping (Grooved-end pipe not acceptable in VCSB)
System Design Pressure: To 150 psig.
 - 1. Piping, 1/4" thru 2": Contractor's option:
 - a. Type L Hard-drawn Copper Tubing: ASTM B88.
 - b. Schedule 40 carbon steel, seamless; ASTM A-106, Grade B, Type S.
 - 2. Piping, 2-1/2" thru 10": Schedule 40 carbon steel, seamless or electric resistance welded, ASTM A-53, Grade B, Type S or ERW.
 - 3. Pipe Fittings: 1/2" thru 2": Contractor's option:
 - a. Wrought Copper, ANSI B16.22.
 - c. 150lb. malleable iron threaded; ASTM A-197.
 - d. Mechanically formed tee fitting, as created by T-Drill, is an acceptable method of installation.
 - 6. Pipe fittings 2-1/2" and larger: Schedule to match mating pipe, carbon steel, butt weld type, ASTM A-234. Weld-o-lets and thread-o-lets will be limited to 2 pipe sizes smaller than the pipe to which they are connected.
 - 7. Brazing: Contractors Option:
 - a. 5% silver, 6% phosphorus, balance copper, 1190°F melting point. AWS A5.8 number BCuP -3. J.W. Harris Stay-Silv® 5 or equal.
 - b. 15% silver, 5% phosphorus, balance copper, 1190°F melting point. AWS 5.8 number BCuP-5. J.W. Harris Stay-Silv® 15 or equal.
 - c. 6% silver, 6.1% phosphorus, balance copper, 1190°F melting point. QQ-B-654A number BCuP -5. J.W. Harris Dynaflow® 5 or equal.
 - 8. Unions: 1/2" thru 2": Contractor's option:
 - a. Wrought Copper, Pressure Class 150, w/solder ends.
 - b. Malleable Iron, Pressure Class 150, w/ threaded ends, ANSI B 13.39.
 - c. Note: Dielectric unions shall be used to connect copper to steel pipe, and shall have metal connections on each end threaded to match the

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adjacent piping. Metal components shall be separated by a nylon insulator to prevent current flow between dissimilar metals. Unions shall be suitable for the system operating pressures and temperatures.

9. Flanges: 150 lb. rated forged carbon steel; weld neck type, with raised face, bored to match the mating pipe I.D.; ASTM A-181, Grade 2, or ASTM A-105, Grade 2.
10. Bolting studs: ASTM A-193, Grade B7. Nuts shall be heavy duty hex type; ASTM A-194, Grade 2H.
11. Gaskets: Full faced style, 1/8" thick. Gasket material shall be Nitrile (NBR) sheet, ASTM F104, Line Call Out F712100A9B4E22K5M6; Based on Garlock Blue-Gard® Style 3000 or acceptable equivalent.
12. Mechanical joints employing grooved-end pipe may be used on this piping system. See Paragraph 2.2 "Mechanical Joint Systems", this section, for specifications.

B. A/C Unit Condensate Drain (D) Piping.

System Design Pressure: 10 psig.

(Where two materials are listed, either may be used.)

1. Drains in Return Air Plenums or other areas - Copper:

- a. Piping, 1/2" thru 4": Type L Hard-drawn Copper Tubing: ASTM B88.
- b. Pipe Fittings, 1/2" thru 4": Contractor's Options:
 - (1) Wrought Copper, ANSI B16.22.
 - (2) Mechanically formed tee fitting, as created by T-Drill, is an acceptable method of installation.
- c. Solder: Lead-free per code.
- d. Brazing for Mechanically formed tee fittings: 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 or equal
- e. Unions: 1/4" thru 4": Wrought Copper, Pressure Class 150, w/solder ends. Note: Dielectric unions shall be used to connect copper to steel pipe, and shall have metal connections on each end threaded to match the adjacent piping. Metal components shall be separated by a nylon insulator to prevent current flow between dissimilar metals. Unions shall be suitable for the system operating pressures and temperatures.

2. Drains, Indoor, not in Return Air Plenums - PVC:

- a. Schedule 40 Polyvinyl Chloride (PVC), ASTM D1785.
- b. Schedule 40 PVC, socket-type, ASTM D2466. Joints shall be made with solvent cement, ASTM D2564.

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2.2 MECHANICAL JOINT SYSTEMS

A. General:

1. All couplings, fittings, and gaskets shall be the products of a single manufacturer.
2. Valve ends shall be compatible with the couplings used on the connecting piping.
3. All exposed piping shall be cleaned, removing all rust, primed and painted black. At substantial completion all exposed piping shall be free of rust and in a “like new condition”.

B. Pipe Wall Thickness (Schedule Number):

1. Where rolled groove joints are used, the pipe wall thickness may, in some cases, be decreased below that specified for the particular fluid system. In all cases, the minimum pipe wall thickness shall be in accordance with ANSI/ASME B31.9, Chapter II, using 150% of the system operating pressure as the design pressure.
2. Pipe having cut (machined) grooves shall have a nominal wall thickness of not less than the wall thickness specified for Schedule 40 pipe of the particular pipe size.
3. Non-metallic pipe shall not be joined with grooved-end pipe mechanical joints.

C. Couplings:

1. Mechanical joint couplings shall be of the external type, for use with cut or rolled-groove end pipes, fittings, and valves.
2. Couplings shall be self-centering, and shall engage and lock-in-place the grooved-end pipes, fittings, and gaskets.
3. All couplings shall be of the rigid style. Flexible couplings shall not be used without the written approval of the Engineer.
4. Couplings shall be Ductile Iron, ASTM A536; or malleable iron, ASTM A47, and shall be designed for not less than 250 psig at 230 Deg. F.
5. The coupling assembly shall be held together by two or more track-head, oval-neck steel bolts, ASTM A183.

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 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

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- 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, 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

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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. Hydronic HVAC Systems Additional Requirements:

1. Provide a 3/4 inch drain valve and a capped hose nipple at each low point in each system, and where indicated.
2. Provide, at each high point in each system, and where indicated, an air collection chamber and a manual air vent consisting of a capped 6-inch long section of 2-inch pipe and a 1/8 inch loose key manual air vent. Drill and tap the pipe cap to accept the air vent.
3. On liquid systems, make branch connections to top of mains for up-feed arrangement, and to bottom of mains for down-feed arrangement, except where main and branch line are of equal size the branch connection may be made to the side of the main for both up-feed and down-feed applications.
4. Provide water seal in the condensate drain from each air handling or air conditioning unit. The depth of each seal shall be equal to the total static pressure rating of the unit to which the seal is connected. Water seals shall be constructed of two tees and an appropriate U bends with the open end of each tee plugged.
5. Slope piping 1 inch per 40 ft, in the direction of flow.

C. Plastic Pipe Systems Additional Requirements:

1. Joints between plastic pipe and other materials shall be subject to the following requirements:
 - a. Joints between different grades of plastic pipe shall be made by use of an approved adapter fitting.
 - b. Joints between the hub of cast-iron soil pipe and plastic pipe shall be made by use of a mechanical joint of the compression or mechanical

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- sealing type.
- c. Joints between plastic pipe and cast-iron pipe, steel pipe, glass pipe, copper tube, and other piping materials shall be made by use of an approved adapter fitting.
- 2. Plastic pipe, fittings, and solvent cement shall not be used in systems where temperature, and operating pressure plus system static head, exceeds materials temperature and pressure limitations.
- 3. Plastic piping materials shall not be installed in air plenums, air chambers, or airshafts.
- D. Mechanical Joint System Additional Requirements:
 - 1. Install in strict accordance with the manufacturers written installation instructions.
 - 2. Coordinate with Section 15250 Insulation to ensure full thickness insulation at mechanical joints.

3.2 WELDING, 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 B31.9-2008 Chapter VI section 936 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 B31.9-2008 Chapter VI section 936 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:
 - 1. 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-

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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.

- E. Piping Identification: All piping shall be marked in accordance with the provisions of Section 15050 - BASIC MATERIALS AND METHODS.

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 and fully comply with ANSI B31.9-2008 Chapter VI section 937:
 - 1. General: Furnish everything required for the tests. Notify Architect/Engineer at least 48 hours before any testing is performed. Independent Agent/Owner shall 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.

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- f. Final Hydrostatic Test: After completion of the final phase of construction, repeat the initial hydrostatic test on the entire piping system(s).
- 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 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, and 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 15060

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SECTION 15080
PIPING 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. Automatic Flow Control Valves.
- B. Strainers.
- C. Thermometers and Accessories.
- D. Pressure Gauges and Accessories.
- E. Pressure and Temperature Test Ports.
- F. Install Miscellaneous Control Devices.

1.3 SUBMITTALS

- A. Submit schedule of all products used. Include make, model and size. When multiple products will be used, generic size and flow range will be acceptable.
- 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. Automatic Flow Control Valves: (NO SUBSTITUTIONS)
 - 1. Flow Design, Inc.
 - 2. Nexus Controls
 - 3. Griswold
- B. Strainers:
 - 1. Crane
 - 2. ITT Grinnell
 - 3. O.C. Keckley
 - 4. Mueller Steam Specialty Co. (MUESSCO).
 - 5. RP&C Division, Conbraco Industries, Inc.
 - 6. Victaulic Co. of America
 - 7. Wheatley Gaso, Inc.

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C. Thermometers and Accessories:

1. Duro Instrument Corp.
2. Taylor
3. H.O. Trerice
4. Weiss
5. Weksler
6. Winter's ThermoGauges

D. Pressure Gauges and Accessories:

1. Ashcroft
2. Duro Instrument Corp.
3. H.O. Trerice
4. Weiss
5. Weksler
6. Winter's Thermogauges

E. Pressure and Temperature Test Ports:

1. Peterson Equipment Co., Inc.
2. Sisco P/T Plugs
3. Owner approved equal.

2.2 FABRICATION

A. Automatic Flow Control Valves:

1. HVAC Water Service:
 - a. Size ½" thru 2-1/2": Brass wye body design, thread or sweat connection, ground joint union, dual temperature and pressure test ports extended to clear required insulation, range 20°F to 230°F rated at 400 psi water. Stainless steel or nickel plated piston brass orifice and spring, replaceable without removing from installation, factory set to control the flow rate within 5% of the tagged rating over an operating pressure differential of at least 10 times the minimum required for full flow condition. GPM and direction of flow shall be clearly marked on flow control valves. Wide open pressure drop shall not exceed 10 ft. Valves shall be calibrated for the fluid being pumped. Based on Flow Design, Inc. AutoFlow Model YR or equal.
 - b. Size 2-1/2" thru 12": Ductile iron body, wafer style connection, dual temperature and pressure test ports, range 20°F to 230°F rated at 150 psi. Stainless steel or nickel plated piston brass orifice and spring, factory set to control the flow rate within 5% of the tagged rating over an operating pressure differential of at least 10 times the minimum required for full flow condition. GPM and direction of flow shall be clearly marked on flow control valves. Wide open pressure drop shall not exceed 10 ft. Valves shall be calibrated for the fluid being pumped. Based on Flow Design, Inc. AutoFlow Model WS or equal.

B. Strainers:

1. "Y" Pattern:

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a. HVAC Water Service:

- (1) Size 1/4" thru 2": Cast iron body, threaded connection, threaded blow-off cover, removable stainless steel screen .045" perforations, rated at 450 PSIG. Based on Mueller Steam Specialty Co. (MUESSCO) #11M or equal.
- (2) Size 2-1/2" and up: Cast iron body, flanged connection, flanged blow-off cover. Blow-off cover tapped for blow-off valve, removable stainless steel screen .045" perforations, rated at 125 PSIGG. If grooved mechanical system is in use a "T" type grooved end, ductile iron body, available with blow off, 304 SS removable screen, choice of mesh size. Based on Victaulic Style 730 (grooved T type) Mueller Steam Specialty Co. (MUESSCO) #751 or equal.

C. Thermometers and Accessories:

1. Industrial Reading Non-Mercury Type:

- a. Construction: Adjust angle, 9" scale with lagging extension brass well, of the blue or red reading spirit (organic) fill type and guaranteed accurate to \pm one scale division. Thermometer shall have glass front to exclude dirt and dust. Thermometers containing mercury are not acceptable. Thermometers installed outdoors shall be specifically designed and weatherproofed for this application.
 - b. Stem Length:
 - (1) 6" pipe and smaller 3-1/2"
 - (2) 8" to 12" pipe 6"
 - c. Ranges:
 - (1) Chilled water 0 to 120°F or 0 to 100°F as available.
 - d. Based on Weksler Type EG5H-9 or equal.
2. Thermometer Well: Construction - Brass or ductile iron body, with lagging extension, length to accommodate thermometer stem length. Based on Weksler or equal.

D. Pressure Gauges and Accessories:

1. Pressure Gauges:

- a. Construction: 4-1/2" dial, high impact polypropylene case, 1/4" bottom connection, 1/2% accuracy in accordance with ANSI B40.1 - 1974 Grade A. Stainless steel rotary with stainless steel pinion gear; stainless steel sector gear; stainless steel link. Stainless steel bourdon tube, 316 stainless steel socket and slotted adjustable pointer.
- b. Case of black high impact polypropylene suitable for surface or direct mounting and with bottom connection. For outdoor locations, provide glycerine filled gauges.
- c. Range: Ranges shall be so selected to indicate pressure reading in midpoint of scale selected.
- d. For condenser water, ice water and other open system pumps, provide a

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- compound gauge with dial calibrated to read in. hg. vac. as well as pressure.
 - e. Based on Weksler Model AA44-2 and AY44-2 or equal.
 - 2. Ball Valve Shut-Off: See Ball Valves Section 15100.
 - 3. Manifold Valves (Trumpet Valve) (Water):
 - a. 2, 3 or 4 port. Brass body, spring return, push button brass valves, 1/4" compression connections. Gauge tap at top, calibrated gauge test port with gauge cock. 125 PSIG rated, 20°F to 220°F range. Based on Flow Conditioning Corporation Hydronic Indicator System or equal.
 - 4. Piston type snubber: Brass body, threaded connections, suitable for mounting horizontal or vertical. (Required at pump inlet and discharge.) Based on Weksler Type RS-1 or equal.
 - 5. Filter type snubber: Brass body, threaded connection, micro metallic stainless steel filter. (For all gauges except pump service). Based on Weksler Type BW42 or equal.
 - E. Pressure and Temperature Test Ports:
 - 1. Brass or stainless steel body with threaded cap and gasket, length to extend past insulation.
 - 2. Two self closing valves with intermediate pocket for added pressure protection. Sized for standard 1/8" probe.
 - 3. Range: 20°F to 230°F.
 - 4. Rating: 250 PSIG water.
 - 5. Based on Peterson Equipment Co., Inc. "Pete's Plug" Model 110 or 110XL or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install in accordance with manufacturers written installation instructions.

3.2 INSTALLATION

A. Flow Control Valves:

- 1. Install with taps in upright or vertical position.
- 2. Tag valve for:
 - a. Type of service.
 - b. Flow in GPM.
- 3. The contractor shall assume the responsibility to obtain the necessary gauges and thermometers to properly take the differential pressure and temperature readings from the flow control valves.
- 4. All flows shall be verified.

B. Strainers:

- 1. "Y" Patterns:
 - a. Strainers preceding automatic steam control valves shall be installed

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with the strainer branch in the horizontal position to eliminate the formation of a water pocket in the strainer branch.

- b. All non-steam “Y” pattern strainers shall be installed with the strainer branch in the downward vertical position.
 - c. For all “Y” pattern strainers, provide blow-off valve assembly consisting of ball-type drain valve with hose end cap and pipe nipple.
- C. Thermometers and Accessories:
- 1. Install and adjust thermometers for optimum visibility.
 - 2. Provide thermometers where indicated on schematic flow diagram or schematic equipment details.
 - 3. Install thermometers in compatible thermometer wells.
- D. Pressure Gauges and Accessories:
- 1. Install and adjust gauge for optimum visibility.
 - 2. Provide ball valve shut-off for all hydronic gauges.
 - 3. In lieu of the trumpet valve the contractor may assemble individual components using ball valves as the isolation valve provided the same functions of the trumpet valve are duplicated.
 - 4. Provide filter type snubbers for all other fluid services.
 - 5. Open shut-off valve only enough to obtain accurate reading. Valve to gauge to be closed at all other times.
- E. Pressure and Temperature Test Ports:
- 1. Install in upright or vertical position as indicated on schematic flow diagram or schematic equipment details.
 - 2. Install in tee or welded outlet.
- F. Install miscellaneous control devices such as thermometer wells, tees for flow measuring stations, connections for differential pressure sensors, etc.

END OF SECTION 15080

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SECTION 15090
SUPPORTS, HANGERS, ANCHORS AND SLEEVES

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. Pipe Hangers, Rods, Supports and Accessories.
- B. Duct Hangers and Supports.
- C. Duct Sleeves.

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. 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®
- B. Duct Hangers and Supports: Fabricated per Specifications
- C. Duct Sleeves: Fabricated per Specifications

2.2 FABRICATION

- A. 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:

Copper Tube, Plastic Steel, Cast Iron or

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<u>Fiberglass Reinforced Pipe Size</u>	<u>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.
- 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.

B. Duct Hangers and Supports: Fabrication and application of duct hangers and supports

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shall be in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, Latest Edition, as applicable.

- C. Duct Sleeves: Sleeves shall be provided for ducts penetrating concrete and masonry walls, stud framed fire rated walls, and poured- in-place concrete floors and roofs. Sleeves shall be sized to accommodate duct, insulation and firestopping. Refer to Division 7 for firestopping requirements.

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 in a “like new condition”.

3.2 INSTALLATION

- A. 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

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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.

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.

B. 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.

C. Duct Sleeves:

1. Secure sleeves to forms for concrete construction. Ensure sleeves are not disengaged or misaligned by concrete placement operations.
2. Provide temporary cap for open end of sleeves to prevent entrance of concrete.
3. Provide temporary internal bracing where required to prevent distortion of sheet metal sleeves by concrete placement operations.
4. Sleeves shall not be installed in structural members, except where indicated or approved.
5. Furnish sleeves to masonry contractor in advance of masonry work. Furnish dimensioned drawings indicating exact location of sleeves.
6. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface, except as indicated otherwise.

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7. Sleeves passing through floors in wet areas, such as areas containing plumbing fixtures or floor drains, shall extend a minimum of 4 inches above the finished floor. Sleeves in wet areas shall be enclosed with 4 inch concrete curb.
8. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance all around between the duct and inside of sleeve, or between jacket over insulation and sleeve.
9. Provide membrane clamping devices on sleeves for waterproof floors.
10. Duct sleeves shall be secured to opening and have a flange turned back to wall to cover any irregularities in the opening provided for the sleeve.

END OF SECTION 15090

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SECTION 15100
VALVES

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. Ball valves.
- B. Butterfly valves.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced to in the text by the basic designation only.
 - 1. American National Standards Institute (ANSI).
 - 2. American Society for Testing and Materials (ASTM).

1.4 SUBMITTALS

- A. Submit schedule and cut-sheets indicating service, make and model number, pressure class, end type and usage (i.e., balance, shut-off).
- B. Product data shall be included in the operation for maintenance instruction manuals along with installation, operation and maintenance instructions.
- C. Refer to Section 15010 for requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Ball Valves:
 - 1. Apollo
 - 2. Crane Company
 - 3. Hammond Valve
 - 4. Milwaukee Valve.
 - 5. Nibco, Inc.
 - 6. Stockham
 - 7. Victaulic Co. of America.
 - 8. Watts
- B. Butterfly Valves:
 - 1. API International, Inc.
 - 2. Bray International, Inc.

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3. Crane Company
4. Demco
5. DeZurik
6. Grinnell
7. Hammond Valve
8. Keystone Valve Co., U.S.A.
9. Milwaukee Valve
10. Mueller Steam Specialty, Co. (MUESSCO)
11. Nibco, Inc.
12. Stockham
13. Victaulic Co. of America.

2.2 FABRICATION

A. Ball Valves:

1. HVAC water service:

- a. Size 1/4" thru 2". Two piece, adapter loaded, full port type with brass body, threaded or sweat connection, stainless steel stem, stainless steel ball, teflon or silicone bronze seat, steel lever handle, indicator stop, 150 lb. 600 WOG.
- b. Size 1/2" thru 2". Two piece, standard port type with brass body, Vic Press 304™ connection, brass ball and stem, Teflon seat, carbon steel handle, 300 CWP. Victaulic Series 589 or equal..
- c. Valves installed in insulated piping to have extended handles to clear insulation. Stem extension shall be made of a non-thermal conducting material with a sleeve to form an insulated vapor seal after the valve is insulated. Based on Nibco T-585-70-66 or equal.

B. Butterfly Valves:

1. HVAC water service – Above Ground Use:

- a. Size 2-1/2" thru 4": 416 stainless steel stem, lug wafer body drilled and tapped for isolation and removal of downstream piping, cast iron or ductile iron body, long neck body extended to allow for a minimum of 2" insulation, aluminum bronze or stainless steel disc, bubble tight EPDM seat, infinite position, memory stop handle. Class 150, 20°F to 210°F range. Based on Nibco LD-2000-3 or equal.
- b. Valves installed in insulated piping to have extended handles to clear insulation.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide shut-off valves on the inlet and outlet of each piece of equipment at the take-off of each major branch from a header and at the base of each pipe riser in order to facilitate service.
- B. Provide drain valves at the base of each pipe riser and at each piece of equipment to facilitate service.
- C. Provide locking device on handle of the expansion tank isolation valve to prevent accidental closing.

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3.2 INSTALLATION

A. Ball Valves:

1. Install valves with adequate access to lever actuator.
2. Provide adequate space for actuator handle in the open and closed position and for packing replacement.
3. Provide infinite position handle with memory stop on the outlet of all heat exchangers for balancing purposes.

B. Butterfly Valves:

1. Install valve between face of 125# or 150 standard ANSI flanges or standard grooved couplings.
2. Assure unrestricted valve movement after installation. Valves should be installed with stem of valve parallel to floor.

END OF SECTION 15100

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SECTION 15170
AIR CONTROL

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. Automatic Air Vent

1.3 QUALITY ASSURANCE

- A. Expansion tanks shall be constructed with materials and standards which comply with the following standards:
 - 1. American Society of Mechanical Engineers (ASME) Codes:
 - 2. Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1.

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with Section 15010 - Mechanical General Provisions.
- B. Submit schedule indicating make, model, size, etc. by system.
- C. Submit statement of Code compliance where applicable.
- D. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Automatic Air Vent:
 - 1. Armstrong Pump Company
 - 2. Bell & Gossett, Inc.
 - 3. Taco, Inc.

2.2 FABRICATION

- D. Automatic Air Vent: Non-ferrous, automatic air vent rated for 240°F and 150 PSIG. Based on Bell and Gossett Model 87.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install in accordance with manufacturers written instructions.

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- B. Install air vents at all high points of system to facilitate air removal for proper flow and heat transfer.

3.2 INSTALLATION

I. Automatic Air Vent:

1. Install where shown on drawings or standard details.
2. Install 1/2" ball valve and nipple between automatic air vent and system.
3. Provide proper access.
4. Do not install automatic air vent in concealed or non-accessible areas or where leakage may cause damage.
5. Pipe discharge to nearest floor drain.

END OF SECTION 15170

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SECTION 15210
VIBRATION ISOLATION

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. Vibration isolators.

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.

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

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1. Amber/Booth Company
2. Mason Industries, Inc.
3. Peabody Noise Control, Inc. - Kinetics.
4. Vibration Mountings and Controls, Inc.

2.2 MATERIALS

A. Vibration Isolators:

1. Type A: Double Deflection Neoprene Mount: Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided for these areas where bolting is required. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang. Based on Mason Type ND.
2. Type B: Spring Type Mount: Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Based on Mason Type SLF.
3. Type C: Restrained Spring Type Mount: Spring type isolators shall be laterally stable with housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. A housing shall be used that includes vertical limit stops to prevent spring extension when weight is removed. The installed and operating heights shall be the same. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operations. Mountings used out of doors shall be hot dipped galvanized. Based on Mason Model SLR.
4. 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.
5. Type E: Horizontal Thrust Restraints: The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad. The spring diameter shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. The spring element shall be contained within a steel frame and designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" movement at start and stop. The assembly shall be furnished with one rod and angle brackets for attachment to both the equipment and ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on either side of the unit. Based on Mason Model WB.
6. Type F: Neoprene Isolation Pads: Neoprene isolation pads shall be single rib or

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crossed, double rib neoprene in-shear pads, in combination with steel shims when required, having minimum static deflections as tabulated. All neoprene pads shall be true neoprene in-shear using alternately higher and lower ribs to provide effective vibration isolation, and shall be molded using 2500 PSI tensile strength, oil resistant, compounds with no color additives. Pads shall be 45 or 65 durometer and designed to permit 60 or 120 psi loading, respectively, at maximum rated deflections. Neoprene in-shear isolation pads shall be provided to meet tabulated minimum operating static deflections without exceeding published maximum static deflections. Use single or, crossed, double rib or laminated composites of both as required. When two pads of ribbed material are laminated, they shall be separated by, and bonded to, a galvanized steel shim plate. Based on Kinetics NPS, NPD, NGS or NGD.

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 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

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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. Packaged Air Handling Units:

1. Base type: None required.
2. Isolator Type: "F" / 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. 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. 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

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- 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. Fiberglass Insulation:
 - 1. Owens-Corning Fiberglas
 - 2. Knauf Fiberglass
 - 3. CertainTeed
 - 4. Johns Manville
- B. Closed Cell Elastomeric Insulation:
 - 1. Armacell LLC
 - 2. Johns Manville
 - 3. Rubatex
- C. Jackets:
 - 1. Southern Asbestos Company
 - 2. John Mansville
 - 3. Owens-Corning Fiberglas
- D. Foamglass Insulation:
 - 1. Pittsburgh Corning
 - 2. Cell-U-Foam Corp.
 - 3. Owner Approved Equal
- E. 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:

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

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- LLC WB Armaflex finish or equal.
- 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 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.

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- 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 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.

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- 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-Coustic 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.

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. This is particularly important on ice water and refrigerant lines.
- 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 and

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- dual temperature 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 from insulation sections or sheet.
 - 4) Outdoors: Provide aluminum pipe jacket.
5. 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:
 - 2) Exposed Indoors: Provide PVC jacket over all insulation that shall be sealed with an acrylic latex finish.
 - 3) Concealed: Provide PVC jacket over fittings fabricated from insulation sections or sheet. Provide ASJ over all other.
 - 4) Exposed Outdoors: Provide acrylic latex finish and aluminum pipe jacket.
- 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

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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 15750
COILS

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 WORK INCLUDED

- A. Electric heating coils.

1.3 QUALITY ASSURANCE

- A. Certify coil capacities, in accordance with ARI Standard 410.
- B. All electric heating coils shall be U.L. listed and comply with NFPA 90A and 90B.

1.4 SUBMITTALS

- A. Submit dimension drawings, performance and product data for approval.
- 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. Electric Heating Coils:
 - 1. Brasch
 - 2. Chromolox
 - 3. Dell
 - 4. Environmental Technologies, Inc.
 - 5. Indeeco

2.2 DESIGN AND CONSTRUCTION

- A. Electric Heating Coils:
 - 1. Electric heating coils shall be of the slip-in or flange type, using wire construction of 80% nickel and 20% chromium supported in ceramic bushings. The heating wire for each step shall be strung along the entire coil face to prevent stratification when operating at less than full capacity.
 - 2. Terminals and nuts shall be constructed of stainless steel and terminal insulators and bracket bushings shall be constructed of ceramic securely stacked in position. Coil terminals shall be machine crimped to coil wires.
 - 3. Casings shall be constructed of not lighter than 22 gauge galvanized steel with galvanized steel supports on 4 inch centers, gusseted and spot welded. A solid cover shall be provided on the terminal box conforming to Paragraph 5.6 of U.L Standard 1096. Three-eighths inch thick rigid fiberglass without metal-to-metal contact shall be

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- installed between the coil and terminal box.
4. Coils shall be tested at twice the rated voltage plus 1,000 volts or at 2,000 volts, whichever is greater. The coils shall be tested and certified for the following: ohm readings to verify capacity, voltage, phase and control voltage.
 5. Safety features shall include an automatic reset thermal cutout wired in series with the control and the heat limiters wired in series with the power legs. All safety devices shall be serviceable through the terminal box without removal of the heater from the duct.
 6. Built-in components shall include an interlocking disconnect switch, contactors, primary fused transformer, single terminal block, pressure type airflow switch and branch circuit fuses per NEC. All components shall be factory wired and mounted either on the heating coil or in a remote cabinet when shown on the drawings. When the interlocking disconnect switch is built in or externally powered, control circuits are indicated, door interlock micro switches shall be installed at the factory. The frame of the heater shall be provided with a ground stud wired to the terminal block for connection to an external grounding conductor.
 7. Solid State Control Relay (SCR) to be provided for infinitely variable power output from 0 to 100% in direct proportion to temperature requirements. Heaters in excess of 20 KW shall have a "vernier" control with an SCR relay and electronic step controller with a minimum of three steps of control. The SCR circuit shall have a KW rating larger than each of the other circuits. The SCR circuit shall be arranged to be first on and last off. When the temperature sensor calls for heat, the SCR circuit will begin to modulate from 0 to 100% capacity. When it reaches 100%, it will stay for one to two minutes. A signal is then sent to the electric step controller to bring in a fixed KW step. The SCR shall then fine tune the KW output. The reverse action shall take place on a fall in temperature. The SCR shall stay at zero output for one or two minutes and then a fixed step shall go off.
 8. Contactors shall be of the magnetic disconnecting type.
 9. Recessed terminals shall be provided where heating coils are installed in internally lined factory fabricated air handling units. Watts density as measured in watts per square inch of wire surface shall not exceed 35 when installed in draw-through units and 25 when installed in blow-through or VAV units.
 10. The heating coil shall be internally wired in such a manner that assures that a balanced electrical load will be provided across all three phases of the load at all times.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins.
- B. Install coils in accordance with manufacturers recommendations.

3.2 INSTALLATION

- A. Electric Heating Coils:
 1. Install heaters so that the access door can swing fully open, without restriction.
 2. Provide uniform duct transition into and out of coil for uniform heating.
 3. In cases where coil is inserted in internally lined duct, provide the necessary cold ends and flanges to prevent hot spots.
 4. Install in proper direction of air flow to ensure that thermal cut-outs are downstream

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- for proper over temperature protection.
5. Coordinate the control stages, etc. with the temperature control contractor.

END OF SECTION 15750

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SECTION 15763
PACKAGED AIR HANDLING UNITS

PART 1 - GENERAL

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. Refer to Division 1 for all requirements pertaining to General Provisions.

1.2 WORK INCLUDED

- A. Packaged Air Handling Units.

1.3 QUALITY ASSURANCE

- A. All electrical components shall be listed and labeled by U.L., ETL or a Nationally Recognized Testing Laboratory (NRTL), listed and labeled.
- B. Unit performance shall be certified in accordance with ARI Standard 430 for central station air handling units.
- C. Coil performance shall be certified in accordance with ARI Standard 410.
- D. All components in the conditioned air stream shall conform to the NFPA-90A Flame/Smoke/Fire Contribution Rating of 25/50/0.
- E. All electrical devices shall conform to NEMA standards.
- F. All wiring shall conform to the NEC.
- G. When connected to a 277/480 VAC system, the heating coil shall be listed and labeled at 277 VAC or 480 VAC for single phase or three phase units respectively, regardless of the voltage scheduled on the drawings.
- H. 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 guide lines of the manufacturer's written installation instructions and that its performance meets or exceeds the operating characteristics, specified and/or scheduled.
- I. In accepting this Contract, the air handling unit manufacturer shall guarantee their units to give capacities not less than the capacities specified with the conditions as specified, without the unit sweating in an unconditioned mechanical room, (it is understood that minor misting of the unit surface may occur at unit seams where thermal breaks do not exist. The manufacturer guarantees that they will take whatever steps are necessary to meet the guarantee, at no additional cost to the Owner, regardless of the extent of the revisions required. A Corporate Officer of the manufacturer shall certify the guarantee and the submittal data.
- J. 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

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the Owner for a period of one year from the date of substantial completion of System. Extended warranty shall be provided for systems installed during earlier phases of construction through to substantial completion of the final phase. Explain the provisions of warranty to the Owner at the "Demonstration of Completed System" meeting to be scheduled with the Owner upon project completion.

K. 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.

L. Air-handling units shall be Owner-Furnished. Contractor to coordinate receipt of units from the factory with owner.

1.4 SUBMITTALS

A. Submit in accordance with Division 1 requirements.

B. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.

C. AHU manufacturer shall provide the following information with each shop drawing/product data submission:

1. Dimensioned arrangement drawings for each AHU including a plan and elevation view of the assembled unit with overall dimensions, lift points, unit shipping split locations and dimensions, installation and operating weights, and installation, operation and service clearances.
2. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.
3. Each component of the unit shall be identified and mechanical specifications shall be provided for unit and accessories describing construction, components, and options.
4. All performance data, including capacities and airside and waterside pressure drops, for components.
5. Fan curves shall be provided for fans with the design operating points indicated and at 15% greater RPM along the system curve with fan efficiency and horsepower clearly indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.

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6. Submit computer coil selection clearly indicating system design conditions, as well as coil hand connections, electric heating coil data, where applicable.
7. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.
8. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height.
9. A coil valve coordination schedule shall be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, coil type and corresponding section location within the AHU, valve style (e.g. global, ball), valve type (e.g. electronic 2-way/3-way), valve position (e.g. normally open/closed), size, flow coefficient (CV), and close-off pressure.
10. An electrical MCA – MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).
11. Sound data shall be provided using ARI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz.

D. The AHU manufacturer shall list any exceptions to the specification.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Packaged Air Handling Units (NO SUBSTITUTIONS):

1. Trane

2.2 FABRICATION

A. Packaged Air Handling Units:

1. General:

- a. Sizes, types and performance as indicated on unit schedule.
- b. Each unit complete with factory furnished components as shown on the plans. Each air handler unit shall be completely factory assembled, or partially assembled, tested and shipped in one piece or in sections for field assembly depending on size. All casings and access doors shall be of double wall construction. All components shall be assembled on a base rail or mounting legs of sufficient height to provide proper condensate drain trapping, provided with the unit, complete with lifting lugs to accept cable in chain hooks.
- c. All units shall have decals and tags to indicate caution areas and to aid unit service. Nameplates shall be fixed to the unit.

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2. Cabinet, Casing and Frame:
 - a. Full height, hinged access doors with stainless steel hinge and lever latching mechanism shall provide access to each cabinet section from both sides. Access doors shall provide gasketing for a positive seal. Doors shall open outward for negative pressure and inward for positive pressure applications, or have a double latching mechanism for safety.
 - b. Unit shall be insulated with U.L. listed minimum 2" thick waterproof foam insulation. Insulation to have a minimum thermal resistance or "R-Value" of 13.
 - c. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8" w.g., whichever is less, and shall not exceed 0.0042" per inch of panel span (L/240).
 - d. Casing air leakage shall not exceed 1% of design airflow at the specified casing pressure.
 - e. Exterior panels of all sections shall be constructed of 18 gauge or heavier galvanized steel. All sections shall include galvanized steel internal liners. Wall thickness shall be 2".
 - f. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

3. Access Doors:
 - a. Access doors shall be 2" double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.
 - b. All doors downstream of cooling coils shall be provided with a thermal break construction of door panel and door frame.
 - c. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.
 - d. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.
 - e. Handle hardware shall be designed to prevent unintended closure.
 - f. Access doors shall be hinged and removable without the use of specialized tools to allow.
 - g. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.
 - h. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.
 - i. All doors shall be a minimum 60" high when sufficient height is available, or the maximum height allowed by the unit height.
 - j. A single door handle shall be provided for each door linking multiple latching points necessary to maintain the specified air leakage integrity of the unit.
 - k. A shatterproof window shall be provided in fan access doors.

4. Coil Sections:
 - a. Coil sections shall be blow thru or draw thru as scheduled or detailed on drawings and incorporate single or multiple coils. Coils shall be guaranteed to have no moisture carry-over.
 - b. Coil row depth shall match that shown on the air handling unit schedule, except that the minimum row depth shall be that listed, or 8 rows,

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- whichever is less. Maximum fin density shall be 130 fins per foot, regardless of the value scheduled.
- c. Water coils shall be of the cartridge type and have threaded connections (direct expansion coil shall have sweat-type connections) located on the same end. Coil headers, distributors and connections shall be completely enclosed in the unit casing. Vent and drain connections shall be provided on all water cooling coils. Coil supports shall be Type 304 stainless steel.
 - d. Coils shall have non-ferrous headers and copper tubes, mechanically bonded to ripple-corrugated aluminum fins. Coils shall have a staggered tube type design. Coils shall have Type 304 stainless steel casing. Coils shall be certified in accordance with Air Conditioning and Refrigeration Institute (ARI) Standard 410-72. Coil performance shall be substantiated by computer generated output data.
 - e. Chilled water coils shall have 1/2" or 5/8" O.D. copper tubes. Coils shall be circuited for minimum pressure drop. Coils shall be tested at 315 pounds air pressure under warm water and be guaranteed for 150 psig working pressures. Coils shall be guaranteed to produce no carryover.
5. Condensate Pan:
- b. A double wall condensate drain pan consisting of inner 18 gauge 304SS pan, an outer 18 gauge galvanized steel pan and minimum 5/8" thick rigid foam insulation between the two pans.
 - c. Pan shall be non-trapping design sloped to the drain connection and guaranteed not to have standing water after shut-down. It shall extend beyond the leaving airside of the cooling coil and extend underneath the coil connections.
 - d. The drain pan shall be thermally isolated from the unit casing. A threaded drain connection shall extend through the unit base.
 - e. For stacked coils, an intermediate Type 304 stainless steel drain pan extending a minimum of 6" past shall be provided with drop tubes on each end, or a method to transfer condensate to the lower drain pan shall be provided.
6. Direct Drive Plenum Fans (Refer to Drawing Schedule):
- a. Fan shall be direct driven, arrangement 4 plenum fan constructed per AMCA requirements for the duty specified. The fan or fans in total shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure.
 - b. Fan/motor assemblies will be internally isolated with spring isolators and flex collars.
 - c. Fan motors shall be E+3, inverter ready pedestal mounted, ODP selected at the operating voltage and efficiency as specified or as scheduled elsewhere. Each fan motor shall be sized so the fan maximum brake horsepower does not exceed motor's nominal nameplate rating.
 - d. Fans shall be positioned in the air tunnel cross section and with adequate spacing upstream and downstream for servicing and airflow.
 - e. Fan downstream access door width shall be wide enough to permit the fan motor, fan wheel or fan motor/wheel removal.
 - f. Fans shall be supplied with a Piezometer Flow measuring station consisting of multiple recessed measuring ports located at the narrowest throat on the inlet cone and a static reference port in the unit. Flow measuring station shall not obstruct the inlet of the fan and shall have no effect on fan performance (flow or static) or sound power levels.

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- Piezometer Flow measurement system will be supplied and installed by the fan manufacturer.
- g. Piezometer signal shall be converted thru an accurate pressure transducer into a 0-10 volt output control signal. Provide a fan calibration formula to convert the flow signal into the fan CFM.
 - h. Units will have an ETL or UL 1995 label.
7. Filter Section:
- a. The filter section shall be capable of accepting 4" face loading filters. They shall be supplied complete with galvanized steel filter racks as an integral part of the unit.
 - b. Provide fixed filter block-offs as required to prevent air bypass around filters.
 - c. Filters shall be accessible from both sides of the unit or as shown on the documents.
 - d. The filter section shall be provided with filters and filter differential pressure gauge (refer to controls drawings) as specified in Section 23 41 00.
8. Return Air/Outdoor Air Mixing Section:
- a. A return air plenum shall provide 100% return air capability. A duct collar shall accept return air ductwork return air connection as detailed on drawings.
9. Factory Plenum Section Casing: Reinforced mill galvanized or primed steel with baked finish, minimum 18 ga. panels, gasketed joints between panels, 1" thick, 3 lbs. density glass fiber insulation with vapor barrier, access doors with safety latch handles. Suitable for 6.0" w.g. positive or 4" w.g. negative static. Field Built Plenums are NOT acceptable.
10. Discharge Air Plenum: A discharge air plenum shall be provided for sound attenuation with outlet velocities as scheduled and will have 1" duct collar for a bottom or front supply air duct connection as detailed.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install 8" manufacturer base rail to allow for condensate trapping.
- B. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer's instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.
- C. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the Owner and the Owner's selected Mechanical Contractor to ensure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or -welded joints, and all other installation and assembly requirements.
- D. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.

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- E. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps shall not be acceptable.
- F. Assemble and install in accordance with manufacturers written installation instructions and details on drawings.
- G. Coordinate duct, piping and electrical work so as to provide access to unit for maintenance, filter replacement, coil, fan shaft and motor removal with minimum disturbance of piping.
- H. Mount units at proper elevation and arrange condensate trap for proper drainage at design pressure differential. Pipe condensate to nearest hub drain.
- I. Install air vents and drain valves to permit proper venting and drainage.
- J. Prior to unit start-up all controls shall be installed and tested.
- K. Prior to initial start-up and for system testing install air filters to protect the unit and ductwork from dirt and debris. After the system has been tested and prior to turning the system over to the Owner, replace the pre-filters with new, clean filters as specified.
- L. All joints or assembled seams of the assembled unit shall be caulked or gasketed air tight up to 1.5 times design static pressure, or 8" w.g., whichever is less, and shall not exceed 0.0042" per inch of panel span (L/240).
- M. Prior to turning the system over to the Owner, all damages incurred during shipping, storing and installing shall be repaired. These repairs shall be sufficient to bring the equipment back to the quality standards equal to the original manufacturing standards. These repairs shall include but are not limited to repairing painted surfaces, dent removal, combing coil fins, repairing or replacing wet, sagging or torn insulation, etc.

END OF SECTION 15763

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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.
- F. The primary air duct for this project supplies "supercool air" which is at a temperature lower than normal. This contractor is cautioned that special provisions shall apply to the installation including extra care on leak tightness and special hanging precautions.

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:

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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. 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. Allowances must be made for duct liner if indicated. 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:

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- 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 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, Architect and/or Engineer.
- C. All ductwork shall be run parallel or perpendicular to building structure whenever possible.
- D. All ductwork shall be properly sealed.

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- 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, 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) 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.

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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.

3.5 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>
1.	Outside Air Duct		2" neg.	A
3.	Supply To Terminal	A.C Unit	3" pos.	A
5.	Return	Inlet Grille to Terminal	2" neg.	A
6.	Return	Term to Return Air Fan	4" neg.	A

Schedule Legend:

Duct Material

A Galvanized Steel

END OF SECTION 15840

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WEST BUILDING DOCK 7 – SERVER ROOM AHU ADDITION

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 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:
 - 1. Draw to a scale of not less than 1/4 inch to one foot on the same size sheets as the contract drawings.

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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 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

2.2 FABRICATION

A. Single Wall Round 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 Pipe	Fittings	Spiral Pipe	Fittings	Spiral 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
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

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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.
 - f. Based on United McGill
- I. 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.
- J. 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.

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- 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 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.

3.4 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) 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.

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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.

3.5 INSTALLATION

A. General:

1. Install generally as indicated.
2. Conceal ductwork in finished spaces unless indicated otherwise.
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 or round ductwork as follows:
 - a. Use slip joints, couplings, etc. sealed with adhesive pre-applied to couplings or duct mate spiralmate 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

Schedule Legend:

Duct Material

A Galvanized Steel

B. Access Door Schedule:

1. Round Duct:

Duct Size

Access Door Size

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- | | | |
|----|-----------------|----------------------------|
| 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" |

END OF SECTION 15846

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WEST BUILDING DOCK 7 – SERVER ROOM AHU ADDITION

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. Fire dampers
- C. Smoke dampers
- D. Combination fire/smoke dampers
- E. Volume dampers.
- F. Flexible duct connectors.
- G. Hardware cloth.
- H. 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 (FAC 9N-3).

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

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- A. Duct Access Doors:
 - 1. Air Balance, Inc.
 - 2. Cesco Products
 - 3. Greenheck, Inc.
 - 4. Nailor Industries, Inc.
 - 5. Nystrom
 - 6. Prefco Products, Inc.
 - 7. Ruskin Manufacturing, Co.
 - 8. Safe Air Inc.

- B. Fire Dampers:
 - 1. Air Balance, Inc.
 - 2. Cesco Products
 - 3. Greenheck, Inc.
 - 4. Nailor Industries, Inc.
 - 5. Prefco Products, Inc.
 - 6. Ruskin Manufacturing, Co.
 - 7. Safe Air Inc.
 - 8. Pottorff

- C. Smoke Dampers:
 - 1. Air Balance, Inc.
 - 2. Cesco Products
 - 3. Greenheck, Inc.
 - 4. Nailor Industries, Inc.
 - 5. Prefco Products, Inc.
 - 6. Ruskin Manufacturing, Co.
 - 7. Safe Air Inc./Dowco
 - 8. Pottorff

- D. Combination Smoke/Fire Dampers:
 - 1. Air Balance, Inc.
 - 2. Cesco Products
 - 3. Greenheck, Inc.
 - 4. Nailor Industries, Inc.
 - 5. Prefco Products, Inc.
 - 6. Ruskin Manufacturing, Co.
 - 7. Safe Air Inc./Dowco
 - 8. Pottorff

- E. 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. Safe Air Inc./ Dowco

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F. Flexible Duct Connectors:

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

G. 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.

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.

B. Fire Dampers:

1. Rating: 1-1/2 hours (UL approved for installation in 2 hour walls).
2. Construction: Minimum 24 gauge galvanized steel frame suitable for connection to ductwork without transition, minimum 24 gauge galvanized steel curtain type blades located out of the airstream, thickness coordinated with wall construction. Where an active smoke control system exists (refer to section 15950) the damper shall be capable of closing in an airstream moving at a minimum of 2000 feet per minute and operating at 4" w.g. pressure (dynamic damper).
3. Sleeves: UL listed minimum gauge galvanized steel with welded construction corners. Rollformed sleeves will not be acceptable unless contractor guarantees in writing to seal voids in sleeve with UL approved sealer to limit air leakage. Length of sleeve shall be coordinated with the wall or floor.
4. Operation: Stainless steel constant force closure spring.
5. Link Setting: 160 or 165°F.

C. Smoke Dampers:

1. Low and Medium Pressure Ductwork:

- a. UL labeled under UL 555S low leakage rated, no more than 10 CFM/SF @

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- 1" w.g. (UL Class II) after exposure to 1000°F for 1 hour (non-degradable). Classified for both horizontal and vertical mounting.
 - b. Construction:
 - 1) Frame 16 galvanized steel.
 - 2) Damper Blades: 14 gauge true airfoil design constructed of galvanized steel of low leakage non-heat degradable design with friction free silicone rubber edge type for a smoke seal to 450°F incorporated into blade and frame shapes. Blade shall be suitable for installation in systems with a maximum velocity of 4,000 FPM and 8" w.g. pressure at closure.
 - c. Damper operation by means of an electric actuator 120V AC, 24V AC or signal from smoke detector alarm circuit. Electric motor actuator to be UL listed with damper assembly for power open, spring closed operation with a maximum travel time of 15 seconds. Motor furnished with all connecting linkage and mounting hardware.
 - d. Damper and actuator shall be provided with a 60 month warranty as described in Paragraph 1.3.C.
- D. Combination Smoke/Fire Dampers:
 - 1. Low and Medium Pressure Ductwork:
 - a. UL labeled under the following standards:
 - 1) UL 555 - 1-1/2 hr. fire endurance.
 - 2) UL 555S - Low leakage rated, no more than 10 CFM/SF @ 1" w.g. (UL Class II) after exposure to 1000°F for 1 hour (non-degradable).
 - 3) Classified for both horizontal and vertical mounting.
 - b. Construction: Single damper designed and rated for combination smoke/fire duty.
 - 1) Frame: 16 ga. galvanized steel.
 - 2) Damper Blades: 14 gauge true airfoil design constructed of galvanized steel of low leakage non-heat degradable design with friction free inflatable silicone coated fiberglass material to maintain smoke leakage rating to a minimum of 450°F and galvanized steel for flame seal to 1900°F. Blade shall be suitable for installation in systems with a maximum velocity of 2,000 FPM and 4" w.g. pressure at closure.
 - 3) Duct sleeve provided by others.
 - c. Operation:
 - 1) Smoke/fire damper operation by means of an integral resettable and re-useable UL listed electric-ambient temperature link, UL listed releasing device and mechanical lock assembly. Link activated by either electric, 120V AC or 24V AC signal from smoke detector alarm circuit or 350°F duct ambient temperature. Damper shall be capable of being reopened by remote signal when the duct temperature drops to 150°F. Electric motor actuator shall be UL listed with the damper assembly for power open/spring closed operation. Motor actuator shall be factory furnished with all connecting linkage and mounting hardware and shall be factory

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- tested for proper operation.
2) Damper and actuator shall be provided with a 60 month warranty as described in Paragraph 1.3.C.

E. Volume Dampers:

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

F. 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

G. 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 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

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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.

B. Fire Dampers:

1. Fire dampers shall be provided where indicated.
2. Review the architectural drawings to determine the wall construction rating so as to provide the proper rated damper.
3. All fire dampers shall be mounted within a UL approved thickness galvanized steel sleeve permanently affixed to the wall by means of perimeter retaining angles.
4. The fire damper shall be permanently attached to the sleeve. All voids around the sleeve and damper and sleeve and wall shall be properly sealed with fire barrier material. (See Section 15050: Basic Materials and Methods for Fire Barrier Material.)
5. Ductwork shall be attached to the fire damper by means of a UL approved break away connection.
6. Access doors or access sections shall be provided at all fire damper locations.

C. Smoke Dampers:

1. Provided where indicated. See combination smoke/fire damper for assemblies in fire rated barriers.
2. Review the architectural drawings to determine the wall construction rating so as to provide the proper rated damper.
3. Provide access doors or access sections at all damper locations.
4. Coordinate the provision of the smoke damper actuator with the automatic temperature control and fire alarm system and ensure adequate space for the mounting of the actuator during installation of the damper and ductwork.

D. Combination Smoke/Fire Damper:

1. Provided where indicated. All smoke dampers in fire rated barriers to be combination type.
2. Review the architectural drawings to determine the wall construction rating so as to provide the proper rated damper.
3. All smoke/fire dampers shall be mounted within a UL approved thickness galvanized steel sleeve permanently affixed to the wall by means of perimeter retaining angles.
4. The smoke/fire damper shall be permanently attached to the sleeve. All voids around the sleeve and damper and sleeve and wall shall be properly sealed with fire barrier material.
5. Ductwork shall be attached to the smoke/fire damper by means of a UL approved break away connection.
6. Access doors or access sections shall be provided at all smoke/fire damper locations.
7. Coordinate the provision of the smoke damper actuator with the Building Control System and assure adequate space for the mounting of the actuator during installation of the smoke/fire damper and ductwork.
8. If pneumatic actuator is provided, all control tubing outside of the rated shaft shall be copper with 95-5 solder.

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

1. Install a 24" long yellow strip of material to each damper handle for easy visual

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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.

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

H. 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"
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 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. 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, Rigid Cell, Panel Type Filters.
- B. Extended Surface, Pleated, Panel Type Pre Filters.

1.3 QUALITY ASSURANCE

- A. High efficiency filter efficiency to be rated as per ASHRAE Standard 52-76 (atmospheric dust). The manufacturer shall guarantee filter performance to be as stated in their literature within tolerances conforming to Section 7.4 of ARI Standard 850-78. Representative filters shall have been tested by an independent, commercially operated test laboratory. The independent test laboratory report shall be available upon request to the specifying engineer and/or owner.
- B. 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, Rigid Cell, 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.
- B. Extended Surface, Pleated, Panel Type Pre Filters:

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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, Rigid Cell, Panel Type Filters:

1. Extended surface rigid cell, 100% synthetic media
2. High-impact plastic frame panels.
3. 4" thick, MERV 14, UL Standard 900 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.
5. Based on Airguard Legacy.

B. Extended Surface, Pleated, Panel Type Pre 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.
5. Based on AAF AM-Air 300.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Install filters and filter gauges in strict accordance with manufacturers recommendations. Provide separate gauge tap and valving so that pressure drop can be measured individually across prefilter and final filters.
- 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.

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 | - | Electrically 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. The work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
- D. The BAS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the integration into the existing complete, fully functional BAS.

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- E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- F. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- G. The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Enterprise-level information and control access.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of BAS functions.
 - 5. Offsite monitoring and management access.
 - 6. Energy management
 - 7. Standard applications for terminal HVAC systems.
 - 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
 - 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.

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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.
 6. UL 916 Energy Management
 7. NFPA 70 - National Electrical Code.

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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
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
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
Smoke Detectors	16	16	16	16
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

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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 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.
 - 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

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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:
 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

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- 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. Scope of work is to provide control points for new AHU's for integration into the existing Honeywell Building Automation System within the West Building. Existing Honeywell control panels to be expanded to accommodate new control points where required.
- G. Acceptable Manufacturers (NO SUBSTITUTIONS)
 - 1) Honeywell Controls

2.2 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
 - 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.

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- ◇ Analog thermometer.
- 3. 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.
- 4. 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.
- 5. Duct Mount Sensors
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
 - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
- 6. 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.
- 7. 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.

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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.
 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: ±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.

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- ◇ 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

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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.
- ◇ 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.*

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(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

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- a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
2. Current Sensing Switches
 - a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
 - b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
 - c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
 - d. Acceptable manufacturers: Veris Industries or approved equal.
3. Air Filter Status Switches
 - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
 - c. Provide appropriate scale range and differential adjustment for intended service.
 - d. Acceptable manufacturers: Cleveland Controls or approved equal.
4. Air Flow Switches
 - a. Differential pressure flow switches shall be snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
 - b. Acceptable manufacturers: Cleveland Controls or approved equal.
5. Air Pressure Safety Switches
 - a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
 - c. Acceptable manufacturers: Cleveland Controls or approved equal.
6. 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.

2.3 Output Devices

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- 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.

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- 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 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

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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.
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.

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.

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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.

3.2 Installation Practices

A. BAS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
 - a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BAS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Automation System shall be taken from panel boards and circuit breakers provided by Division 16.
2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BAS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

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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.
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.

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- 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.
 - 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. 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.
 - 11. Air Differential Pressure Status Switches:
 - a. Install with static pressure tips, tubing, fittings, and air filter.
 - 12. 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.

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

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the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BAS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

2. Operational training of the BAS shall include at a minimum: changing set points, overrides, starting and stopping equipment, log in to field controllers when the server or PC is down. The BAS contractor shall be required to develop a training outline for this procedure. The training outline, including the lesson plans and course materials, shall be reviewed and approved by the engineer of record through the submittal process.

3.4 Sequence of Operations – 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.

- 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

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

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

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 Control System (BCS).

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 defined herein.

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- 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 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.
- K. 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.
- L. 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
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

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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

- A. Refer to the drawings for the Sequence of Operations.

END OF SECTION

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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.

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.

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 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

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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.

INVESTIGATION OF SITE

- D. Check site and existing conditions thoroughly before bidding. Advise A/E of discrepancies or questions noted.
- E. 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, the electrical bidder shall verify every aspect of the proposed work 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.
- F. 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.
- G. 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.
- H. 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.
- I. All items removed and not re-used shall be immediately turned over to OCCC as they are made 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.
- J. Work is in connection with existing West building 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 during only approved hours as directed by Orange County Convention Center Project Manager. Notify project manager at least 72 hours in advance of any shut-down of existing systems. Perform work during non-general office or show operating hours unless otherwise accepted by Orange County. 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.

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1.7 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.

1.8 MATERIALS AND EQUIPMENT

- 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.

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- 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 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 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.

1.9 MISCELLANEOUS CIRCUITS REQUIRED

- A. 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.
- B. 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

1.10 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

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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 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).

1.11 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 Mechanical and Electrical.
- H. It is the responsibility of this Contractor to coordinate the exact required location of 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,

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

1.12 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.

1.13 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.

1.14 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.

1.15 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.

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- 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 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.

1.16 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.

1.17 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

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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.

- 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.

1.18 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.

1.19 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.

1.20 SUBSTANTIAL COMPLETION

- A. The Contractor shall be fully responsible for contacting all applicable parties Engineer and Orange County 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.

1.21 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.

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PART 2 - PRODUCTS (Not Applicable)

PART 3- EXECUTION (Not Applicable)

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. Panelboards
 - 6. Long Lead Items
- 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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BINDER EXAMPLES FOR SUBMITTALS
Insert In Vinyl Pockets (Front & Spline) 3-Ring Binder

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MPE NO. 2013-144B

ELECTRICAL SUBMITTALS

(Size To 8-1/2" x 11")

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MPE NO. 2013-144B

SYSTEMS SUBMITTALS

(Size To 8-1/2" x 11")

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CENTER
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SERVER ROOM
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MPE NO 2013-144B

ELECTRICAL
SUBMITTALS

(Size To 11")

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COUNTY
CONVENTION
CENTER
WEST BUILDING
DOCK 7 –
SERVER ROOM
AHU ADDITION

MPE NO.2013-144B

SYSTEMS
SUBMITTALS

(Size To 11")

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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.
- C. Request for substitution will not be considered after 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.

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4. Compliance Statement. Each request shall include the following compliance statement 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.

1.5 REQUEST FOR SUBSTITUTION SUBMITTALS (AFTER BID)

- A. Substitution requests submitted after bid will not be reviewed.
- B. Submittals for items noted as an Accepted Substitution on Contract Drawings, these specifications, or listed in an addenda, shall be submitted as required in Section 16012 - Submittals.

1.6 CONSIDERATION AND ACCEPTANCE

- A. Request for substitutions will not be considered if:
 1. Submittal does not comply with all requirements as noted above or contain all information required above.
 2. If submittal does not contain Compliance Statement, fully filled out.
 3. If Compliance Statement contains a 'no' or 'N'.
 4. Submittals are submitted beyond time limitations noted above.
- B. Samples.
 1. Sample may be required to be submitted, if deemed necessary by the A/E to determine if the substitution meets specifications.
 2. Where required by A/E on an individual basis, samples may be required after written notice of acceptance and approval has been made of each substitution.
 3. The A/E reserves the right to reject sample and consequently the substitution should the sample not meet the requirement of the contract documents.
- C. Substitutions will be considered on basis of design, concept of the Work, and overall conformance with information given in Contract Documents, including but not limited to:
 1. Design criteria, which shall be equal or superior to the specified item.
 2. Finishes, which shall be identical or superior to finishes of specified product.
 3. Lenses or louvers, which shall be identical size, thickness and type material specified.
 4. Physical size and dimension which are identical or within design criteria limitations as determined by the Engineer.
 5. Photometric data, which shall be identical or superior in quantity and quality.
 6. Trim detail and mechanical qualities, which shall be identical or within design criteria limitations as determined by the Engineer.
- D. The Engineer's decision on acceptance or rejection of substitutions will be final.
- E. Substitution requests, if accepted will be included in an addenda.

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- F. Approval of a substituted item or listing a substituted item as an accepted substitution, does not modify or act as a waiver in any way, the requirements of the contract documents. See Section 16012 for additional requirements on accepted substitution submittals, equipment, etc.
- G. The naming of any manufacturer as an accepted substitution does not imply automatic approval as a substitution. It is the sole responsibility of the Contractor to ensure that any price quotations received and submittals made are for systems that meet or exceed these specifications.

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:

AASHTO	American Association of State Highway and Transportation Officials
ACA	American Correctional Association
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
ASTM	ASTM International American Society for Testing and Materials International
BOCC	Board of County Commissioners Orange County
CRSI	Concrete Reinforcing Steel Institute
DMS/DOC	Department of Management Services Division of Communications
EIA/TIA	Electronics Industries Alliance/Telecommunications Industry Association
FAC	Florida Administrative Code
FBC	Florida Building Code
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FFPC	Florida Fire Prevention Code

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FGC	Florida Building Code (Fuel Gas)
FLA	State of Florida
FMC	Florida Building Code (Mechanical)
FS	Florida Statutes
IEEE	Institute of Electrical and Electronics Engineers, Inc
LPCR	Local Power 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
 - i) Electronics Industries Association/Telecommunications Industry Association
 - j) Florida Building Code, 2010
 - k) Florida Fire Prevention Code, 2010
 - l) Institute of Electrical and Electronics Engineers
 - m) Illumination Engineering Society
 - n) Local Power Company Requirements
 - o) Lightning Protection Institute
 - p) Local Telephone Company Requirements

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- q) National Electrical Code, 2008
- r) National Energy Conservation Policy Act
- s) National Electrical Safety Code
- t) National Electrical Manufacturers Association
- u) NFPA 1 Fire Code, 2009
- v) NFPA 101 Life Safety Code, 2009
- w) Occupational Safety and Health Act
- x) Safety Code for Elevators and Escalators
A17.1a, 2008 and A17.1b, 2009 Addenda
- y) Safety Code for Existing Elevators and Escalators
A17.3, 1996
- z) Sheet Metal and Air Conditioning Contractors
- aa) Underwriters Laboratories, Inc.
- bb) 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 in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with Orange County Convention Center.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing 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.

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- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling 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 for all panelboards being modified for this project.

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. Fire detection devices, smoke detection devices.
 - 2. Controls and alarms.
 - 3. Building grounding systems.
- 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 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.
 - b) 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.
 - c) Test each AHU shut down relay for full functionality with the alarm system.
 - d) Test Fire Alarm System sufficiently to determine existing operating condition of

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system. Check automatic detectors.

- 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.

2. Ground System:

- a) Test ground system at each panel being modified.

B. The Electrical Contractor shall investigate all existing systems as called out in this performance verification prior to the beginning of any work which could affect these systems.

C. Each system shall be retested after completion of remodel and/or renovation to ensure proper operation is maintained. Demonstrate operation per Section 16095 Demonstration of Completed Electrical Systems.

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 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 Equipment
 - a) Circuit breakers
 - b) Fuses and fuseholders
3. Miscellaneous Electrical Equipment
 - a) Electrical systems controls and equipment
 - b) Electrical power equipment
 - c) Relays
 - d) Starting devices
 - e) Surge suppression equipment

- 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.

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. 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 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.
- B. 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.
- C. 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
 - f) DC High Voltage Cable Test Report
 - g) Ground Test Information

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- 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) Panelboards.
 - c) 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.
 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) Transformers; in addition to above provide:
 1. Recommended periodic testing procedures.
 2. Parts list.
 3. Any special manufacture suggested O & M information.
 4. Installation/removal instructions.
 5. Check-Out Memo Form
 - d) Motor Control; in addition to above provide the following:
 1. Internal wiring diagrams.
 2. Wiring diagrams.
 3. Bus diagrams.
 4. Operation and maintenance requirements, instructions, and recommended testing.
 5. Parts list.
 6. Copy of directory.
 7. Testing data, motor test information sheets.
 8. Check-Out Memo Form
 9. 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.
 2. Parts list.

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3. Recommended testing and replacement procedures.
- e) Fire Alarm
 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:

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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

BINDER EXAMPLES FOR SUBMITTALS
Insert In Vinyl Pockets (Front & Spline) 3-Ring Binder

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AHU ADDITION

MPE NO. 2013-144B

**ELECTRICAL OPERATION AND
MAINTENANCE BROCHURE**

(Size To 8-1/2" x 11")

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WEST BUILDING DOCK 7 – SERVER ROOM
AHU ADDITION

MPE NO. 2013-144B

**SYSTEMS OPERATION AND MAINTENANCE
BROCHURE**

(Size To 8-1/2" x 11")

ORANGE
COUNTY
CONVENTION
CENTER
WEST BUILDING
DOCK 7 –
SERVER ROOM
AHU ADDITION

MPE NO 2013-144B

**ELECTRICAL
OPERATION AND
MAINTENANCE
BROCHURE**

(Size To 11")

ORANGE
COUNTY
CONVENTION
CENTER
WEST BUILDING
DOCK 7 –
SERVER ROOM
AHU ADDITION

MPE NO 2013-144B

**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, Orange County 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 1/2" C (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 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.
5. Direct flexible conduit bearing set screw type not acceptable.

2.6 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.

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2.7 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. Compression Type
 - 3. Zinc plated malleable iron or steel.
 - 4. T&B Series 5031/5030.

2.8 RIGID POLYVINYL CHLORIDE CONDUIT

- A. Comply with:
 - 1. NEMA TC 2.
 - 2. UL 651.
 - 3. NEC 352.
- B. Conduit material:
 - 1. Shall be high impact PVC, tensile strength 55 psi, flexural strength 11000 psi.
- C. Fittings:
 - 1. NEMA TC 3.
 - 2. UL 514.
- D. General:
 - 1. Shall be UL listed and identified.
 - 2. Shall conform to all national, state and local codes.
 - 3. Manufacturer shall have five years experience in manufacturing PVC conduits.

2.9 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.
 - 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.

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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, 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.
- 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.
- 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 ADDITIONAL REQUIREMENTS FOR RIGID NON-METALLIC CONDUIT (PVC CONDUIT)
- A. Rigid non-metallic PVC conduit is not allowed anywhere inside building(s) except underground, in slab, in poured in place concrete, and in block wall up to first outlet box (if not over 40" AFF) if

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allowed by codes. Rigid non-metallic PVC conduit may be used exterior to building as stated elsewhere in these specifications.

- B. Join rigid non-metallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- C. Threads will not be permitted on rigid non-metallic PVC conduit and fittings, except for rigid steel to rigid non-metallic PVC couplings.
- D. Installation of rigid non-metallic PVC conduit shall be in accordance with manufacturer's recommendations.
- E. Rigid non-metallic PVC conduit shall not be used to support fixture or equipment.
- F. Field bends shall be made with accepted hotbox. Heating with flame and hand held dryers are prohibited.

3.6 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.

3.7 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'.

3.8 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

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not included or shown on Drawings.

- C. Grounding conductors run with exterior/ underground feeders shall be bare only.
- 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.

3.9 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.

3.10 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 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

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NEC 300, whether shown on Drawings or not.

- O. Provide continuous fiber polyline 1000 lb. minimum tensile strength pull string in each empty conduit except sleeves and nipples. This includes all raceways which do not have conductors furnished under this Division of the specifications. Pullcord must be fastened to prevent accidental removal
- P. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- Q. Grounding and bonding of conduit under provisions of Section 16170 Grounding and Bonding .
- R. Identify conduit under provisions of Section 16195 Identification for Electrical Systems.
- S. Install all conduits concealed from view unless specifically shown otherwise on Drawings
- T. Rigid steel box connections shall be made with double locknuts and bushings.
- U. 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.
- V. 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.
- W. 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.
- X. 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.
- Y. 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."
- 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 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 unless otherwise noted.
- 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.
- D. Insulation: ANSI/NFPA 70, Type THHN/THWN and XHHW.

2.2 ALUMINUM CONDUCTORS

- A. Aluminum conductors may be evaluated on a cost savings basis. Each feeder EC suggested shall be submitted in writing for EOR to verify and/or approve for use.
- B. Minimum aluminum conductors shall be compact stranded aluminum alloy with XHHW-2 insulation. Alcan Stabiloy AA-8000 Series, 600 volt, UL listed and labeled.

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

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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 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

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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.
- 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 and lighting 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

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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 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. 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.
- G. Do not install flush mounting boxes back-to-back in walls; provide minimum 6" separation. Provide minimum 24" separation in acoustic rated walls.

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- 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. Back-to-back mounting shall not be permitted. Trim rings shall be extended to within 1/8" of finish wall surface.

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- 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:

Disconnects	6'-6" AFF to centerline of highest breaker/fuse
Space Sensors	4'-0" AFF to top
 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. 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.
- 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 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. Ground bus bars and associated components.

- B. Product data shall prove compliance with specifications, National Electrical Code, manufacturers'

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specifications, and written installation data.

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.

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- E. Requirement in these specifications to comply with a specific code/standard article, etc. is not to be construed as deleting of requirements of other applicable codes/standards and their articles, etc.

3.2 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. Provide separate, insulated (bare if with feeder in PVC conduit outside of building(s)) conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- D. 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.
- E. 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.
- F. 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.
- G. 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.
- H. 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.

3.3 PULLBOX, MANHOLE, HANDHOLE GROUNDING.

- A. One 30 ft. ground rod electrode shall be driven vertically to a minimum depth of 30' plus 1' below grade in each manhole, handhole or pullbox (in ground).
- B. The complete installation shall exceed the minimum requirements of the NEC.
- C. Provide additional ground rod electrodes as required to provide resistance called for herein.
- D. Where more than one ground rod electrode is required bond the two or more ground rod electrodes together with a copper ground conductor.
- E. Bond to counterpoise system (whenever counterpoise system is provided.)
- F. Bond grounding electrode to all exposed metal parts of manhole, handhole, and pullbox

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(including metal cover) with #6 copper ground conductor. Connect to ground rod electrode with exothermic weld. Connect to metal cover with exothermic weld. Connect to other metal parts with exothermic weld or UL accepted grounding clamp. Provide 3' or more slack ground cable on cover connection as required to facilitate removal of cover.

3.4 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 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.

3.5 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.

3.6 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.

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- 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 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.

3.7 INTERFACE WITH OTHER PRODUCTS

- A. Interface with communications system installed under 16700 series specification sections.

3.8 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.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Verify conditions under provisions of Section 16061.
- B. Verify that equipment is ready for electrical connection, wiring, and energization.

2.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.

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- 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.

2.3 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) Black 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:

COLOR CODE FOR JUNCTION BOXES KRYLON PAINT NUMBER

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
BAS	Cameo White K04129
Grounding	Fluorescent Green K03106

- B. Conduit (not subject to public view) longer than 20' shall be painted with above color paint band 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

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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.

2.5 UNDERGROUND WARNING TAPE

- A. Description: Minimum 6" wide plastic tape, detectable type, with suitable warning legend describing buried lines. Systems conduits shall have orange colored tape. Power/lighting conduits shall have red colored tape.

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. (Only Existing conduits being reused or modified apply)
- F. 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.

PART 2 - PRODUCTS

2.1 CONSTRUCTION

- A. Switches shall be 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 and NEMA 4X for outdoor locations as a minimum. 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. Disconnect switches installed between any variable speed drive type of unit (VFD, AFD, USD, etc.) and its respective motor(s), shall have auxiliary break before break (open) interlock control contact.
- J. Disconnect switches installed to disconnect HVAC equipment are to be fusible type with fuses

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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.
- 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 16484
MOTOR CONTROL

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 of the Specification covers factory-assembled, metal-enclosed motor control units for distribution and control of power from incoming line terminals to outgoing feeder terminals, installed and tested in place.
- B. Motor control units shall include all protective devices and equipment as listed on Drawings or as included in these Specifications, with necessary interconnections, instrumentation, and control wiring.

1.3 FURNISHING OF EQUIPMENT

- A. Unless specifically noted otherwise, automatic motor starters for all equipment requiring them shall be furnished under the section or division where equipment is specified, and installed under this Section of the Specifications.
- B. Provide all labor, materials, and equipment necessary to properly install all motor starters. Provide motor starters for all new motors to be wired, where starters are not elsewhere specified under work of that division which provides the motored equipment.
- C. Unless specifically noted otherwise manual motor starters shall be furnished and installed under this Section of the Specifications.
- D. Disconnect switches for 120V fractional hp exhaust fans to be provided by Division 15 Contractor at exhaust fan. Any other required disconnect switch to be provided and installed by Division 16 Contractor.
- E. Provide and install 75 degree rated lugs on all non-unitary mechanical equipment such as pumps, air handling units and individual motor units/equipment. Coordinate with Division 15 Contractor prior to bid.
- F. Where a disconnect switch is mounted between an adjustable frequency drive and the motor, the disconnect must have a late make, early break auxiliary contact. This contact shall be wired into the AFD control circuit so that the control circuit is disconnected before the power circuit is broken

1.4 CONTROL ITEMS

- A. Unless specifically noted otherwise, all control, alarm and interlock wiring required for proper operation of equipment furnished by any other contractor and the required raceways shall be furnished and installed under the division where the equipment is specified.
- B. Where required by Electrical Drawings, Division 15 Specification, and/or Mechanical Drawings, this Contractor shall connect power feeder to mechanical equipment via control devices furnished by Division 15 Contractor (i.e. starters, line voltage, t'stats, line voltage switch, control relays, etc.).
- C. Provide and install power circuits to all control devices requiring them (i.e. 120V dampers, control panels, control devices, etc.) whether shown on Drawings or not. Coordinate requirements of all Divisions and/or Sections of these Specifications prior to bid.

1.5 SUBMITTALS

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- A. Shop Drawings and Product Data:
 - 1. Shop Drawings, Individually mounted AC Manual Starter:
 - a) Shop Drawings shall clearly indicate:
 - 1. Frame sizes and Interrupting Capacity of manual starter and/or disconnect unit.
 - 2. Horsepower rating at rated voltage of manual starter and/or disconnect unit.
 - 3. Electrical ratings.
 - 4. Single line diagram for power and control connections with numbered terminals and all required accessories.
 - 5. All required accessories.
 - 2. Shop Drawings, Individually mounted AC Magnetic Starter:
 - a) Shop Drawings shall clearly indicate:
 - 1. Frame sizes and interrupting capacity of starter and/or disconnect unit.
 - 2. Horsepower rating at rated voltage of starter and/or disconnect unit.
 - 3. Electrical ratings.
 - 4. Single line diagram for power and control connections with numbered terminals and all required accessories.
 - 5. All required accessories.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design:
 - 1. Square D
- B. Accepted Substitutions:
 - 1. General Electric
 - 2. Siemens/ITE

2.2 GENERAL

- A. Motor starters shall be manual, magnetic, or combination type as denoted on the Drawings.
- B. Pilot lights shall have long-life lamps rated 7500 hours minimum.
- C. Enclosures shall be NEMA 1 for indoor locations and NEMA 3R for outdoor or wet locations except where indicated as NEMA 4.
- D. Multi-speed or stop type controllers shall have thermal overload relays in each ungrounded conductor for each speed or step.
- E. Where multi-speed motors are scheduled on the Drawings, the motor controls shall be compatible with the type motor and have adjustable time deceleration for transition from high to low speeds.

2.3 INDIVIDUALLY MOUNTED AC MANUAL STARTERS

- A. Where manual motor starter switch is called for on Drawings, it shall be a combination across-the-line manual type starter with overloads and disconnect rated in accordance with NEMA standards, sizes and horsepower rating. Final rating of overloads shall be field set and recorded. Unit shall be mounted on NEMA 1 enclosures, unless otherwise noted.

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- B. Manual motor starter switch shall include green "run" pilot light, and shall be surface or flush mounted as noted on Drawings.

2.4 INDIVIDUALLY MOUNTED AC MAGNETIC STARTERS

A. Combination Starter and Disconnect:

- 1. Where combination starter and disconnect switch is called for on Drawings, it shall be a combination across-the-line magnetic type starter with motor circuit protection (magnetic only breaker) disconnect, rated in accordance with NEMA standards, sizes and horsepower rating. Final magnetic setting of MCP shall be field set and recorded with unit shall be mounted on NEMA 1 enclosures, unless otherwise noted.

B. Individual Starter Without Disconnect:

- 1. Where individually mounted starter is called for on Drawings, it shall be across-the-line magnetic type rated in accordance with NEMA standards, sizes, and horsepower ratings. Unit shall be mounted on NEMA 1 enclosure, unless otherwise noted.

C. Starters:

- 1. Motor starter, unless otherwise noted, shall be across-the-line magnetic type rated in accordance with NEMA standards, sizes, and horsepower ratings. Starters shall be equipped with double break silver alloy contacts. All contacts shall be replaceable from front without removing starter from enclosure. Overload relays shall be provided in each phase, and shall be melted alloy or bimetallic type. Thermal units shall be of the one-piece construction and interchangeable.
- 2. Starters shall be equipped with minimum of two (normally open) auxiliary contacts in addition to the normally open auxiliary seal-in interlock and shall be suitable for the addition of at least two additional external electrical interlocks, one normally open and one normally closed. All starters shall have red "run" pilot light, "Hand-Off-Auto" selector switch, and nameplate. Control voltage shall be as required. Starters shall contain fused control transformers to provide correct control voltage.
- 3. Starter for all 3-phase motors shall include 3-phase power monitor as manufactured by Time Mark Corporation (Model #A258B for 480V, 3 phase system) (Model #258B for 208V/240V, 3 phase system) (Model #B258B for 120V system) providing solid state protection by opening starter for loss of any phase, low voltage of any or all phases, and phase reversal. Monitor shall be field adjustable for drop-out voltage of (340-480VAC) (160-240VAC) (85-125VAC).

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine area to receive motor-control units to assure adequate clearance for motor control unit installation.

3.2 INSTALLATION

- A. Install motor control units in accordance with manufacturer's written instructions and NEC.
- B. All starters and their respective 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. Starters shall be installed with their turning axis of their handles approximately 5'-0" above finished floor. Provide rigid steel (galvanized for exterior use) mounting stands, brackets, plates, hardware, and accessories for a complete installation.
- C. Starters shall be mounted where shown on the Drawings. Where the starter also provides the code-required disconnecting means for a load, the starter shall be located within sight of the load

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and as close as feasible.

- D. Provide fusing for all fusible switches.
- E. Provide properly sized heater elements for every starter overload relay. The element shall be sized using the nameplate full load running current of the actual equipment supplied to the job.
- F. Provide a heater element selection chart on the inside of each starter door.
- G. Provide spare pilot light lamps to the Owner. Provide two of each type and size load.
- H. Provide nameplate for each control units.
- I. Coordinate conductor terminations on all equipment connections. Replace all 60 degree lugs/connections with 75 degree lug/connection.

3.3 ADJUSTMENT AND CLEANING

- A. Adjust operating mechanisms for free mechanical movement.

3.4 IDENTIFICATION

- A. Refer to Section 16195 Identification for Electrical Systems.
- B. Provide engraved plastic nameplates under the provisions of Section 16195 Identification for Electrical Systems.
- C. Provide labels and identification as required by the NEC.
- D. Nameplate shall show panel name, voltage and name of panel that feeds each motor starter device, and UL short circuit rating.
- E. Each motor starter device shall have engraved nameplate describing load/equipment being fed by device.
- F. All circuit identifications/nameplates shall be checked to verify accuracy of the description of the load and/or equipment being fed.

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 seven 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 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. The existing system is a Simplex Grinnell addressable 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. Duct Detectors
 2. Surge Suppression
 3. Programming
 4. Grounding

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5. Firestopping
 6. Wire and Cable Labeling
 7. Electrical power required to comply with all functions and operations called for in this section of the specifications.
 8. 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. HVAC system control and/or shutdown
 2. Control of fire, smoke, and/or combination fire/smoke dampers
 3. 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 in a Class system for all circuits to match existing.
- 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. 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
- K. 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.
- L. 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:

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- 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:
 - 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.

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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-46 Fire Protection System Contractors and Systems
 - (c) Ch 69A-48 Fire Safety Standards for the Fire Alarm Systems
 - 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) Orange County – Orange County Convention Center
 - d) 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 – Convention Center
 3. 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.

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:

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1. Ductwork accessories: smoke dampers
2. 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: Match Existing System maintained by Orange County Convention Center.
- 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 within fifty 50 miles of the project with capability to provide emergency service 7-days-a-week, 24 hour days. The installing Contractor shall have been actively engaged in the business of selling, installing and servicing fire alarm systems for at least ten 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.

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- 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.
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, 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).

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- b) Submit Product Data for each type of suppressor:
 - 1. Dimensions
 - 2. Means of mounting
 - 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.
 - a) Complete network wiring diagrams for all components and interfaces to equipment supplied by others.
- 17. All drawings required herein shall be on AutoCAD 2007 or higher.
- 18. 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 other than the design Engineer of Record perform signing and sealing.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit in accordance with Sections 16010
- B. In addition to the requirements of 16010 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

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MAINTENANCE DATA".

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.
- C. Drawings required herein are in addition to those required under "PROJECT RECORD DOCUMENTS".

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

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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.

1.12 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.

1.13 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).

1.14 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.

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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. 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).
 6. Unlock all electrically locked time-out room doors (coordinate with the architect and door hardware supplier, provide all electrical required).
 7. Shut down all air handlers, exhaust fans supplying or exhausting air, and fan terminal boxes (FTB).
 8. 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.
 9. Shut all fire and/or smoke dampers in ducts associated with the air handling units and exhaust fans which are shut down.
 10. Transmit signals to the building elevator control panel to initiate return to the main floor or alternate floor.
 11. Transmit signals to the building automation system to tell system that the fire alarm system has taken control of respective mechanical system.
 12. 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.
 13. 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. 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).
 6. 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.

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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. 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.
- G. Lamp Test: manual lamp test function causes alarm indication at each lamp on the fire alarm control panel and the remote annunciator.
- H. When the fire alarm system is activated as a drill, all incidental functions shall be exercised including notification of the fire department.
- I. 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.
- J. 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.
- K. 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.)

1.15 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.
 - c) One for each duct smoke detector.
 - d) Zones as required by NFPA and FBC.

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

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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.

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

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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. 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.

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 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 SURGE SUPPRESSION

- A. Non-Addressable Initiation Devices:
 - 1. Plug-in replacement modular design with associated female wiring connector.

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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.
 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.

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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.

D. Terminations

1. Provide terminals sized for circuits required on project.
2. Where surge suppression modules are for mounting on 'M' block assembly, provide M block assembly complete with grounding system that mates with surge suppression equipment.

E. Terminal Cabinets

1. Provide terminal cabinets for all terminations and surge suppression equipment including 120V ac power surge suppressor as required in Section 16691. Size terminal cabinets as required to facilitate installation of terminations and surge suppression in a neat and workmanlike manner.
2. Terminal cabinet to meet specifications in Section 16160 unless specifically manufactured for use.
3. Manufacturers:
 - a) Interior.
 1. Square "D"
 2. Hoffman
 3. BUD
 - b) Exterior.
 1. Hoffman
 2. BUD
 3. Carlon

2.10 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.

2.11 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.

2.12 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.

PART 3 - EXECUTION

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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 firework 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 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.

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- 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, 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.

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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. 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.
 - 3. 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.
 - 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.

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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.

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.
- E. Provide and install permanent cable markers on all cables/wire lines, telephone lines, etc. at terminal strips, terminal cabinets and at main equipment.

3.7 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

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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 in 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 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

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- 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.
 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.

3.8 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.

3.9 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.

3.10 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.

3.11 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.

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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.

3.12 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 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.

3.13 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.

3.14 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