ORANGE COUNTY FIRE STATION #31
HVAC REPLACEMENT
BID DOCUMENTS

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

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

JUNE 10, 2015

ORANGE COUNTY
FIRE STATION #31 – HVAC REPLACEMENT
BID DOCUMENTS

DIVISON 1 – GENERAL REQUIREMENTS

DIVISIONS 02 THRU 14 – NOT USED

DIVISON 15 – MECHANICAL

DIVISON 16 – ELECTRICAL

SECTION 01010
SUMMARY OF WORK

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.

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

1.2 PROJECT DESCRIPTION

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

1.3 SCOPE OF WORK

A. The scope of work for the demolition of the existing HVAC systems shall include the following:

1. Removal of (3) existing HVAC air handling units located in various mechanical rooms on the 1st floor.
2. Removal of supply air, return air and outside air ductwork connected to air handling equipment on the 1st floor including all ceiling diffusers and grilles.
3. Removal of all refrigerant piping connected to air handling equipment on the 1st floor and run in 4" PVC underground conduit to the exterior condensing unit. 4" underground PVC conduit to be reused.
4. Removal of condensate drain piping connected to AHUs and run to existing floor drains in the mechanical room.
5. Removal of (3) air cooled heat pump condensing units. Existing concrete pads for condensing units to remain.
6. Removal of (2) rooftop air conditioning units serving the 2nd floor. Existing roof curbs to remain.
7. Removal of all supply air and return air ductwork associated rooftop A/C units.
8. Removal of all 2nd floor ceiling supply diffusers and return air grilles.
9. Removal of all temperature control devices and associates wiring.
10. Removal of all (4) roof exhaust fans and associated ductwork and grilles serving restrooms or storage rooms. Existing roof curbs for exhaust fans to remain.
11. Removal of the kitchen hood and associated exhaust fan. Remove all associated ductwork. Existing wall vent cap to remain.
12. Removal of outdoor air intake on roof for 1st floor air handling units and all associated ductwork. Existing roof curbs to remain.

B. The scope of work for the replacement of the existing HVAC systems shall include the following:

1. Provide (3) split system air handling units and associated heat pump condensing units for the 1st floor.

    a. Air handling units to be located in the same mechanical rooms as removed AHUs.
    b. Heat pump condensing units to be located on existing concrete pads. Existing concrete pads to be extended for new heat pump units.

2. Provide new supply air, return air ductwork, distribution system connected to air handling units and to new ceiling diffusers and grilles in spaces served.
3. Provide (3) new roof exhaust fans and associated ductwork and grilles to serve the existing restroom on the 1st and 2nd floors in the building.

    a. Provide adaptor roof curbs for new exhaust fans installed on existing roof curbs.

4. Provide new rooftop air conditioning unit for the 2nd floor, dorm room area.
5. Provide new supply air and return air ductwork for rooftop unit serving the 2nd floor.
6. Provide new ceiling diffusers and return air grilles for 2nd floor spaces.
7. Provide new roof exhaust fan and associated ductwork and grilles for the storage spaces in the Apparatus Bay. Exhaust fans to have manual control.
8. Provide new in-line exhaust fan and associated ductwork for the Apparatus Bay exhaust.

    a. Provide new carbon monoxide (CO) monitoring and alarm system. CO monitoring system shall use Apparatus Bay exhaust fans for ventilation.
    b. Provide new wall exhaust louver for Apparatus Bay in-line exhaust fan.
    c. Provide relay to open Apparatus Bay roll-up doors should in-line Apparatus Bay exhaust fan be activated.

9. Provide new kitchen hood and associated ductwork connected to existing wall vent cap.

    a. Install fire suppression system in new kitchen hood.

10. Provide a new 100% outdoor air rooftop unit to provide ventilation air for the HVAC systems serving the building.

    a. Provide motorized dampers in each outdoor air duct connected to the AHU return duct or RTU return air duct.

11. Provide new Building Management Control System (BMS). New BMS shall control al HVAC equipment and exhaust fans.
12. Provide Test and Balance of all HVAC systems including exhaust systems.

1.4 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 furniture and/or equipment if necessary to perform the work included in the contract. The contractor is responsible for placing the furniture and/or

equipment back in its original location. The contractor is responsible for any damages to furniture, equipment, etc., which occur during construction. The contractor shall provide protection for floors, walls, furniture, equipment and any other items that may be subject to damage during the construction periods and will be required to repair or replace to original or better condition.

G. The contractor shall coordinate with the Owner on the operation of the security alarm system prior to the start of active construction. The contractor shall submit an action plan for operation of the security alarm system during construction to the Owner for acceptance prior to start of active construction. This action plan shall be in place prior to the start of active construction. Any false security alarms that occur during construction and deemed by the Owner to be the fault of the contractor, the contractor shall pay all cost incurred from the local police and/or sheriff department for responding to a false alarm.

H. The contractor shall take digital pictures or video of pre-existing conditions of the interior and exterior of the building prior to the start of active construction. Failure to provide digital pictures or video prior to start of construction places the responsibility on the Contractor to complete the necessary replacement, repairs, and/or cleaning as determined by the Owner, at no additional cost to the Owner. One CD copy of digital pictures or video of the existing site conditions shall be submitted to the Owner.

I. The contractor shall at all times maintain daily cleanup of construction areas. Costs for work areas that are not cleaned by the contractor will be cleaned by the Owner and those costs shall be charged back to the contractor via change order.

J. The contractor shall provide a construction schedule to the Owner's Project Manager prior to the pre-construction meeting.

K. The contractor shall update the construction schedule weekly and submit it to the Owner's Project Manager for review.

1.5 WORK UNDER OTHER CONTRACTS

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

1.6 WORK SEQUENCE

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

1.7 CONTRACTOR USE OF PREMISES

A. General: During the construction period, the contractor shall have full use of the premises for construction operations, including use of the site. The contractor's use of the premises is limited only the Owner's right to perform construction operations with its own forces or to employ separate contractors on portions of the project.

B. General: Limited use of the premises to construction activities in areas indicated within the limit of the premises. The Contractor may only use portion(s) of the site for storage or work areas only with prior approval from Orange County Project Manager.

1. Confine operations to areas within Contract limits indicated on the Drawings. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

2. Keep driveways and entrances serving the premises clear and available to the Owner and the Owner's employees at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

3. Burial of Waste Materials: Do not dispose of organic and hazardous material on site, either

by burial or by burning.

4. Where appropriate, maintain the existing building in a watertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.
5. Confine construction operations to the areas permitted by the contract documents and other Owner directives.
6. Provide protection and safekeeping of material and equipment stored on premises.
7. Contractor will move any stored material and equipment, which interfere with operations of the Owner or other contractors at no additional cost to the Owner.
8. Comply with Owner's requirements for ingress and egress procedures, prohibitions against firearms, procedures for transportation of workers, safety and fire prevention requirements and all applicable pollution control requirements. Refer to the following reference requirements:
    a) Orange County Safety and Health Manual http://www.orangecountyfl.net/VendorServices/OrangeCountySafetyandHealthManual.aspx
    b) Orange County Policy Manual page 96 regarding Firearms http://www.orangecountyfl.net/portals/0/resource%20library/employment%20-%20volunteerism/Policy%20Manual.pdf
9. Contractor to require all employees and subcontractors to wear non-objectionable clothing; prohibit revealing clothing and articles of clothing with offensive writings displayed. The contractor shall require offending personnel to leave the premises until such clothing is changed.
10. Contractor employees and subcontractors will not fraternize with County employees or the general public during the entire construction period.
11. Use of sound equipment (such as boom boxes, stereos, radios, etc.) is not allowed.
12. Contractor and their personnel shall abide to Orange County Tobacco free policy while on any Orange County property. This policy shall apply to building, parking lots, parks, break areas and worksites. Tobacco is defined as tobacco products, including but not limited to: Cigars, cigarettes, pipes, chewing tobacco and snuff. Failure to abide by the policy may result in civil penalties levied under Chapter 386, Florida Statutes and/or Contract enforcement remedies. Refer to the following documents:
    a) Orange County Smoking Policy: http://www.orangecountyfl.net/Portals/0/resource%20library/employment%20-%20volunteerism/Employee%20Handbook.pdf
13. Conduct that is disrespectful, abusive or otherwise objectionable to the Owners' employees or general public will not be allowed at any time during the construction period. Repetitive complaints and violations of the requirements listed above will be cause for dismissal and or permanent removal of offending personnel from the project.
14. Contractor to coordinate with the Owner the site location for storage of equipment, machinery, materials, tools and a construction waste dumpster.
15. Contractor shall at all times keep the premises free of all waste or surplus materials, rubbish and debris, which is caused by contractor employees or subcontractors resulting from their work. Contractor shall maintain a safe work environment to all building occupants during the construction period.

1.8 SECURITY AND IDENTIFICATION

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

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

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

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

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

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

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

1.9 OWNER OCCUPANCY

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

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

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

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

1.10 DISTRIBUTION OF RELATED DOCUMENTS

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

1.11 CONTRACT DOCUMENT FILE

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

period.

PART 2 - PRODUCTS

2.1 ASBESTOS FREE MATERIAL

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

PART 3 - EXECUTION (Not applicable).

END OF SECTION

SECTION 01027
APPLICATION FOR PAYMENT

PART I GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

B. The Contractor's Construction Schedule and Submittal Schedule are included in Section 01300 – "SUBMITTALS".

1.03 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Submit the Schedule of Values to the Owner at the earliest feasible date, but in no case later than Preconstruction Meeting. Refer to Section 01200.
2. Sub-Schedules: Where the Work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.

1. Identification: Include the following project identification on the Schedule of Values:

a. Project name and location.
b. Name of the Architect
c. Project Number
d. Contractor's name and address
e. Date of submittal

2. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

a. Generic name
b. Related Specification Section
c. Change Orders (numbers) that have affected value
d. Dollar Value
e. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items:

a. A value will be given for at least every major specification section

(subsections can logically be grouped together).

b. A single material subcontractor (i.e. sod, window blinds) will not be required to be broken down into labor and material unless it is anticipated the materials will be stored and invoiced prior to installation.

c. All multiple item subcontracts or work items (i.e. concrete, roofing, painting, mechanical, electrical items, etc.) will be shown broken down at least in labor and material (all taxes, burden and overhead and profit included).

d. Mobilization (move-on, bond, insurance, temporary office and sanitary service installation) shall not exceed 2 1/2% of contract price.

e. For multi-story work all items broken down per floor.

f. Concrete broken down at least into foundation slab on grade, columns, beams and suspended slabs.

g. Masonry divided into C.M.U. brick, stem walls, exterior walls, interior walls and elevator shaft.

h. Plumbing broken down at least into underslab rough-in, vents and stacks, supply piping, equipment items (each listed separately), fixtures and trim.

I. HVAC: Typically shown per specification section, labor and material, per floor.

j. Electrical: same as HVAC.

k. Fire protection broken down at least into underground, rough-in and trim. All per building and labor and material.

l. Logical grouping of specification subsections are permitted.

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

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

6. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.

   a. At the Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.

7. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the contract sum.

1.04 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as reviewed by the Owner's representative and paid for by the Owner.

   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the Final Application for Payment involve additional requirements. See items G, I, J and K of this section.

B. Payment Application Times: The period of construction work covered by each Application of Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use the County's most updated form as the form for

Application for Payment. Form given at the Preconstruction Conference.

D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

E. Transmittal: Submit six (6) original executed copies of each Application for Payment to the Project Manager by means ensuring receipt within 24 hours; one copy shall be complete, including waivers of lien and similar attachments, when required.

1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Project Manager.

F. Waivers of Mechanics Lien: With each Application for Payment submit waivers of mechanics liens from subcontractors of sub-subcontractors and suppliers for the construction period covered by the previous application.

1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. The Owner reserves the right to designate which entities involved in the work must submit waivers.
4. List all Subcontractor's start and finish dates to substantiate any Notice to Owner received by the Project Manager.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

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

H. Interim Application for Payment: Payment will be processed once a month. No applications will be processed without receipt of previous months waiver of lien described in subsection F above. Payment for item will be based on percentage completed as determined and approved by the County Project Manager or invoice for stored materials. Retainage (10%)

will be held for all interim applications.

I. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work. Application shall also include all items listed in Part H. above.

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

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

K. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment. Application for Payment includes the following:

1. Completion of Project Close-Out requirements
2. Completion of items specified for completion after Substantial Completion
3. Assurance that unsettled claims will be settled
4. Assurance that all work has been completed and accepted
5. Proof that taxes, fees and similar obligations have been paid
6. Removal of temporary facilities and services
7. Removal of surplus materials, rubbish and similar elements
8. Change of door locks to Owner's access

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION 01027

SECTION 01035
MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

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

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

1.03 MINOR CHANGES IN THE WORK

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

1.04 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Proposed changes in the work that will require adjustment to the Contract Sum or Contract Time will be issued by the Project Manager, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.

1. Proposal requests issued by the Project Manager are for information only. Do not consider them instruction either to stop work in progress, or to execute the proposed change.
2. Unless otherwise indicated in the proposal request, within 7 days of receipt of the proposal request, submit to the Project Manager from the Owner's review, an estimate of cost necessary to execute the proposed change.

a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include a statement indicating the effect the proposed change in the work will have on the Contract Time.
d. Contractor and subcontractors will provide a complete detailed labor and material breakdown to justify change order request amount.

B. Contractor-Initiated Change Order Proposal Requests: When latent or other unforeseen conditions in mutual accord with the Owner Representatives findings require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to

the Architect.

1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
3. 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.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Schedules
2. Installation and removal of temporary facilities
3. Delivery and processing of submittals
4. Progress meetings
5. Project close-out activities

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment (if any) involved in performance of, but not actually incorporated in, the Work.

E. Lack of coordination as specified in this and other sections of the contract documents are in grounds for assessment of back charges and/or termination in order to remediate the situation.

1.04 SUBMITTALS

A. Coordination Drawings: Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the interrelationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Comply with requirements contained in Section “Submittals”.
4. Refer to Division-15 Section “Basic Mechanical Requirements,” and Division-16 Section “Basic Electrical Requirements” for specific coordination Drawing requirements for mechanical and electrical installations.

B. Staff Names: At the Preconstruction Conference submit a list of the Contractor’s principal staff assignments, including the Superintendent and other personnel in attendance at the site; identify individuals, their duties and responsibilities; list their addresses and telephone numbers.

1. Post copies of the list in the project meeting room, the temporary field office, and each temporary telephone.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Manufacturer’s Instructions: Comply with manufacturer’s installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.

E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to Project Manager for final decision.

F. Recheck measurements and dimensions, before starting each installation.

G. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

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

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect/Project Manager for final decision.

3.02 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as directed by the Project Manager and as frequently as necessary to ensure its integrity and safety through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where the applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading
2. Excessively high or low temperatures
3. Excessively high or low humidity
4. Air contamination or pollution
5. Water
6. Solvents
7. Chemicals
8. Soiling, staining and corrosion
9. Rodent and insect infestation
10. Combustion
11. Destructive testing
12. Misalignment
13. Excessive weathering
14. Unprotected storage
15. Improper shipping or handling
16. Theft
17. Vandalism

END OF SECTION 01040

SECTION 01045
CUTTING AND PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division-15 and Division-16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.03 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
3. List products to be used and firms or entities that will perform Work.
4. Indicate dates when cutting and patching is to be performed.
5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
7. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.04 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load carrying capacity or load-deflection ratio.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements.

a. Foundation construction
b. Bearing and retaining walls
c. Structural concrete

d. Structural steel
e. Lintels
f. Timber and primary wood framing
g. Structural decking
h. Miscellaneous structural metals
I. Stair systems
j. Exterior curtain wall construction
k. Equipment supports
l. Piping, ductwork, vessels and equipment

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 Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner.

1. If possible retain the original installer or fabricator to cut and patch the following categories of exposed work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:

a. Processed concrete finishes
b. Preformed metal panels
c. Window wall system
d. Stucco and ornamental plaster
e. Acoustical ceilings
f. Carpeting
g. Wall covering
h. HVAC enclosures, cabinets or covers
I. Roofing systems

PART 2 PRODUCTS

2.01 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect unless otherwise

indicated by Architect/Owner. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 EXECUTION

3.01 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

1. Before proceeding, meet at the site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed 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 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 01095
REFERENCE STANDARDS AND DEFINITIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 DEFINITIONS

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

B. Indicated: The term *indicated* refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as shown, noted, scheduled and specified are used, it is to help the reader locate the reference; no limitation on location is intended.

C. Directed: Terms such as directed, requested, authorized, selected, accepted, required, and permitted mean directed by the Project Manager, requested by the Architect/Project Manager and similar phrases.

D. Approved: This term approved means accepted, where used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.

E. Regulations: The term Regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. Furnish: The term furnish is used to mean supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. Install: The term install is used to describe operations at project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

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

I. Installer: An Installer is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term experienced, when used with the term Installer, means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
2. Trades: Use of titles such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.

J. Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

K. Testing Laboratories: A testing laboratory is an independent entity engaged to perform specific inspections or tests, either at the Project sites or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.03 SPECIFICATION FORMAT AND CONTENT EXPLANATION

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

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

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

    a. The words, shall be shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.04 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copies directly into the Contract Documents to the extend reference. Such standards are made part of the Contract Documents by reference.

B. Publication Dates: Comply with the standard in effect as of the date of the Contract Documents.

C. Conflicting Requirements: Where compliances with two or more standards are specified, and the standards may establish different or conflicting requirements for minimum quantities or quality levels. Refer requirements that are different, but apparently equal, and uncertainties to the Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity of quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Architect/Owner for a decision before proceeding.

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

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

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

1.05 GOVERNING REGULATIONS/AUTHORITIES

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

1.06 SUBMITTALS

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

1.07 TRADE REFERENCES

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

AA Aluminum Association

AABC Associated Air Balance Council

AAMA American Architectural Manufacturer’s Association

AAN American Association of Nurserymen

AASHTO American Association of State Highway and Transportation Officials

ACI American Concrete Institute

ACIL American Council of Independent Laboratories

ACPA American Concrete Pipe Association

ADC Air Diffusion Council

AGA American Gas Association

AHA	American Hardboard Association
AI	Asphalt Institute
AIHA	American Industrial Hygiene Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	Air Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASC	Adhesive and Sealant Council
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society of Testing of Materials
AWI	Architectural Woodwork Institute
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
CISPI	Cast Iron Soil Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
DHI	Door and Hardware Institute
DLPA	Decorative Laminate Products Association
EIMA	Exterior Insulation Manufacturers Association
FGMA	Flat Glass Marketing Association
FM	Factory Mutual Engineering and Research

GA	Gypsum Association
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
IESNA	Illuminating Engineering Society of North America
MBMA	Metal Building Manufacturer’s Association
ML/SFA	Metal Lath/Steel Framing Association
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NAAMM	National Association of Architectural Metal Mfgs.
NAPA	National Asphalt Pavement Association
NAPF	National Association of Plastic Fabricators (Now DLPA)
NBHA	National Builder's Hardware Association (Now DHI)
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NECA	National Electric Contractors Association
NEII	National Elevator Industry, Inc.
NFPA	National Fire Protection Association
NHLA	National Hardwood Lumber Association
NPA	National Particle board Association
NPCA	National Paint and Coatings Association
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association (Now NWWDA)
NWWDA	National Wood Window and Door Association (Formerly NWMA)
PDI	Plumbing and Drainage Institute
RFCI	Resilient Floor Covering Institute
RMA	Rubber Manufacturers Association
SDI	Steel Deck Institute
S.D.I.	Steel Door Institute

SGCC Safety Glazing Certification Council

SHLMA Southern Hardwood Lumber Manufacturers Association (Now HMA)

SIGMA Sealed Insulating Glass Manufacturers Association

SMACNA Sheet Metal and Air Conditioning Contractor's National Association

SJI Steel Joist Institute

SPRI Single Ply Roofing Institute

SSPC Steel Structures Painting Council

SWI Steel Window Institute

TCA Tile Council of America

UL Underwriters' Laboratories

WCMA Wall Covering Manufacturers Association

WRI Wire Reinforcement Institute

WSFI Wood and Synthetic Flooring Institute

1.08 FEDERAL GOVERNMENT AGENCIES

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

CE Corps of Engineers
(US Department of the Army)
Chief of Engineers - Referral
Washington, DC 20314 (202) 272-0660

CFR Code of Federal Regulations
Available from the Government Printing Office
North Capitol St. Between G and H Street, NW
Washington, DC 20402 (202) 783-3238

(MATERIAL IS USUALLY FIRST PUBLISHED IN THE FEDERAL REGISTER)

CPSC Consumer Product Safety Commission
5401 Westbard Avenue
Washington, DC 20816 (800) 638-2772

CS Commercial Standard
(US Department of Commerce)
Government Printing Office
Washington, DC 20402 (202) 377-2000

DOC	Department of Commerce 14th Street and Constitution Ave., NW Washington, DC 20230	(202) 377-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590	(202) 426-4000
EPA	Environmental Protection Agency 401 M. St., SW Washington, DC 20460	(202) 382-2090
FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Avenue SW Washington, DC 20590	(202) 366-4000
FCC	Federal Communications Commission 1919 M. Street NW Washington, DC 20554	(202) 632-7000
NBS	National Bureau of Standards (U.S. Department of Commerce) Gaithersburg, MD 20899	(301) 921-1000
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) Government Printing Office Washington, DC 20402	(202) 523-7001
PS	Product Standard of NBS (U.S. Department of Commerce) Government Printing Office Washington, DC 20402	(202) 783-3238
USDA	U.S. Department of Agriculture Independence Avenue Between 12th and 14 Street, SW Washington, DC 20250	(202) 447-8732

PART 2- PRODUCTS (Not Applicable)

PART 3- EXECUTION (Not Applicable)

END OF SECTION 01095

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1. Pre-Construction Conference
2. Pre-Installation Conference
3. Coordination Meetings
4. Progress Meetings

B. Construction schedules are specified in Section 01300 Submittals.

1.03 PRE-CONSTRUCTION CONFERENCE

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

B. Attends: The OWNERS, Representative, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule
2. Critical Work sequencing and/coordinating
3. Designation of responsible personnel
4. Procedures for processing field decisions and Change Orders
5. Procedures for processing Applications for Payment
6. Distribution of Contract Documents
7. Submittal of Shop Drawings, Product Data and Samples
8. Preparation of record documents
9. Use of the Premises
10. Office, Work and storage areas
11. Equipment deliveries and priorities
12. Safety procedures
13. First aid
14. Security
15. Housekeeping
16. Working hours

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

1. Schedule of Values

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

1.04 PRE-INSTALLATION CONFERENCE

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

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:

a. Contract Documents
b. Options
c. Related Change Orders
d. Purchases
e. Deliveries
f. Shop Drawings, Product Data and Quality Control Samples
g. Possible conflicts
h. Compatibility problems
I. Time schedules
j. Weather limitations
k. Manufacturer's recommendations
l. Comparability of materials
m. Acceptability of substrates
n. Temporary facilities
o. Space and access limitations
p. Governing regulations
q. Safety
r. Inspection and testing requirements
s. Required performance results
t. Recording requirements
u. Protection

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

1.05 COORDINATION MEETINGS

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

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved, to include subcontractors and

representatives.

C. Contractor shall record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.06 PROGRESS MEETINGS

A. Conduct progress meetings at the Project site at bimonthly intervals or more frequently if necessary as directed by the Project Manager. Notify the Owner at least 48 hours in advance of scheduled meeting time and dates. Coordinate dates of meetings with preparation of the payment request.

B. Attendees: In addition to representatives of the Owner and Architect, each subcontractor, supplier or other entity concerned with current progress of involved in planning, coordination or performance of future activities with the project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.

1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time, ahead, or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
2. Review the present and future needs of each entity present, including such items as:

a. Interface requirements
b. Time
c. Sequences
d. Deliveries
e. Off-site fabrication problems
f. Access
g. Site utilization
h. Temporary facilities and services
I. Hours of work
j. Hazards and risks
k. Housekeeping
l. Quality and work standards
m. Change Orders
n. Documentation of information for payment requests.

D. Reporting: No later than 3 days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, 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

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 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

a. The Project Manager reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

3. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

a. Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Project

Manager will promptly advise the Contractor when a submittal being processed must be delayed for coordination.

b. If an intermediate submittal is necessary, process the same as the initial submittal.
c. Allow two weeks for reprocessing each submittal.
d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.

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

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Project Manager using transmittal form as provided by the Project Manager. Submittals received from sources other than the Contractor will be returned without action.

1. On the transmittal record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitation. Include Contractor [illegible]cation that information complies with Contract Document requirements.

2. Transmittal Form: As provide by the Project Manager

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

1.04 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Critical Path Method (CPM) Schedule: Prepare a fully developed, horizontal bar-chart type Contractor's construction schedule. Submit in accordance with Section 01200 Project Meetings.

1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the work as indicated in the Schedule of Values.
2. Within each time bar, indicate estimated completion percentage in 10 percent

increments. As work progresses, place a contrasting mark in each bar to indicate Actual Completion.

3. Prepare the schedule on a sheet, series of sheets, stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
4. Secure time commitments for performing critical elements of the work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the work.
5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment request and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

B. Phasing: Provide notations on the schedule to show how the sequence of the work is affected by requirements for phased completion to permit work by separate Contractors and partial occupancy by the Owner prior to Substantial Completion.

C. Work Stages: Indicate important stages of construction for each major portion of the work, including testing and installation.

D. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the work. Indicate where each element in an area must be sequenced or integrated with other activities.

E. Cost Correlation: At the head of the schedule, provide a two item cost correlation line, indicating 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 Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the project meeting room and temporary field office.

1. When revision are made distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

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

1.05 SUBMITTAL LOG

A. After development and acceptance of the Contractor's construction schedule, prepare a complete log of submittals.

1. Coordinate submittals log with the list of subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.
2. Prepare the log in chronological order; include all submittals required. Provide the following information:

a. Scheduled date for the first submittal

b. Related Section number
c. Submittal category
d. Name of subcontractor
e. Description of the part of the work covered
f. Scheduled date for resubmittal
g. Scheduled date the Architect's final release or approval.

3. All submittals must be received within the first 25% of contract time.

B. Distribution: Following response to initial submittal, print and distribute copies to the Project Manager, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

C. Log Updating: Revise the log after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.06 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Project Manager at weekly intervals:

1. List of subcontractors at the site
2. Approximate count of personnel at the site
3. High and low temperatures, general weather conditions
4. Accidents and unusual events
5. Meetings and significant decisions
6. Stoppages, delays, shortages, losses
7. Meter readings and similar recordings
8. Emergency procedures
9. Orders and requests of governing authorities
10. Change Orders received, implemented
11. Services connected, disconnected
12. Equipment or system tests and start-ups
13. Partial completions, occupancies
14. Substantial Completions authorized

1.07 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered a Shop Drawings and will be rejected.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. All required dimensions
2. Identification of products and materials included
3. Compliance with specified standards
4. Notation of coordination requirements
5. Notation of dimensions established by field measurement

6. Sheet Size: Except for templates, patterns and similar full-size Drawings on sheets at least 8" x 11" but no larger than 24" x 36".
7. Initial Submittal: Submit one correctable translucent reproducible print and one blue- or black-line print for the Project Manager s review; the returned.
8. Initial Submittal: Submit 2 blue-or black-line prints for the Architect's review; one will be returned.
9. Final Submittal: Submit 5 blue-or black-line prints; submit 7 prints where required for maintenance manuals. 3 prints will be retained; the remainder will be returned.
10. Final Submittal: Submit 3 blue-or black-line prints; submit 5 prints where required for maintenance manuals. 2 prints will be retained; the remainder will be returned.

    a. One of the prints returned shall be marked-up and maintained as a Record Documents.

11. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connections with construction.

C. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.

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

1.08 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer’s installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as “Shop Drawing”.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

    a. Manufacturer's printed recommendations
    b. Compliance with recognized trade association standards
    c. Compliance with recognized testing agency standards
    d. Application of testing agency labels and seals
    e. Notation of dimensions verified by field measurement
    f. Notation of coordination requirements
    g. Manufacturers local representative and phone number.

2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
3. Preliminary Submittal: Submit a preliminary single-copy of Product Data where selection of options is required.

4. Submittals: Submit six (6) copies of each required submittal. The Project Manager will return two (2) sets to the Contractor marked with action taken and corrections or modifications required.

    a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

5. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

    a. Do not proceed with installation until an applicable copy of Product Data applicable is in the Installer's possession.
    b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.09 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of materials, color range sets, and swatches showing color, texture and pattern.

1. Mount, display, or package Samples in the manner specified to facilitate review of qualities indicated. Prepare Samples to match the Architect's/Owner's Sample. Include the following:

    a. Generic description of the Sample
    b Sample source
    c. Product name or name of manufacturer
    d. Compliance with recognized standards
    e. Availability and delivery time

2. Submit Samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

    a. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.
    b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation and similar construction characteristics.

3. Preliminary submittals: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.

    a. Preliminary submittals will be reviewed and returned with the Architect's/Owner's mark indicating selection and other action.

4. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; one will be returned marked with the action taken.

5. Maintain sets of Samples, as returned, at the project site, for quality comparisons

throughout the course of construction.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.

1. Field Samples specified in individual sections are special types of Samples. Field Samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the work will be judged.

a. Comply with submittal requirements. Process transmittal forms to provide a record of activity.

1.10 ARCHITECT'S ACTION

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

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

B. Action Stamp: The Architect/Project Manager will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, similarly as follows, to indicate the action taken:

1. Final Unrestricted Release: Where submittals are marked "No Exceptions Taken", that part of the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.

2. Final-But-Restricted Release: When submittals are marked "Made Corrections Noted" that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.

3. Returned for Resubmittal: When submittal is marked "Revise and Resubmit", do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.

a. Do not permit submittals marked "Revise and Resubmit" to be used at the Project site, 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

SECTION 01400
QUALITY CONTROL SERVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for quality control services.

B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.

D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Those requirements, including inspections and test, cover production of standard products as well as customized fabrication and installation procedures.
2. Inspection, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitates compliance with Contract Document requirements.
3. Requirements for the Contractor to provide quality control services required by the Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.03 GENERAL QUALITY CONTROL

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

1.04 WORKMANSHIP

A. Comply with well-known standards recognized be each trade except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by persons qualified to produce workmanship of specified quality. Said qualifications shall be determined by well-known standards recognized by the trade for each respective portion of contract work.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration and racking.

1.05 MANUFACTURER'S INSTRUCTIONS

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

1.06 MANUFACTURER'S CERTIFICATES

A. When required by individual Specifications Section, submit manufacturer's certificate and supporting documentation, in duplicate, that products meet or exceed specified requirements.

B. ASBESTOS FREE MATERIALS - Manufacturer and/or supplier shall provide a written and notarized statement on manufacturer's company letterhead to certify and warrant that product (s) utilized on project are asbestos free.

1.07 MOCKUPS

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

1.08 MANUFACTURER□S FIELD SERVICES

A. When specified in respective Specification Sections, require supplier and/or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, test, adjust and balance of equipment as applicable and to make appropriate recommendations.

B. Representative shall submit written report to Owner listing observations, recommendations, and certifying full conformance and compliance with manufacturers standards or requirements.

1.09 TESTING LABORATORY SERVICES

A. The County shall employ and pay for services of an Independent Testing Laboratory to perform inspections, tests for construction materials (soils, concrete) and threshold inspections.

B. Services will be performed in accordance with requirements of governing authorities and with specified standards.

C. Reports will be submitted to the County, Contractor and Architect giving observations and results of tests, indicating compliance or noncompliance with specified standards and with Contract Documents.

D. Contractor shall cooperate with testing laboratory personnel; furnish tools, samples of materials, design, mix equipment, storage and assistance as requested.

1. The contractor shall be responsible for notifying the testing laboratory at least 24 hours prior to expected time for operations requiring testing services. Longer length of notice to testing laboratory shall be provided by Contractor when required by the testing laboratory to ensure the timely scheduling and performance of all tests required.
2. The Contractor is responsible for obtaining and paying tests including but not limited to test and balance, portable water bacteriological tests and test required in Divisions 7 through 16.

E. The costs of any tests which fail will be paid for by the Contractor. The amount to be

reimbursed to the County by the Contractor, will be the amount invoiced to the County by the testing laboratory in accordance with the testing services fees set forth in its contract with the County.

1.10 TEMPERATURE/HUMIDITY LOG

A. The Contractor shall be responsible for preparing rain, temperature and humidity measuring devices at the project site and maintaining a log of temperature and humidity measurements.

B. Said log shall contain a daily record of exterior temperature, rainfall amount and humidity conditions and where environmental conditions are specified in individual sections, a daily record of the temperature and humidity conditions where the work of those sections is stored and installed.

C. The Temperature/Humidity Log shall be available to the Project Manager.

1.11 RESPONSIBILITIES

A. The Owner shall provide inspections, tests and similar quality control services, specified in individual Specification Sections and these services include those specified to be performed by an independent agency and not by the Contractor.

B. The Contractor shall cover all costs of tests or inspections to evaluate means and methods of installation performed as a substitution and not as originally specified.

1. Retesting: The Contractor is responsible for retesting where results of required inspections, test or similar services prove unsatisfactory and do not indicate compliance with Contract Documents requirements, regardless of whether the original test was the Contractor's responsibility.

a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

2. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to:

a. Providing access to the work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
b. Taking adequate quantities of representatives samples of materials that require testing or assisting the agency in taking samples.
c. Providing facilities for storage and curing the test samples.
d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
e. Security and protection of samples and test equipment at the Project site.

C. Duties of the Testing Agency: The independent testing agency engages to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with Architect and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. The agency is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the Work.
3. The agency shall not perform any duties of the Contractor.

D. Coordination: The Contractor and each agency engaged to perform inspection, tests and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition, the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.12 SUBMITTALS

A. Qualification for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with “Recommended Requirements for Independent Laboratory qualification” by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engages on the Project shall be authorized by authorities having jurisdiction to operate in the State in which the Project is located.

PART 2- PRODUCTS (Not Applicable)

PART 3- EXECUTION

3.01 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finished to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for “Cutting and Patching”.

B. Protect construction exposed by or for quality control service activities, and protect and repaired construction.

C. Repair and protection in the Contractor’s responsibility regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 01400

SECTION 01600
MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section 01300 -Submittals.

C. Standards: Refer to Section “Definitions and Standards” for applicability of industry standards to products specified.

D. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Section 01300 “Product Substitution”.

1.03 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents such as “specialties”, “systems”, “structure”, “finishes”, “accessories”, and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.

1. “Products” are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term “product” includes the term “material”, “equipment”, “system” and terms of similar intent.

a. “Named Products” are items identified by manufacturer’s product name, including make or model designation, indicated in the manufacturer’s published product literature that is current as of the date of the Contract Documents.

b. “Foreign Products”, as distinguished from “domestic products”, are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens nor living within the United States and its possessions.

2. “Materials” are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the work.

3. “Equipment is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.04 SUBMITTALS

A. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Project Manager. Include generic names of products required. Include the manufacturer’s name and proprietary product names for each item listed.

1. Coordinate the product list schedule with the Contractor and the Schedule of Submittals.
   a. Related Specification Section Number
   b. Generic name used in Contract Documents
   c. Proprietary name, model number and similar designations.
   d. Manufacturers name and address
   e. Suppliers name and address
   f. Installers name and address
   g. Projected delivery date, or time span of delivery period.

2. Initial Submittal: Within 30 days after date of commencement of the work, submit 3 copies of an initial product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

   a. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.

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

   a. A list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.05 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturers or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data.

   a. Name of product and manufacturer
   b. Model and serial number
   c. Capacity

d. Speed
e. Ratings
f. Additional pertinent information

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deteriorating and loss, including theft.

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

PART 2 PRODUCTS

2.01 PRODUCT SELECTION

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

1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situation on other projects.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous project experience. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.

a. Where products or manufacturers are specified by name, accompanied by the term "or equal" or "or approved equal" comply with the Contractor Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

2. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of those products only, the Contractor may propose any

available product that complies with Contract requirements. Comply with Contract Document provisions concerning “substitutions” to obtain approval for use of an unnamed product.

3. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
4. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated.

    a. Manufacturer’s recommendations may be contained in published product literature, or by the manufacturer’s certification of performance.

5. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
6. Visual Matching: Where Specifications require matching an established Sample, the Architect’s decision will be final on whether a proposed product matches satisfactorily.

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

7. Visual Selection: Where specified product requirements include the phrase “... as selected from manufacturer’s standard colors, pattern, textures...” or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.
8. Asbestos free materials: No products containing asbestos shall be used for any part of the work for this product. Provide verification.

PART 3- EXECUTION

3.01 INSTALLATION OF PRODUCTS

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

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

END OF SECTION 01600

SECTION 01631
PRODUCTS SUBSTITUTIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for handling request for substitutions made during bidding and after award of the Contract.

B. The Contractor's Installation Schedule and the Schedule of Submittals are included under Section "Submittals".

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

D. Procedural requirements governing the Contractor's selection of products and product options are included under Section "Materials and Equipment".

1.03 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.

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

a. Within thirty (30) days after Contract award, the Contractor may submit for approval substitutes for any equipment and/or material. In addition to the product documents, a written certification shall accompany the documentation indicating that the proposed substitute will have the same characteristics, will perform in accordance with the design requirements and that complies with all the requirements set for in the Contract. Any additional information required by the 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.

b. 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 commencement of the Work. As long as this time allowance will not impact the construction schedule.

1. Submit three (3) copies of each request for substitution for consideration. Submit

requests in the form and in accordance with procedures required for Change Order proposals.

2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitution, and the following information, as appropriate:

   a. Product Data, including Drawings, and descriptions of products, fabrication and installation procedures.
   b. Samples, where applicable or requested.
   c. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
   d. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
   e. A statement indicating the substitution's effect on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
   f. Cost information, including a proposal of the net change, if any in the Contract Sum.
   g. Certification by the Contractor that the Substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

3. Architect's Action: Within two weeks of receipt of the request for substitution, the Architect will request additional information or documentation necessary for evaluation of the request if needed. Within two (2) weeks of receipt of the request, or one week of receipt of the additional information or documentation, which ever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the project specified by name. Decision on the use of a product substitution or its rejection by the Architect is considered final. Acceptance will be in the form of a Change Order.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Architect when one or more of the following conditions are satisfied, as determined by the Architect; otherwise request will be returned without action except to record noncompliance with these requirements.

   1. Extensive revisions to Contract Documents are not required.
   2. Proposed changes are in keeping with the general intent of Contract Documents.
   3. The request is timely, fully documented and properly submitted.
   4. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the work promptly or coordinate activities

properly.

5. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
6. A substantial advantage is offered to the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar consideration.
7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
8. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
9. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

B. The Contractor's submittal and Project Manager's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

C. Substitution request constitutes a representation that the Contractor:

1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.
2. Will provide the same warranty for substitution as for specified product.
3. Will coordinate installation and make other changes which may be required for work to be complete in all respects.
4. Waives claims for additional costs which may subsequently become apparent. All costs associated with the substitution will be paid by the Contractor regardless of approvals given, and regardless of subsequent difficulties experienced as a result of substitutions.

END OF SECTION 01631

SECTION 01700
PROJECT CLOSE-OUT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements for project close-out, including but not limited to:

1. Inspection procedures
2. Project record document submittal. (substantial completion requirements)
3. Operating and Maintenance Manual Submittal (substantial completion requirements).
4. Submittal of warranties (substantial completion requirement).
5. Final cleaning

B. Close-out requirements for specific construction activities are included in the appropriate Sections in Divisions 2 through 16.

C. Final Payment to be made when the County has received all required close-out documents.

1.03 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for Certification of Substantial Completion, complete the following: List exceptions in the request.

1. In the Application for Payment that coincided with, or first follows, the date Substantial Completion in claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the work is not complete.

2. Advise Owner of pending insurance change-over requirements.
3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
4. Obtain and submit releases enabling the Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
5. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: On receipt of a request for inspection, the Project Manager will either proceed with inspection or advise the Contractor of unfilled requirements. The Project Manager will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. Results of the completed inspection will form the basis of requirements for final acceptance.
2. Should the project fail to meet the standards required for Substantial Completion as defined in the documents, the Contractor will pay the expense of a second inspection by the Architect/Consultants and the Owner. Cost will be deducted from the Contractor's retainage.

1.04 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following list exceptions in the request:

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and complete operations where required.
2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the Architect or Owner's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Project Manager.
4. Submit final meter readings for utilities, a measured record of stored fuel and similar data as of the date of Substantial Completion, or when the Owner took possession of the responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit a final liquidated damages settlement statement
7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Reinspection Procedure: The Architect will reinspect the work upon receipt of notice that the work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.

1. Upon completion of reinspection, the Architect will prepare a certification of final acceptance, or advise the contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

1.05 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposed; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Architect's reference during normal working hours.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation; where the installation varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Provide for project photographs if deemed necessary by Owner's representative.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.

2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
3. Note related Change Order numbers where applicable.
4. Organize record drawing sheets, and print. suitable titles, dates and other identification on the cover of each set.
5. Provide three (3) additional sets of black line drawing sets of As-Builts Drawings.

C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual work performed in comparison with the text of the specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Project Data.

1. Upon completion of the Work, submit record Specifications to the Architect for the Owner's records.

D. Record Project Data: Maintain one copy of each Product Data submittal. Mark these documents to show significant variation in actual work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work which cannot otherwise be readily discerned later by direct observation. Note related Change Orders and mark-up of record drawings and Specifications.

1. Upon completion of mark-up, submit complete set of record Product Data in the three ring binder (indexed) to the Architect for the Owner’s records.

E. Record Sample Submitted: Immediately prior to the date or dates of substantial completion, the Contractor will meet at the site with the Architect and the Owners 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 Owners Sample storage area.

F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the work. Immediately prior to the date or dates of substantial completion, complete miscellaneous record and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Project Manager for the Owner's records.

G. Maintenance Manuals: Organize operating and maintenance data into five (5) suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:

1. Emergency instructions
2. Spare parts list
3. Copies of warranties
4. Wiring diagrams
5. Recommended turn-around cycles
6. Inspection procedures
7. Shop Drawings and Product Data
8. Fixture lamping schedule

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 CLOSE-OUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that required regular maintenance. If installers are not experienced in procedures, provide instruction by manufacturers representatives. All items to be provided or competed prior to Certificate of Substantial Completion being issued by the Owner. Include a detailed review of the following items:

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

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

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

2.02 PROJECT CLOSE-OUT MANUALS AT SUBSTANTIAL COMPLETION

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

B. Bind in commercial quality 8 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.

3.02 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section - Temporary Facilities.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

a. Remove labels that are not permanent labels.
b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
c. Clean exposed exterior and interior hard-surfaced finished to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface. Remove waste and surplus materials from the site in an appropriate manner.

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

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

E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage

systems. Remove waste materials from the site and dispose of in a lawful manner.

1. Where extra materials of value remaining after completion of associated work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 01700

SECTION 01740
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contractor Documents, including manufacturers standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
2. General close-out requirements are included in Section "Project Close-Out".
3. Specific requirements for warranties for the work and products and installations that are specified to be warranted, are included in the individual Sections of Division 2 through 16.
4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties to not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.03 WARRANTY REQUIREMENTS

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

B. Reinstatement of Warranty. When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligation, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligation, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

E. The Owner reserves the right to refuse to accept work for the Project where a special warranty, certification, or similar commitment is required on such work or part of the Work,

until evidence is presented that entities required to countersign such commitments are willing to do so.

1.04 WARRANTY PERIOD

A. The Contractor shall participate with the County and the Architect's representative, at the beginning of the tenth month of the warranty period, in conducting an on site review and evaluation of all items of equipment, materials and workmanship covered by the warranties and guarantees. Contractor shall act promptly and without cost to the County to correct all defects, problems, or deficiencies determined as such by the Architect/Owner during on the site review.

B. All warranties and guarantees shall commence on the date of Substantial Completion except for items which are determined by the County to be incomplete or a non-comply status at the time of Substantial Completion. The coverage commencement date for warranties and guarantees of such work shall be the date of the County's acceptance of that work.

C. Warranty period shall be manufacturer's standard for product specified except where specific warranty periods are specified in individual sections. But in no case less than one year.

1.05 SUBMITTALS

A. Submit written warranties to the Owner prior to the date certified for Substantial Completion. If the Architect's Certificate of substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the work, submit written warranties upon request of the Project Manager.

1. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Project Manager within fifteen days of completion of that designated portion of the work.

B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepared a written document that contains appropriate terms and identification, ready for executing by the required parties. Submit a draft to the Architect for approval prior to final execution.

1. Refer to individual Sections of Division 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.

C. Form of Submittal: At Final Completion compile two (2) copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Bind (3) three sets of warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8 1/2" by 11" paper.

1. Provide heavy paper dividers with Celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.
2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS', the Project title or name, and the name of the Contractor.

3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2- PRODUCTS (Not Applicable)

PART 3- EXECUTION (Not Applicable)

END OF SECTION 01740

SECTION 15010
MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 WORK INCLUDED:

A. The work covered under this Division of the Specifications is intended to include the furnishing of all materials, equipment and labor necessary for or reasonably incidental to, the installation of a complete and fully operative mechanical and plumbing systems as indicated on the drawings and specified in this section.

1. The work shall consist generally of, but is not limited to, the following major items:

a. HVAC Equipment
b. Ductwork and Insulation
c. Piping and Insulation
d. Temperature Controls
e. Test and Balance

B. Work Not Included:

The following work is not included in this Section:

1. Electrical

C. Fees and Permits:

1. Obtain all permits required for his/her work and include the cost of same in his/her bid.

D. Certificate of Inspection:

1. The Contractor shall, at his/her expense, have a final inspection made of the complete mechanical installation and shall deliver a certificate of approval of the complete work to the Owner before receiving his/her final payment.

1.02 SUBMITTALS

A. Submit properly identified manufacturer's literature and technical data as defined in Section 01300 Submittals, before commencing work.

B. Shop Drawings:

1. Submit copies of manufacturer's drawing of HVAC equipment, piping, insulation, plumbing fixtures and any other special mechanical equipment to be installed, and shall receive the Project Engineer's acceptance before ordering the same for installation.

2. All shop drawings shall be submitted in 3-ring binders with each specification section indicated with tabs.

3. If shop drawings are submitted intermittently and not in 3-ring binders, they will not be reviewed and will be returned to contractor for proper submittal.

4. Accepted Equivalent:

   Any manufacturer and/or catalog number listed on the drawings or in the Project Manual shall be construed to mean "or accepted equivalent".

   a. Any substitutions to be considered as "Accepted Equivalent" shall be submitted with both the cut of the proposed substitution and a cut of the specified equipment to the Project Engineer in writing, and returned to the Contractor at least ten days prior to bid opening.

   b. No substitutions shall be submitted or will be allowed after the contract has been awarded.

1.03 QUALITY ASSURANCE

A. Qualifications of manufacturers, materials and equipment:

1. Material and equipment, except as herein otherwise noted, shall be new and conform to standards specified herein defined to include equipment, piping, insulation, and the like.

2. Materials and equipment shall be of an approved design.

   a. Similar materials shall be of one manufacturer wherever possible.

3. Equipment offered under these Specifications shall be limited to products regularly produced and recommended for service ratings in accordance with manufacturer's catalogs, engineering data, or other comprehensive literature made available to the public and in effect at the time of opening of bids.

4. Install equipment in strict accordance with manufacturer's instruction for type, capacity and suitability of each piece of equipment used.

   a. Obtain these instructions which shall be considered a part of these Specifications.

B. Qualifications of supervisor, workmanship and installers:

1. The Contractor shall have a master mechanic constantly supervising the work covered by these Specifications, and so far as possible shall keep

the same foreman on the job from start to finish.

a. The workmanship of the entire job shall be first class in every way and only experienced and competent workers shall be employed for the work.

1.04 CODES AND REGULATIONS

A. Work shall be installed in accordance with the regulations and requirements of the Life Safety Code NFPA No. 101, Standard Building Code as well as all rules, state and local codes regulations and requirements.

B. Where ducts and/or pipes penetrate fire rated walls, ceilings or floors, the penetrations shall be firestopped in accordance with Chapter 7, Section 705 of the standard building code.

1. The above shall be ascertained and fully coordinated before the installation of any material, equipment, and the like, and any discrepancy shall be immediately brought to the attention of the Project Architect in writing, and the Contractor shall receive a disposition of same before proceeding with the work.

2. Furnish, without additional charge, any additional materials and labor that may be required for compliance with these codes, law, rules, regulations or requirements even though the work is not mentioned in these Specifications or shown on the Drawings.

C. Material and equipment shall bear the label of approval of the National Board of Fire Underwriters Laboratory.

1.05 INSPECTIONS

A. All work and materials covered by these Specifications and shown on the Drawings shall be subject to inspection at any and all times by representatives of the Project Architect or Owner.

B. If the Project Engineer or Owner's inspectors find that any material does not conform with these Specifications, the Contractor shall within three days after being notified by the Project Engineer or Owner, remove the material from the premises, and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.

C. Tests:

The Owner reserves the right to inspect and test any portion of the equipment during the progress of this work.

1. The Contractor shall test the entire system in the presence of the Owner or the Owner's representative when the work is completed to insure that all portions are free from defects.

2. All equipment, material and labor necessary to conduct the above tests shall be furnished at the Mechanical Contractor's expense.

1.06 PRODUCT HANDLING

A. Protection of Equipment, Material and Work: The Contractor shall effectively protect, at his/her own expense, much of his/her work, materials or equipment, as is liable to injury during the construction period.

1. Openings into any part of the duct and piping system as well as associated fixtures, equipment, and the like, both before and after being set in place, shall be securely covered or otherwise protected to prevent obstruction or injury due to carelessness or maliciously dropped tools or materials, grit, dirt, or any foreign matter.

a. The Contractor will be held responsible for all damage done until his/her work is fully and finally accepted.

2. Cover duct and pipe ends with capped bushings.

B. Repair of damage: In the event of damage, repair shall be made immediately, to the Project Architect's satisfaction and at no additional cost to the Owner.

C. Special Handling: Special care, storage and handling of new and existing pluming fixtures shall be taken to minimize breakage.

1.07 JOB CONDITIONS

A. Accuracy of Data: The data given herein and on the Drawings are as exact as could be secured.

1. The Specifications and Drawings are for the assistance and guidance of the Contractor.

2. Exact locations, distances, levels, and the like, will be governed by the building field conditions and the Contractor shall use the data contained herein with this understanding.

B. Drawings:

1. The mechanical drawings are diagrammatic, but shall be followed as closely as actual construction and work of other Contractors will permit.

2. Deviations from drawings required to make the work of the Contractor conform to the building as constructed, and to the work of other contractors, shall be made by the Contractor at his/her expense.

3. It is not the intention of the drawings or specifications to indicate each piece of pipe, ductwork, fittings and the like, required for the satisfactory operation of the installation and whereby one is indicated, but not

specified, or specified but not indicated on the drawings, it shall be considered to be both specified and indicated.

C. Measurements:

1. Review the Contract Drawings and Specifications and visit the job site to ascertain all conditions, including conduit runs, interfacing, interferences, conflicts, discrepancies, etc., and shall report the same to the Engineer for clarification ten days prior to submittal of the bid.

2. Failure to comply with this condition shall constitute an acceptance of the conditions and any necessary changes will be at Contractor's expense.

3. The Contractor shall make all measurements necessary for his/her work and shall assume responsibility for their accuracy.

D. Structural difficulties: Should any structural difficulties prevent the setting of equipment, and the like, at points indicated on the drawings, the necessary deviation therefrom, as determined by the Project Architect will be permitted and shall be made without additional cost.

E. Cooperation with Other Contractors

1. The Contractor shall arrange all parts of his/her work in proper relation to the work of other contractors.

2. Where interferences occur, the Contractor shall, before installing the work involved, consult with the Project Engineer as to exact location and level of his/her work.

3. The Contractor shall be responsible for arrangement of his/her work and equipment and maintenance of proper headroom under this work.

4. Should work installed by him/her require any modifications to avoid interference with the other work, such changes shall be made without additional cost.

5. The Engineer's decision as to determination or allocation or responsibility where conditions require changing of work, shall be final.

6. If any work of the Contractor is dependent for its proper execution on contiguous work, examine such work and report in writing any defect thereon or conditions rendering it unsuitable.

7. The beginning of work, without making such report, shall constitute an acceptance of such work, and any defects in his/her own work consequently shall be his/her responsibility.

1.08 CLEANING

A. Keep the premises free of debris and unusable materials resulting from the work, and immediately upon completion of the work remove such debris and material from the site and leave floors broom clean in areas affected by the work.

1.09 GUARANTEE

A. Leave the mechanical installation in proper working order and without charge, replace any work or materials which develop defects within one year from date of final inspection and acceptance by the Owner.

1.10 DEFINITIONS

A. In this Division "provide" is used as a term contraction meaning "to furnish, install and connect up completely in the specified or in an approved manner for the item and/or material described".

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION Not Used

END OF SECTION

SECTION 15030
ELECTRICAL PROVISIONS OF MECHANICAL WORK

PART 1 - GENERAL

1.01 Standards: For electrical equipment and products, comply with applicable NEMA Standards, and refer to NEMA standards for definitions of terminology herein. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

PART 2 - PRODUCTS

2.01 MOTORS:

A. Manufacturer: Except where item of mechanical equipment (which otherwise complies with requirements) must be integrally equipped with motor produced by another manufacturer, provide motor for mechanical equipment by one of the following single manufacturers:

1. Allis Chambers
2. U.S. Motors
3. Century Electric
4. General Electric
5. Louis Allis
6. Marathon Electric
7. Reliance Electric
8. Westinghouse Electric

B. Motor Characteristics: Except where more stringent requirements are indicated, and except where required item of mechanical equipment cannot be obtained with fully complying motor, comply with the following requirements for motors of mechanical work:

1. Temperature Rating: Rated for 40 deg. environment with maximum 50 deg. temperature rise for continuous duty at full load (Class A Insulation).
2. Starting Capability: Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts/hour for manually controlled motors.
3. Phases and Current Characteristics: Provide squirrel-cage induction polyphase motors for 1/2 hp and larger, and provide capacitor-start single phase motors for 1/3 hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split phase type. Coordinate current characteristics with power specified in Division 16 sections, and with individual equipment requirements specified in other Division 15 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
4. Service Factor: 1.15 for polyphase motors, and 1.35 for single phase motors.

C. Motor Construction: Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.

1. Frame: NEMA No.48.
2. Bearing: Ball or roller bearing with inner and outer shaft seals, regreasable except permanently sealed where motor is normally inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division 15 for fractional-hp light duty motors where sleeve type bearings are permitted.
3. Enclosure Type: Except as otherwise indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 15 for other enclosure requirements.
4. Overload Protection: Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
5. Noise Rating: Provide "Quiet" rating on motors located in occupied spaces of building.
6. Efficiency: All motors shall be "Energy Efficient", provide motors having minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency is not scheduled, provide motor with higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112, test Method B.

D. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, rating, characteristics, construction, special features, and similar information.

E. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

2.02 STARTERS, ELECTRICAL DEVICES AND WIRING:

A. Motor Starter Manufacturer: Except where item of mechanical equipment must be integrally furnished with motor starter produced by another manufacturer, provide motor starters for mechanical equipment manufactured by only one of the following manufacturers:

1. Allen Bradley
2. Cuttler Hammer
3. General Electric
4. Square D

5. Westinghouse Electric

B. Motor Starter Characteristics: Comply with NEMA standards and NEC. Provide Type I general purpose enclosures with padlock ears, and with frames and supports for mounting on wall, floor, or panel as indicated. Where starter location is not within sight of motor, provide disconnect switch within sight of motor. Provide type and size of starter recommended by motor manufacturer and equipment manufacturer for applicable protection and start-up conditions; refer to individual equipment sections for basic load requirements.

1. Manual Switches: provide manual switch and pilot light for motors 1/3 hp and smaller, except where interlocked or automatic operation is indicated. Provide extra switch positions and pilot lights for multi-speed motors.
2. Overload Protection: Provide melting alloy type thermal overload relays.

C. Magnetic Starters: Provide magnetic starters for motors 1/2 hp and larger, and for smaller motors where interlock or automatic operation is indicated. Include the following:

1. Maintained contact push-button and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, switches, and similar devices as required for coordination with control requirements of Division 15 Controls section.
4. Built-in 120 volt control circuit transformer, fused from line side, where services exceed 240 volts.
5. Externally operated manual reset.
6. Undervoltage release or protection.

D. Deliver starters and wiring devices which have not been factory installed on equipment to electrical installer for installation.

E. Electrical Heating Elements: Where electric resistance coils and other heating elements are included in mechanical equipment, or otherwise indicated as mechanical work, and except as otherwise indicated, provide 120 volt units where rating is less than 2 KW, higher voltage single phase units where rating is 2 KW but less than 5 KW and higher voltage 3 phase units where rating is 5 KW and greater.

F. This Contractor shall furnish all motor starters except those in the motor control center which are provided under Division 16. This Contractor shall coordinate and supply all technical information to electrical on the equipment with starters in the motor control center.

PART 3 - EXECUTION

3.01 EQUIPMENT FABRICATION:

A. General: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of

motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives, arranged for lubrication and similar running maintenance without removal of guards.

END OF SECTION

SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements specified in Division 15 Section "Basic Mechanical Requirements" apply to this Section.

1.02 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:

1. Mechanical equipment nameplate data.
2. Excavation for underground utilities and services, including underground piping (under the building and from building to utility connection), tanks, basins, and equipment.
3. Miscellaneous metals for support of mechanical materials and equipment.
4. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
5. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
6. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.

1.03 DEFINITIONS

A. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
3. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
4. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for the following products:

1. Air Handling Units
2. Heat Pump Condensing Units.
3. Packaged Roof Top Air Handling Units.
4. Exhaust fans.
5. Access panels and doors.
6. Joint sealers.

C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.

D. Coordination drawings for access panel and door locations in accordance with Division 15 Section "Basic Mechanical Requirements."

E. Samples of joint sealer, consisting of strips of actual products showing full range of colors available for each product.

F. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

G. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer for the installation and application joint sealers, access panels, and doors.

B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

1. Provide UL Label on each fire-rated access door.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.07 PROJECT CONDITIONS

A. Conditions Affecting Excavations: The following project conditions apply:

1. Maintain and protect existing building services which transit the area affected by selective demolition.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
3. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available and included in Section. Data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
4. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
5. Remove existing underground utilities indicated to be removed.

    a. Uncharted or Incorrectly Charted Utilities: Contact utility owner immediately for instructions.
    b. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to Architect prior to utility interruption.

6. Use of explosives is not permitted.

C. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do no apply joint sealers to wet substrates.

1.08 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.

B. Notify the Architect at least 5 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS

2.01 MECHANICAL EQUIPMENT NAMEPLATE DATA

A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.02 SOIL MATERIALS

A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.

C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than 2 inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

2.03 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.

F. Fasteners: Zinc-coated, type, grade, and class as required.

2.04 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 15/32 inches.

2.05 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
3. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work include, but are not limited to, the following.
4. Products: Subject to compliance with requirements, provide one of the following:

a. One-Part, Nonacid-Curing, Silicone Sealant:

1) "Chem-Calk N-Cure 2000," Bostic Construction Products Div.
2) "Dow Corning 790," Dow Corning Corp.
3) "Silglaze N SCS 2501," General Electric Co.
4) "Silpruf SCS 2000," General Electric Co.
5) "864," Pecora Corp.
6) "Rhodorsil 5C," Rhone-Poulenc, Inc.
7) "Spectrum 1," Tremco, Inc.
8) "Spectrum 2," Tremco, Inc.
9) "Dow Corning 795," Dow Corning Corp.
10) "Rhodorsil 6B," Rhone-Poulenc, Inc.
11) "Rhodorsil 70," Rhone-Poulenc, Inc.
12) "Omniseal," Sonneborn Building Products Div.
13) "Chem-Calk 100," Bostik Construction Products Div.
14) "Gesil N SCS 2600," General Electric Co.

b. One-Part, Mildew-Resistant, Silicone Sealant:

1) "Dow Corning 786," Dow Corning Corp.
2) "SCS 1702 Sanitary," General Electric Co.
3) "863 #345 White," Pecora Corp.
4) "Rhodorsil 6B White," Rhone-Poulenc, Inc.
5) "Proglaze White," Tremco Corp.
6) "OmniPlus," Sonneborn Building Products Div.

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior

and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

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

a "Chem-Calk 600," Bostik Construction Products Div.
b. "AC-20," Pecora Corp.
c. "Sonolac," Sonneborn Building Products Div.
d. "Tremco Acrylic Latex 834," Tremco, Inc.

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire- rated walls and floors. Sealants and accessories shall have fire- resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

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

a. "Dow Corning Fire Stop Foam," Dow Corning Corp.
b. "Pensil 851," General Electric Co.
c. “Tremco Firestop Foam”, Tremco, Inc.

2.06 ACCESS DOORS

A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

1. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
2. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
3. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

C. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or

concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

1. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

D. Locking Devices: Flush, screwdriver-operated cam locks.

E. Locking Devices: Where indicated, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

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

1. Bar-Co., Inc.
2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div. Inryco, Inc.
5. Nystrom, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.04 EXCAVATION

A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in

excavations regardless of time period excavations will be open.

1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

C. Install sediment and erosion control measures in accordance with local codes and ordinances.

D. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

E. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

F. Excavation for Underground Tanks, Basins, and Mechanical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

G. Trenching: Excavate trenches for mechanical installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and

backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.

5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.

    a. For pipes or equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom 1/4 of the circumference. Fill unevenness with tamped sand backfill. At each pipe joint over-excavate to relieve the bell or pipe joint of the pipe of loads, and to ensure continuous bearing of the pipe barrel on the bearing surface.

H. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F (1 deg 2 C).

I. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of piping, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
5. Other areas, use excavated or borrowed materials.

J. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

K. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

L. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

M. Place backfill and fill materials evenly adjacent to structures, piping, and

equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

N. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

O. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.04 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.05 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials

and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.06 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
2. Comply with recommendations of ASTM C 790 for use of acrylic- emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around mechanical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

3.07 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

END OF SECTION

SECTION 15055
BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section specifies piping materials and installation methods common to more than one section of Division 15 and includes joining materials, piping specialties, and basic piping installation instructions.

B. Related Sections:

1. Division 15 Basic Mechanical Requirements section applies to the work at this Section.
2. Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Divisions 2 and 15.
3. Valves are specified in a separate section and in individual piping system sections of Division 15.
4. Expansion Compensation is specified in a separate section of Division 15.
5. Supports and Anchors are specified in a separate section of Division 15.
6. Mechanical Identification is specified in a separate section of Division 15.
7. Fire Barrier Penetration Seals are specified in Division 7, Section 07842 – Firestopping Systems.

1.03 SUBMITTALS:

A. Refer to Division 1 and Basic Mechanical Requirements for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:

1. Escutcheons
2. Dielectric Unions and Fittings
3. Mechanical Sleeve Seals

C. Quality Control Submittals:

1. Submit welders' certificates specified in Quality Assurance below.

1.04 QUALITY ASSURANCE:

A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

B. Welding procedures and testing shall comply with ANSI Standard B31.1.0 - Standard Code for Pressure Piping, Power Piping, and The American Welding Society, Welding Handbook.

C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturer Uniformity: Conform with the requirements specified in Basic Mechanical Requirements, under "Product Options."

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering piping materials and specialties which may be incorporated in the work include, but are not limited to, the following:

C. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:

1. Pipe Escutcheons:

a. Chicago Specialty Mfg. Co.
b. Sanitary-Dash Mfg. Co.
c. Grinnell

2. Dielectric Unions:

a. Eclipse, Inc.
b. Perfection Corp.
c. Watts Regulator Co.

3. Mechanical Sleeve Seals:

a. Thunderline Corp.
b. Or approved equal.

2.02 PIPE AND FITTINGS:

A. Refer to the individual piping system specification sections in Division 15 for specifications on piping and fittings relative to that particular system.

2.03 JOINING MATERIALS:

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

D. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 PIPING SPECIALTIES:

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with setscrew. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Sleeves:

1. Sheet-Metal Sleeves: 10 gage, galvanized sheet metal, round tube

closed with welded longitudinal joint.

2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

E. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATIONS:

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.

I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained. Refer to Division 7 for special sealers and materials

3.03 FITTINGS AND SPECIALTIES:

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.

C. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

D. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.

E. Install Flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.

F. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).

G. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.04 JOINTS:

A. Steel Pipe Joints:

1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.

2. Pipe Larger Than 2":

a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.1.0 Code for Pressure Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:

1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.1.0 - Standard Code for Pressure Piping, Power Piping and ANSI B9.1 - Standard Safety Code for Mechanical Refrigeration.
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
3. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

C. Joints for other piping materials are specified within the respective piping system sections.

3.05 FIELD QUALITY CONTROL:

A. Testing: Refer to individual piping system specification sections.

END OF SECTION

SECTION 15060
PIPES AND PIPE FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to pipes and pipe fittings specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of pipes and pipe fittings required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of pipes and pipe fittings specified in this section include the following:

1. Copper Tube.
2. Plastic Pipe Schedule 40 PVC, DWV.
3. Miscellaneous Piping Materials/Products.

C. Pipes and pipe fittings furnished as part of factory fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar services for not less than 5 years.

1.04 CODES AND STANDARDS:

A. Welding: Qualify welding procedures, welders, and operations in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

1. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).

B. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job site brazing of piping work.

1.05 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

B. Brazing Certifications: Submit reports as required for piping work.

C. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of Division 1.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Except for concrete, corrugated metal, hub and spigot, clay and similar units of pipe, provide factory applied plastic end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 GENERAL:

A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings: Provide factory fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.02 COPPER TUBE AND FITTINGS:

A. Copper Tube: ASTM B 88; Type (wall thickness) as indicated for each service; hard drawn temper, except as otherwise indicated.

B. DWV Copper Tube: ASTM B 306.

C. ACR Copper Tube: ASTM B 280.

D. Cast Copper Solder Joint Fittings: ANSI B16.18.

E. Wrought Copper Solder Joint Fittings: ANSI B16.22.

F. Cast Copper Solder Joint Drainage Fittings: ANSI B16.23.

G. Wrought Copper Solder Joint Drainage Fittings: ANSI B16.29.

H. Cast Copper Flared Tube Fittings: ANSI B16.26.

I. Bronze Pipe Flanges/Fittings: ANSI B16.24.

J. Copper Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.03 PLASTIC PIPE PVC:

A. Plastic piping for condensate drainage can be Schedule 40 PVC in accordance with ASTM D2665 PVC solvent cement shall be in accordance with ASTM D2564.

2.04 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

A. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements.

1. Tin Lead Solder: ASTM B 32, Grade 50A (copper drainage).
2. Tin Antimony Solder: ASTM B, Grade 95TA (domestic water).
3. Silver Lead Solder: ASTM B 32, Grade 96TS (refrigerant piping).

B. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.

1. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.

C. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.

1. Available manufacturers: Subject to compliance with requirements, manufacturers offering piping connectors which may be incorporated in the work include, but are not limited to the following:

a. Fernco, Inc. or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping system, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.

1. Comply with ANSI B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Located runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

3.02 PIPING SYSTEM JOINTS:

A. General: Provide joints of type indicated in each piping system.

B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

C. Braze copper tube and fitting joints where indicated, in accordance with ASME B31.

D. Solder copper tube and fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into depth

fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

3.03 PIPING INSTALLATIONS:

A. Install drainage piping from lowest end of slope to highest, solidly bedded in filtering or drainage fill. Shape bed for bells of piping (if any).

3.04 CLEANING, FLUSHING, INSPECTING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31.

3.05 PIPING TESTS:

A. Test pressure piping in accordance with ASME B31.

B. General: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

1. Required test periods is 2 hours.
2. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are lower Class or pressure rating.
3. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.
4. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

C. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

D. Drain test water from piping systems after testing and repair work has been completed.

END OF SECTION

SECTION 15140
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to supports and anchors specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of supports and anchors specified in this section include the following:

1. Horizontal Piping Hangers and Supports.
2. Vertical Piping Clamps.
3. Hanger Rod Attachments.
4. Building Attachments.
5. Saddles and Shields.
6. Spring Hanger and Supports.
7. Miscellaneous Materials.
8. Anchors.
9. Equipment Supports.

C. Supports and anchors furnished as part of factory fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable plumbing codes, pertaining to product materials and installation of supports.
2. UL and FM Compliance: Provide products which are UL listed and FM approved.
3. MSS Standard Compliance:

a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

b. Select and apply pipe hangers and supports, complying with MSS SP-69.
c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
d. Terminology used in this section is defined in MSS SP-90.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 HORIZONTAL PIPING HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper plated hanger and supports for copper piping systems.

B. Adjustable Steel Clevis Hangers: MSS Type 1.

C. Steel Double Bolt Pipe Clamps: MSS Type 3.

D. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast iron floor flange.

E. Adjustable Roller Hangers: MSS Type 43.

F. Adjustable Pipe Roll Stands: MSS Type 46.

2.02 VERTICAL PIPING CLAMPS:

A. General: Except as otherwise indicated, provide factory fabricated vertical piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper plated clamps for copper piping systems.

B. Two Bolt Riser Clamps: MSS Type 8.

C. Four Bolt Riser Clamps: MSS Type 42.

2.03 HANGER ROD ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory fabricated hanger rod attachments complying with MSS SP-58 of one of the following MSS types listed, selected by Installer to suit horizontal piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger rod attachments to suit hanger rods. Provide copper plated hanger rod attachments for copper piping systems.

B. Steel Turnbuckles: MSS Type 13.

2.04 BUILDING ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper plated building attachments for copper piping systems.

B. Concrete Inserts: MSS Type 18.

C. Center Beam Clamps: MSS Type 21.

D. Welded Beam Attachments: MSS Type 22.

E. Steel Brackets: One of the following for indicated loading:

1. Medium Duty: MSS Type 32.

2.05 SADDLES AND SHIELDS:

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39, fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

D. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

1. Elcen Metal Products Co.
2. Pipe Shields, Inc.
3. Or approved equal.

2.06 SPRING HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory fabricated spring hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Spring Cushion Hangers: MSS Type 48.

2.07 MANUFACTURERS OF HANGERS AND SUPPORTS:

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

1. B-Line Systems, Inc.
2. Carpenter and Patterson, Inc.
3. Corner & Lada Co., Inc.
4. Elcen Metal Products Co.
5. Fee & Mason Mfg. Co.; Div. Figgie International.
6. ITT Grinnel Corp.

2.08 MISCELLANEOUS MATERIALS:

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No.2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION:

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of

inserts, anchors, and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 INSTALLATION OF BUILDING ATTACHMENTS:

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforced bars through openings at top of inserts.

3.04 INSTALLATION OF HANGERS AND SUPPORTS:

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire water piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

E. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

4. Insulated Piping: Comply with the following installation requirements.

   a. Clamps: Attach clamps, including spacers (if any) to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
   b. Shields: Where low-compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8" and over, install wood insulation saddles.
   c. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.05 INSTALLATION OF ANCHORS:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instruction, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in piperuns between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.06 EQUIPMENT SUPPORTS:

A. Concrete housekeeping bases will be provided as work of Division 3. Furnish to Contractor, scaled layouts of all required bases. Furnish templates, anchor bolts, and accessories, necessary for base construction.

B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory fabricated tank saddles for tanks mounted on steel stands.

3.07 ADJUSTING AND CLEANING:

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 15161
VIBRATION ISOLATION

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section pertains to the furnishing of all labor, equipment, material and services necessary to provide complete vibration isolation systems for equipment, piping and ductwork including:

1. Vibration isolators.

B. The general provisions of the contract, including General and Supplementary Conditions, and Special Conditions apply to the work specified in this section.

C. The vibration isolators and equipment bases shall be the product of one manufacturer who shall determine mounting sizes and provide field supervision and inspection to assure proper installation and performance.

1.02 QUALITY ASSURANCE:

A. The general provisions of the contract, including General and Supplementary Conditions, and Special Conditions apply to the work specified in this section.

1.03 SUBMITTALS:

A. Shop drawings as listed shall be submitted.

1. Vibration isolators: Provide catalog cuts, isolation efficiencies and deflections.

1.04 DELIVERY, STORAGE AND HANLDING:

A. Preparation for Transport: Prepare isolators for shipping as follows:

1. Ensure isolators are dry and protected against rusting.

2. Protect valve ends against mechanical damage.

B. Storage: Use the following precautions during storage:

1. Do not remove isolators unless necessary for inspection: then reinstall for storage.

2. Protect valves against weather. Where practical store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support isolators off the ground or pavement and protect in watertight enclosures.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. 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. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height.

B. 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 busing 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 deg. 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. Submittals shall include a scale drawing of the hanger showing the 30 deg. capability.

C. Air handling equipment shall be protected against excessive displacement which might result from high air thrusts in relation to the equipment weights. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad as described in Specification B with the same deflection as specified for the mountings or hangers. 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 complete with rods and angle brackets for attachment to both the equipment and ductwork or equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on either side of the unit.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Installation shall be in accordance with the manufacturers instructions.

B. Vibration isolators shall provide the required deflection under imposed loads and shall produce uniform loading and deflection even when equipment weight is not evenly distributed. Leveling bolts shall not be used as jacking devices. Isolators shall be as follows, except as noted:

TABULATION OF VIBRATION ISOLATION FOR MECHANICAL SYSTEMS

EQUIPMENT ITEM	SPAN OF SUPPORTING STRUCTURE DEFLECTION	TYPE ISOLATOR	MASON INDUSTRIES SPEC.REFER.	MINIMUM STATIC
Air Handling Units	30N	D	B-J	.75"
Inline Fans	30N	D	B-J	.75"

END OF SECTION

SECTION 15190
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. This section is Division 15 Basic Mechanical Materials and Methods section, and is part of each Division 15 section making reference to identification devices specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division 15 sections.

B. Types of identification devices specified in this section include the following:

1. Painted identification materials.
2. Plastic pipe markers.
3. Underground type plastic line markers.
4. Plastic duct markers.
5. Valve tags.
6. Engraved plastic laminate signs.
7. Plastic equipment markers.
8. Plasticized tags.

C. Mechanical identification furnished as part of factory fabricated equipment is specified as part of equipment assembly in other Division 15 sections.

D. Refer to other Division 15 sections for identification requirements at central station mechanical control center; not work of this section.

E. Refer to Division 16 sections for identification requirements of electrical work; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut off and similar special uses, by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering mechanical identification materials which may be incorporated in the work include, but are not limited to the following:

1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

2.02 MECHANICAL IDENTIFICATION MATERIALS:

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.03 PAINTED IDENTIFICATION MATERIALS:

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4" high letters for ductwork and not less than 3/4" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated of, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.04 PLASTIC PIPE MARKERS:

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Pressure Sensitive Type: Provide manufacturer's standard preprinted, permanent adhesive, color-coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1.

C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 deg. around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

D. Large Pipes: For external diameters of 6" and larger (including insulation, if any) provide either full band or strip type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
3. Strapped to pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Manufacturer's standard preprinted nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with name as shown or specified.

F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions) or as separate unit of plastic.

2.05 PLASTIC DUCT MARKERS:

A. General: Provide manufacturer's standard laminated plastic, color-coded duct markers. Conform to the following color code:

1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside return, and mixed air.

B. Nomenclature: Include the following:

1. Direction of airflow.
2. Duct service (supply, return, exhaust, etc.)
3. Duct origin (from).
4. Duct destination (to).
5. Design cfm.

2.06 PLASTIC TAPE:

A. General: Provide manufacturer's standard color-coded pressure sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1 except where another color selection is indicated.

2.07 UNDERGROUND TYPE PLASTIC LINE MARKERS:

A. General: Manufacturer's standard permanent, bright colored, continuous printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

1. Provide multi-ply tape consisting of solid aluminum foil core between 2 layers of plastic tape.

2.08 VALVE TAGS:

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32" hole for fastener.

1. Provide 1-1/2" diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

B. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and number corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.09 ENGRAVED PLASTIC LAMINATE SIGNS:

A. General: Provide engraving stock melamine plastic laminate, complying with FS

L-P-387, in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16", except as otherwise indicated.

C. Thickness: 1/8" except as otherwise indicated.

D. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

E. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.10 PLASTIC EQUIPMENT MARKERS:

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible.

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 1-1/2" x 4 markers for control devices, dampers, and valves, and 4-1/2" x 6" for equipment.

2.11 PLASTICIZED TAGS:

A. General: Manufacturer's standard pre-printed or partially pre-printed accident prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large size primary wording (as examples: DANGER, CAUTION, DO NOT OPERATE).

2.12 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations, and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No.3, Air Supply No.1H, Standpipe F12).

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS:

A. Coordination: Where identification is to be applied or surfaces which require insulation, painting or other covering or finish, include valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceiling and similar removable concealment.

3.02 DUCTWORK IDENTIFICATION:

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment) and at 50' spacing along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housing, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specific signs, at Installer's option.

3.03 PIPING SYSTEM IDENTIFICATION:

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow.

1. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or

rectangle 2" beyond ends of lettering.

2. Stenciled markers with lettering color complying with ANSI A13.1.
3. Plastic pipe markers with application systems as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
4. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine room, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.04 UNDERGROUND PIPING IDENTIFICATION:

A. General: During back-filling/top-soiling of each exterior underground piping system, install continuous underground type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of fields.

3.05 VALVE IDENTIFICATION:

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, convenience and lawn watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.

3.06 MECHANICAL EQUIPMENT IDENTIFICATION:

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operation devices.

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gages, thermometers and similar units.
3. Pumps, compressors, chillers, condensers and similar motor-driven units.
4. Heat exchangers, coils, evaporators, cooling towers, heat recovery units and similar equipment.
5. Fans, blowers, primary balancing dampers and mixing boxes.
6. Packaged HVAC central station and zone type units.
7. Tanks and pressure vessels.
8. Strainers, filter, humidifiers, water treatment systems and similar equipment.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 or 3/4 of size of principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

E. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceiling or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

3.07 ADJUSTING AND CLEANING:

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.08 EXTRA STOCK:

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

ORANGE COUNTY – FS #31
HVAC REPLACEMENT

SECTION 15250
MECHANICAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Division 15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of mechanical insulation required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Piping System Insulation:

a. Fiberglass.
b. Closed Cellular Foam (Armaflex).

2. Ductwork System Insulation:

a. Fiberglass

C. Refer to Division 15 section "Supports and Anchors" for protection saddles, protection shields, and thermal hanger shields; not work of this section.

D. Refer to Division 15 section "Low Pressure Ductwork" for duct linings, not work of this section.

E. Refer to Division 15 section "Mechanical Identification" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instruction for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

C. Samples: Submit manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged, or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. Knauf Fiber Glass GmbH.
3. Manville Products Corp.
4. Owens-Corning Fiberglass Corp.
5. Pittsburg Corning Corp.
6. Armacell LLC.

2.02 PIPING INSULATION MATERIALS:

A. All insulation material and mastic shall be asbestos-free.

B. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.

1. Class 1 for use to 450 deg. F. (230 deg. C.).

C. Closed Cellular Foam Piping Insulation: ASTM C534, Grade 1, Type l.

1. Type I – Pipe and tubing insulation.

D. Jackets for Piping Insulation: ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient.

1. Encase pipefitting insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.

E. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, and Protective Finished: As recommended by insulation manufacturer for application indicated.

2.03 DUCTWORK INSULATION MATERIALS:

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class

1. Class 1 - 400 deg. F (204 deg. C.)

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, type 1, Class B-4.

1. Type I - Resilient, flexible.

C. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.01 INSPECTIONS:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been

corrected in manner acceptable to Installer.

3.02 HVAC PIPING SYSTEM INSULATION:

A. Insulation Omitted: Omit insulation on cold piping within unit cabinets provided piping is located over drain pan.

B. Sub-Freezing Piping (0-39 deg. F)(-18-4 deg. C.):

1. Application Requirements: Insulate the following sub-freezing HVAC piping systems:

a. Refrigerant suction lines between evaporators and compressors.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Closed Cellular Foam: 1” thick for pipe sizes up to and including 1”, 1-1/2”.

C. Cold Piping (40 deg. F.)(4.4 deg. C) to ambient:

1. Application Requirements: Insulate the following cold HVAC piping systems:

a. Air conditioner condensate drain piping.
b. Refrigerant suction lines.

2. Insulate each piping system specified above with one of the following types and thickness of insulation:

a. Closed Cellular Foam

3.03 DUCTWORK SYSTEM INSULATION:

A. Cold Ductwork (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold ductwork:

a. Supply air and return air ductwork.

b. Outdoor air intake ductwork between air entrance and return air duct.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Machine, fan and equipment rooms: 2" thick flexible fiberglass,

minimum R-6.

b. Concealed spaces: 2" thick flexible fiberglass or 1 2" thick rigid fiberglass, minimum R-6.

3.04 EQUIPMENT INSULATIONS:

A. Cold Equipment (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold equipment:

a. Drip pans under chilled equipment.

2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:

a. Cellular Glass: 1 2" thick.
b. Foam Rubber: 3/4" thick.

3.05 INSTALLATION OF PIPING INSULATION:

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purposes.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulations joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor barrier jackets on pipe insulation and protect to prevent puncture or other damage.

F. Cover valves, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

3.06 INSTALLATION OF DUCTWORK INSULATION:

A. General: install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that

insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through wall, floors, and similar ductwork penetrations, except where otherwise indicated.

F. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

G. Blanket Fiberglass Insulation:

1. Insulation shall be tightly wrapped on the ductwork with all circumferential joints butted and longitudinal joints lapped 2 inches and stapled. Joints shall be finished with two coats of an approved vapor barrier mastic, reinforced with glass cloth extending 3 inches onto adjacent insulation. One coast of mastic shall be embedded in the mastic to ensure complete adhesion of the cloth. Adhere insulation to ducts with 4-inch wide strips of an approved bonding adhesive, at 8 inches on center. Additionally secure insulation to bottom of rectangular ducts over 24 inches wide with weld pins to stick clips at no more than 18 inches on center.

2. Insulation shall be butted with facing overlapping all joints shall be finished with two coats of an approved vapor barrier mastic, reinforced with glass cloth; extending 2 inches onto adjacent insulation. One coast of mastic shall be applied to the insulation prior to the application of the glass cloth, which shall be embedded in to ensure complete adhesion of the cloth. Breaks, punctures, pin penetrations in facing shall be sealed with vapor barrier tape and vapor barrier adhesive.

3.07 INSTALLATION OF EQUIPMENT INSULATION:

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purposes.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

E. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored blocks, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

F. Cover insulated surfaces with all service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

G. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

3.08 PROTECTION AND REPLACEMENT:

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 15530
REFRIGERANT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements of the following Division 15 Sections apply to this section:

1. Basic Mechanical Requirements.
2. Basic Mechanical Materials and Methods.
3. Supports and Anchors.
4. Mechanical Insulation.

1.02 SUMMARY

A. This Section includes refrigerant piping used for air conditioning applications. This Section includes:

1. Pipes, tubing, fittings, and specialties.
2. Special duty valves.
3. Refrigerants.

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

1. Section 15050 Basic Mechanical Materials and Methods for trenching and backfilling for installation of underground refrigerant piping and for materials and methods for sealing pipe penetrations through fire/smoke barriers.
2. Division 15, Section "Mechanical Identification" for labeling and identification of refrigerant piping.
3. Division 15, Section "Mechanical Insulation" for pipe insulation.

C. Products installed but not furnished under this Section include pre-charged tubing, refrigerant specialties, and refrigerant accessories furnished as an integral part of or separately with packaged air conditioning equipment.

1.03 SUBMITTALS

A. Product data for the following products:

1. Each type valve specified.
2. Each type refrigerant piping specialty specified.

B. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment

connection details. Show interface and spatial relationship between piping and proximate to equipment.

C. Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under "Quality Assurance" below.

D. Maintenance data for refrigerant valves and piping specialties, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 15 Section "Basic Mechanical Requirements."

1.04 QUALITY ASSURANCE

A. Qualify brazing processes and brazing operators to perform brazing work.

B. Regulatory Requirements: Comply with provisions of the following codes:

1. ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.
2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.
3. BOCA Basic National Mechanical Code.
4. ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

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

1. Refrigerant Valves and Specialties:

a. Alco Controls Div, Emerson Electric.
b. Danfoss Electronics, Inc.
c. EATON Corporation, Control Div.
d. Henry Valve Company.
e. Parker-Hannifin Corporation, Refrigeration and Air Conditioning Division.
f. Sporlan Valve Company.

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATION" for identification of systems where the below specified pipe and fitting materials are used.

B. Copper Tubing: ASTM B 280, Type ACR, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.

C. Copper Tubing: ASTM B 88, Type L, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing.

2.03 FITTINGS

A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

2.04 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

2.05 VALVES

A. General: Complete valve assembly shall be UL-listed and designed to conform to ARI 760.

B. Globe: 450 psig maximum operating pressure, 275 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through or angle pattern, with solder-end connections.

C. Check Valves - Smaller Than 7/8 inch: 500 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.

D. Check Valves - 7/8 inch and Larger: 450 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

E. Solenoid Valves: 250 deg. F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2-inch conduit adapter, and 24 volt, 60 Hz. normally closed holding coil.

F. Evaporator Pressure Regulating Valves: pilot-operated, forged brass or cast bronze; complete with pilot operator, stainless steel bottom spring, pressure gage tappings, 24 volts DC, 50/60 Hz, standard coil; and wrought copper fittings for solder end connections.

G. Thermal Expansion Valves: thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

2.06 REFRIGERANT PIPING SPECIALTIES

A. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.

B. Strainers: 500 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.

C. Moisture/liquid Indicators: 500 psig maximum operation pressure, 200 deg. F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.

D. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:

1. Standard capacity desiccant sieves to provide micronic filtration.
2. High capacity desiccant sieves to provide micronic filtration and extra drying capacity.

E. Suction Line Filter-Drier: 350 psig maximum operation pressure, 225 deg. F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant. for removal of acids and moisture for refrigerant vapor.

F. Suction Line Filters: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets, as follows:

G. Flanged Unions: 400 psig maximum working pressure, 330 deg. F maximum operating temperature; two brass tailpiece adapters for solder end connections to copper tubing; flanges for 7/8 inch through 1-5/8 inch unions shall be forged steel, and for 2-1/8 inch through 3-1/8 inch shall be ductile iron; four plated steel bolts, with silicon bronze nuts and fiber gasket. Flanges and bolts shall have factory-applied rust-resistant coating.

H. Flexible Connectors: 500 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.

2.07 REFRIGERANT

A. Refrigerant No. 22, in accordance with ASHRAE Standard.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.

3.02 PIPE APPLICATIONS

A. Use Type L, or Type ACR drawn copper tubing with wrought copper fittings and brazed joints above ground, within building. Use Type K, annealed temper copper tubing for 2 inch and smaller without joints, below ground and within slabs. Mechanical fittings (crimp or flair) are not permitted.

1. Install annealed temper tubing in pipe duct. Vent pipe duct to the outside.

B. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Article "CLEANING" below.

3.03 PIPING INSTALLATIONS

A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration."

B. Install piping in as short and direct arrangement as possible to minimize pressure drop.

C. Install piping for minimum number of joints using as few elbows and other fitting as possible.

D. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

E. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

F. Insulate suction lines. Liquid line are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.

1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

G. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

I. Slope refrigerant piping as follows:

1. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
2. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.

3. Liquid lines may be install level.

J. Use fittings for all changes in direction and all branch connections.

K. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

L. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

M. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

N. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

O. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

P. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.

Q. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.

R. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

S. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

T. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver.

1. Install moisture/liquid indicators in lines larger than 2-1/8 inch OD, using a bypass line.

U. Install unions to allow removal of solenoid valves, pressure-regulating valves, expansion valves, and at connections to compressors and evaporators.

V. Install flexible connectors at the inlet and discharge connection of compressors.

3.04 HANGERS AND SUPPORTS

A. General: Hanger, supports, and anchors are specified in Division 15 Section "SUPPORTS AND ANCHORS." Conform to the table below for maximum spacing

of supports:

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe rollers complete supports for multiple horizontal runs, 20 feet or longer supported by a trapeze.
4. Spring hangers to support vertical runs.

C. Install hangers with the following minimum rod sizes and maximum spacing:

NON. PIPE SIZE	MAX. SPAN-FT	MIN. ROD SIZE - INCHES
1	7	3/8
1-1/2	9	3/8
2	10	3/8
3	12	1/2
3-1/2	13	1/2
4	14	5/8
5	16	5/8
6	17	3/4
8	19	7/8
10	22	7/8
12	23	7/8

D. Support vertical runs at each floor.

3.05 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do no apply heat near the bulb of the expansion valve.

B. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.

C. Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.

3.06 VALVE INSTALLATIONS

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

C. Install solenoid valves ahead of each expansion valve. Install solenoid valves in horizontal lines with coil at the top.

1. Electrical wiring for solenoid valves is specified in Division 16 but work is to be done under this contractor. Coordinate electrical requirements and connections.

D. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.
4. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

E. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

3.07 EQUIPMENT CONNECTIONS

A. The Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow servicing and maintenance.

3.08 FIELD QUALITY CONTROL

A. Inspect, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.

B. Repair leaking joints using new materials, and retest for leaks.

3.09 CLEANING

A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:

1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.

2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.10 ADJUSTING AND CLEANING

A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Clean and inspect refrigerant piping systems in accordance with requirements of Division-15 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.11 COMMISSIONING

A. Charge system using the following procedure:

1. Install core in filter dryer after leak test but before evacuation.
2. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg F is indicated on vacuum dehydration indicator.
3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.
6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

C. Review data in Operating and Maintenance Manuals. Refer to Division 1 section "Project Closeout."

D. Schedule training with Owner through the Architect, with at least 7 days advance notice.

END OF SECTION

SECTION 15681
HEAT PUMP UNITS – VARIABLE SPEED

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Division 15 Section 15050 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 SUMMARY:

A. Section includes:

1. Residential air-cooled heat pump units.

B. Related Sections:

1. Section 15030 - Electrical Provisions for Mechanical Work
2. Section 15530 - Refrigerant Piping
2. Section 16142 - Electrical Connections for Equipment

1.03 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories and installation and start-up instructions.

B. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of heat pump units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

C. Operation and Maintenance Data: Submit maintenance data and parts list for each heat pump unit, control, and accessory; including "trouble shooting" maintenance guide; plus servicing, and preventative maintenance procedures and schedule. Include this data and product data in maintenance manual in accordance with requirements of Division 1.

1.04 QUALITY ASSURANCE:

A. Manufacturers Qualifications: Firms regularly engaged in manufacture of heat pump units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Capacity ratings for heat pump units shall be in accordance with ARI Standard 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".

2. Refrigeration system of heat pump units shall be constructed in accordance with ASHRAE Standard ASHRAE 15 "Safety Code for Mechanical Refrigeration".

3. Heat pump units shall meet or exceed the minimum COP/Efficiency levels as prescribed in ASHRAE 90A "Energy Conservation in New Building Design" and the 2001 Florida Energy Efficiency Code.

4. Heat pump units shall be listed by UL and have UL label affixed.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Handle heat pump units and components carefully to prevent damage. Follow manufacturer's written instructions for rigging. Replace damaged heat pump units or components.

B. Store heat pump units and components in clean dry place off the ground. Protect from weather, water, and physical damage.

1.06 SPECIAL PROJECT WARRANTY:

A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.01 RESIDENTIAL AIR-COOLED HEAT PUMP UNITS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering residential air-cooled heat pump units which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide residential air-cooled heat pump units of one of the following:

1. Carrier Corporation
2. Lennox Industries

3. The Trane Co.
4. Or approved equal

C. General: factory-assembled and tested air-cooled heat pump units, consisting of compressor, condenser coil, fan, motor, refrigerant reservoir, and operating controls. Capacity and electrical characteristics are scheduled on the Drawings.

D. Casing: galvanized steel finished with baked enamel, complete with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Unit shall be complete with brass service valves, fittings, and gage ports on exterior of casing.

E. Compressor: hermetically sealed with built-in overloads and vibration isolation. Compressor motor, shall have thermal and current sensitive overload devices, internal high-pressure protection, high and low pressure cutout switches, start capacitor and relay, 2-pole contactor, crankcase heater, and temperature actuated switch and timer to prevent compressor rapid cycle.

Compressor shall utilize R-410A refrigerant.

Unit shall have a variable speed digital scroll compressor with inverter technology with capability of modulating compressor capacity down to 50% of maximum capacity.

F. Condenser: coil shall have copper tubes and aluminum fins, or aluminum tubes and aluminum fins; complete with liquid accumulator and liquid subcooler. Aluminum propeller fan shall be direct driven, with permanently lubricated fan motor having thermal overload protection.

G. Accessories:

4. Low-voltage thermostat and subbase to control heat pump unit and evaporator fan.

5. Precharged and insulated suction and liquid tubing of length indicated.

6. Head pressure control to modulate condenser fan motor speed for low ambient conditions.

7. Heat reclaim device providing preheating of domestic hot water with hot gas from heat pump unit.

8. Low-voltage control transformer.

6. Factory installed high capacity drier.

7. Factory installed 4 way reversing valve.

8. Factory installed and piped expansion valve with sensing bulb located on suction line.

9. Factory installed solid state time/temperature defrost controller and thermstat.

10. Furnish factory fabricated hail guard on heat pump unit coil.
11. Provide vandal proof condensing unit guard (cage assembly) to prevent theft of heat pump unit. Provide keyed lock(s) for cage.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verify surrounding grade drainage, service accessibility and airflow clearance requirements are acceptable. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

A. General: Install heat pump units in accordance with manufacturer=s installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support:

1. Install ground-mounted units on 4" thick reinforced concrete pad, 4" larger on each side than heat pump unit. Concrete is specified in other Divisions. Coordinate installation of anchoring devices.
2. Residential Units: Connect pre-charged refrigerant tubing to unit's quick-connect fittings. Run tubing so as not to interfere with access to unit.

a. Install furnished accessories.

3. Air-Cooled Heat Pump Units: Connect refrigerant piping to unit; maintain required access to unit.

a. Low-voltage wiring. All low voltage wiring between air-handling unit, heat pump unit and sensors shall be in metal conduit. Provide flexible conduit at all equipment connections.

3.03 FIELD QUALITY CONTROL:

A. Testing:

1. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

3.04 DEMONSTRATION:

A. Provide services of manufacturer's authorized service representative to provide start-up service and to instruct Owner's personnel in operation and maintenance of heat pump units.

B. Start-up heat pump units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

C. Train Owner's personnel on start-up and shutdown procedures, troubleshooting procedures, servicing, and preventative maintenance schedule and procedures. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division One.

1. Schedule training with Owner, provide at least 7-day prior notice to Architect/Engineer.

END OF SECTION

SECTION 15850
STATIONARY LOUVERS

PART 1- GENERAL

1.1 SECTION INCLUDES

A. Miami-Dade County, Florida approved extruded aluminum stationary louvers.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete.

B. Section 04200 - Masonry Units.

C. Section 05100 - Structural Metal Framing.

D. Section 06100 - Rough Carpentry.

E. Section 07410 - Metal Wall Panels.

F. Section 07600 - Flashing and Sheet Metal.

G. Section 07920 - Joint Sealants.

H. Section 09910 - Paints.

I. Section 15850 - Air Outlets and Inlets.

1.3 REFERENCES

A. AAMA 605.2 - High Performance Organic Coatings on Architectural Extrusions and Panels.

B. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

C. Miami-Dade County, Florida Building Code Compliance Office (BCCO) - Check List For Approval Of Wall Louvers.

D. Miami-Dade County, Florida Building Code Test Standard Protocols, Volume 2.

1.4 SUBMITTALS

A. Comply with requirements of Section 01330 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data including performance data.

C. Shop Drawings: Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.

1.5 QUALITY ASSURANCE

A. Louvers approved by the Miami-Dade County BCCO for use in open structures that do not have the ability to drain water that may penetrate. Approval based on tests and procedures performed in accordance with BCCO test protocol PA 100(A)-94, PA 201 and PA 203.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage: Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.

C. Handling: Protect materials and finishes during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Ruskin Manufacturing, 3900 Dr. Greaves Road, Kansas City, Missouri 64030. Phone (816) 761-7476. Fax (816) 765-8955.
B. Or approved equal.

2.2 EXTRUDED ALUMINUM STATIONARY LOUVERS

A. Fabrication:

1. Model: EME6625D.

2. Frame:
   a. Material: Extruded aluminum, Alloy 6063-T5.
   b. Wall Thickness: 0.125 inch (3.2 mm), nominal.
   c. Depth: 6 inches (152 mm).

3. Blades:
   a. Style: Vertically mounted.
   b. Material: Extruded aluminum, Alloy 6063-T5.
   c. Wall Thickness: 0.081 inch (2.1 mm), nominal.
   d. Centers: 1.5 inches (38 mm), nominal.

4. Bird Screen:
   a. Material: Aluminum, 1/2 inch mesh x 0.063 inch (13 mm mesh x 1.6 mm), intercrimp.
   b. Frame: Removable, rewireable.

5. Sill Flashing:
   a. Formed aluminum, 0.063 inch (1.6 mm), upturned sides to prevent water leakage.

6. Installation Subframes:
   a. Material: .125@ (3.2 mm) thick continuous aluminum channel with .188@ (4.7 mm) thick aluminum integral continuous fastening angle to allow installation in any wall system.

7. Assembly: Maximum field assembly size: Unlimited width x 96@ high.

B. Performance Data:

1. Based on testing 48-inch x 48-inch (1,219 mm x 1,219 mm) size unit in accordance with AMCA 500.
2. Free Area: 42 percent, nominal.
3. Free Area Size: 6.80 square feet (0.63 m^2).
4. Maximum Recommended Air Flow Through Free Area: 1,856 feet per minute (566 m/min).
5. Air Flow: 12,621 cubic feet per minute (357 m^3/min).
6. Maximum Pressure Drop: 0.21 inches w.g. (0.05 kPa).

C. Water Penetration: 98 percent effective at preventing water penetration through louver when tested at 75 miles per hour (121 km/h) wind with 3 inches per hour (76 mm/h) rainfall and 1,856 feet per minute (566 m/min) airflow through the free area in a modified HEVAC test chamber.

D. Louver Dade County Test Performance:

1. PA-100(A)-95 Wind Driven Rain Resistance Test: A 48@ x 48@ (1,219 mm x 1,219 mm) sample shall allow no water penetration at 35 and 70 MPH (56 and 113 kph) wind velocities and shall allow no more than 1 milliliter of water penetration per minute at 90 and 110 MPH (145 and 177 kph) velocities. Simulated rainfall applied in each test shall be 8.8@ (223.5 mm) per hour.
2. PA 201-94 Large Missile Impact Test: Louver must allow no interior penetration after at least six impacts with a 9.0 lb. (4.08 kg) Southern Pine 2@ x 4@ (51 x 102 mm) board traveling at a minimum of 50 ft/sec (15.24 m/sec).
3. PA 203-94 Cyclic Wind Pressure Test: Louver must withstand the following pressure cycles:

   a. 600 cycles at +80.0 PSF (3.83 kPa) and -70 PSF (3.35 kPa).
   b. 70 cycles at +96.0 PSF (4.60 kPa) and -84 PSF (4.02 kPa).
   c. 1 cycle at +208.0 PSF (9.96 kPa) and -182 PSF (8.71 kPa).

4. Duration of loads shall be 1 to 3 seconds per cycle. Louver components shall recover 100% after loading.
5. Design Wind Load: Incorporate structural supports and mullions required to withstand design wind load of +160 PSF (7.66 kPa) and -140 PSF (6.70 kPa).

2.3 ACCESSORIES

A. Bird Screens:

B. Insect Screens:

2.4 FACTORY FINISH

A. Standard mill finish.

B. Kynar 500 Fluoropolymer Coating:

1. Conform to AAMA 605.2.
2. Apply coating following cleaning and pretreatment.
3. Cleaning: AA-C12C42R1X.
4. Dry louvers before final finish application.
5. Total Dry Film Thickness: Approximately 1.2 mils (0.03 mm), when baked at 450 degrees F (232 degrees C) for 10 minutes.

C. Modified Fluoropolymer (50 Percent Kynar) Coating:

1. Conform to AAMA 605.2.
2. Apply coating following cleaning and pretreatment.
3. Cleaning: AA-C12C42R1X.
4. Dry louvers before final finish application.
5. Total Dry Film Thickness: Approximately 1.2 mils (0.03 mm), when baked at 450 degrees F (232 degrees C) for 10 minutes.

D. Acrodize Fluoropolymer Coating:

1. Conform to AAMA 605.2.
2. Apply coating following cleaning and pretreatment.
3. Cleaning: AA-C12C42R1X.
4. Dry louvers before final finish application.
5. Total Dry Film Thickness: Approximately 1.2 mils (0.03 mm), when baked at 450 degrees F (232 degrees C) for 10 minutes.

E. Color Anodize Finish:

1. Comply with Aluminum Association AA-C22A44.
2. Apply finish following chemical etching and pretreatment.
3. Electrolytically deposited color anodized finish.
4. Minimum Thickness: 0.7 mils (0.018 mm).

F. Clear Anodize Finish:

1. Comply with Aluminum Association AA-C22A31. Clear anodize finish 204-R1.
2. Apply finish following chemical etching and pretreatment.
3. Minimum Thickness: 0.4 mils (0.01 mm), 30 minute anodizing process.

G. Clear Anodize Finish:

1. Comply with Aluminum Association AA-C22A41. Clear anodize finish 215-R1.
2. Apply finish following chemical etching and pretreatment.
3. Minimum Thickness: 0.7 mils (0.018 mm), 60 minute anodizing process.

H. Prime Coat:

1. Apply alkyd prime coat following chemical cleaning and pretreatment.
2. Primer preparation for field painting.

I. Color for Fluoropolymer Coating: Color as selected by Architect from manufacturer's standard colors.

J. Color for Anodize Finish: [Black] [Clear Anodize] [Dark Bronze] [Medium Bronze].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.

B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.

C. Install joint sealants as specified in Section 07920.

D. Apply field topcoat within 6 months of application of shop prime coat. Apply field topcoat as specified in Section 09910.

3.3 CLEANING

A. Clean louver surfaces in accordance with manufacturer's instructions.

B. Repair minor damaged surfaces as directed by Architect.

END OF SECTION

ORANGE COUNTY – FS #31
HVAC REPLACEMENT

SECTION 15855
AIR HANDLING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Division 15 Section 15050 Basic Mechanical Materials and Methods sections apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of air handling unit work is indicated on drawings and schedules, and by requirements of this section.

B. Types of packaged air handling units specified in this section include the following:

1. Indoor draw-through.

C. Refer to other Division 15 sections for vibration control units used in conjunction with air handling units; not work of this section.

D. Vibration control units required for air handling units is specified in other Division 15 sections, and is included as work of this section.

E. Refer to other Division 15 sections for field applied insulation to air handling units; not work of this section.

F. Refer to other Division 15 sections for condensate, hot and chilled water, and condensate drain piping required in conjunction with packaged air handling units, not work of this section.

G. Refer to other Division 15 sections for balancing of the factory fabricated air handling units; not work of this section.

H. Refer to Division 16 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory installed by manufacturer.
2. Interlock wiring between electrically operated equipment units; and between equipment and field installed control devices.

a. Interlock wiring specified as factory installed is work of this section.

I. Provide the following electrical work as work of this section, complying with requirements of Division 16 sections.

1. Control wiring between field installed controls, indicating devices, and unit control panels.

    a. Control wiring specified as work of Division 15 for Automatic Temperature Controls is work of that section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged air handling units with characteristics, sizes and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards 210 and 500.
2. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central Station Air Handling Units", display certification symbol on units of certified models.
3. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
4. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
5. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards.
6. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air handling units.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finished of materials, and installation instructions.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air handling units. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

D. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists.

Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 1.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air handling units with factory installed shipping skids and lifting lugs; pack components in factory fabricated protective containers.

B. Handle air-handling units carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to air handling unit manufacturer.

C. Store air handling units in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air handling units which may be incorporated in the work include, but are not limited to the following:

1. Carrier Corporation
2. Lennox Industries
3. The Trane Company
4. Or approved equal

2.02 AIR HANDLING UNITS:

A. General: Provide factory fabricated and factory tested air handling units as indicated, of sizes and capacities as scheduled, and as specified herein.

B. Casings: Construct casing of 18 ga. minimum mill galvanized steel, designed to withstand specified operating pressures. Provide casing panels and/or access doors that are easily and quickly removable for inspection and access to internal parts.

1. Provide single zone units consisting of fan section, coil section, adjustable fan motor mounting, and drain pan.
2. Provide reinforced points of support for either setting or hanging units.
3. Provide drain pan, located under cooling coil section and humidifier section, extensive enough to catch condensate leaving coil at highest catalogued face velocity. Provide at least one drain connection at low point in drain pan.
4. Cover casing and frame with protective finish on both sides.

C. Coils: Provide cooling coils of scheduled capacity, mounted in unit in manner permitting removal.

1. Construct coils with copper tubing primary surface and aluminum secondary

surface bonded to tubes by method approved by specified manufacturer. Provide chilled water coils with threaded connections. Provide chilled water coils with drain and vent connections. Provide direct expansion coils with solder connections, liquid refrigerant distributors, and connections for gravity oil drainage. Pitch coils in unit casing for drainage.

2. Provide electric heating coil with automatic reset thermal cutouts for primary over- temperature protection and with load carrying manual reset thermal cutouts, factory wired in series with each heater stage, for secondary protection. Include over-current cutouts and sub-circuiting fusing in assembly, and construct with the following additional construction features:

    a. Open-Coil Electric Element: Construct coils with resistance wire of 80% nickel/20% chromium, insulated by floating ceramic bushings. Recess bushings into casing openings and secure on supporting brackets, spaced 4" o.c. maximum.

D. Coil Sections: Provide common or individual casing for heating and cooling coils as required. Design internal structure of coil section to allow for removal of coils, and provide suitable baffles to assure no air bypass around coils. Provide condensate pans and drain connections to cooling coil sections of sufficient size to contain and remove coil condensate. Insulate coil section casings and drain pans as specified in "Insulation" paragraph. Coil shall utilize R-410A refrigerant.

E. Fan Sections: Provide forward curved fans specifically designed and suitable for class of service indicated. Provide adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts, or similar devices, to secure base in proper position. Provide belt-driven fans with adjustable pitch pulley permitting fan speed to be varied. Design fan shafts so as not to pass through first critical speed when unit comes up to rated RPM. Provide grease lubricated fan bearings with externally accessible fittings for lubrication. Statically and dynamically balance fan assemblies in fan housing after final assembly.

F. Blower Motor: Blower shall utilize a variable speed high efficiency ECM (electronically communicating motor)

G. Filter Boxes: Provide filter boxes with wither hinged access doors or quickly removable panels, at each end. Provide racks to receive filters in either flat or angle type pattern.

H. Insulation: Insulate unit casing from air entrance to coils, to air outlet from unit, including bypass duct if used. Insulate framing angles exposed to air stream. Securely attach insulation, of sufficient thickness and density to prevent condensation from forming on unit casing. Protect insulation against deterioration from air currents.

1. Provide insulation with fire retarding characteristics, complying with NFPA 90A. Insulate drain pans as required to prevent condensate formation on unit exterior at ambient conditions to be encountered.

I. Air Filters: Provide air filters to fit in filter box, of the following type:

1. Disposable Type: Provide disposable type air filters 2" thick, consisting of viscous coated fibers with filtering media encased in fiberboard cell sides having perforated metal grids on each side to provide media support.

    a. Provide filters with clean resistance not exceeding 0.10" w. g. at face velocity of 300 fpm, and ASHRAE weight arrestance efficiency of 70-82% based on final operating resistance of 0.5" w. g.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine areas and conditions under which air handling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF AIR HANDLING UNITS:

A. General: Install air handling units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air handling units with other work.

C. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

D. Support: Install floor mounted air handling units on one of the following:

1. Painted steel support platform customized to match AHU. Size minimum height – 12”. See detail on plans.

E. Mounting: Mount air-handling units on vibration isolators, in accordance with manufacturer's instructions.

F. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

G. Piping Connections: Refer to Division 15 HVAC sections. Provide piping, valves, accessories, gages, supports, and flexible connectors as indicated.

H. Duct Connections: Refer to Division 15 Air Distribution sections. Provide ductwork,

accessories, and flexible connections as indicated.

I. Grounding: Provide positive equipment ground for air handling unit components.

3.03 FIELD QUALITY CONTROL:

A. Testing: Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.04 EXTRA STOCK:

A. Provide one complete set of filters for each air-handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

B. Provide one spare set of belts for each belt-driven air-handling unit, obtain receipt from Owner that belts have been received.

END OF SECTION

SECTION 15870
POWER VENTILATORS (EXHAUST FANS)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Requirements of the following Division 15 Sections apply to this section:

1. "Basic Mechanical Requirements."
2. "Basic Materials and Methods."

1.02 SUMMARY

A. This Section includes the following types of power ventilators:

1. Ceiling-mounted and inline ventilators.
2. Centrifugal Rood Ventilators.

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

1. Division 15 Section "Vibration Control" for vibration hangers and supports.
2. Division 15 Section "Testing, Adjusting, and Balancing" for air-handling systems testing, adjusting, and balancing requirements and procedures.

C. Products furnished but not installed under this Section include roof curbs for roof-mounted exhaust fans.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for selected models, including specialties, accessories, and the following:

a. Certified fan performance curves with system operating conditions indicated.
b. Certified fan sound power ratings.
c. Motor ratings and electrical characteristics plus motor and fan accessories.
d. Materials gages and finishes, including color charts.
e. Dampers, including housings, linkages, and operators.

2. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

3. Coordination drawings, in accordance with Division 15 Section "Basic Mechanical Requirements," for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

   a. Roof framing and support members relative to duct penetrations.
   b. Ceiling suspension members.
   c. Method of attaching hangers to building structure.
   d. Size and location of initial access modules for acoustical tile.
   e. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

4. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
5. Product certificates, signed by manufacturers of air-handling units, certifying that their products comply with specified requirements.
6. Maintenance data for exhaust fans, for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 15 Section "Basic Mechanical Requirements."

1.04 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof curbs and equipment supports specified in

Section 15050 Basic Mechanical Materials and Methods.

B. Coordinate the size and location of structural steel support members.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to, the following:

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

1. Ceiling-Mounted and Inline Ventilators:

a. Cook (Loren) Co.
b. Greenheck Fan Corp.
c. Penn Ventilator Co.
d. Acme Co.

2.02 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.03 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA L (50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

D. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.04 CEILING-MOUNTED AND INLINE VENTILATORS

A. General Description: Centrifugal fan designed for installation in ceiling, wall, or concealed inline applications.

B. Housing: Galvanized steel lined with acoustical insulation. Furnish with back draft damper.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Stainless steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories: Manufacturer's standard wall cap, and transition fittings as indicated.

2.05 CENTRIFUGAL ROOF VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged aluminum base with venturi inlet cone.

1. Up-blast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:

1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable 1/2-inch mesh, 16-gage, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops.
4. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.

    a. Blades: Die-formed sheet aluminum.
    b. Frame: Extruded aluminum, with waterproof, felt blade seals.
    c. Linkage: Nonferrous metals, connecting blades to counter weight or operator.
    d. Operators: Manufacturer's standard electric motor.
    e. Operators: Manufacturer's standard pneumatic motor.

5. Roof Curbs: Prefabricated, heavy-gage, galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Size as required to suit roof opening and fan base.

    a. Overall Height: 12 inches.

2.06 MOTORS

A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

C. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation).

D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.

1. Bases: Adjustable.
2. Bearings: The following features are required:

    a. Ball or roller bearings with inner and outer shaft seals.
    b. Grease lubricated.
    c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

3. Enclosure Type: The following features are required:

    a. Open drip-proof motors where satisfactorily housed or remotely

located during operation.

b. Guarded drip-proof motors where exposed to contact by employees or building occupants.

4. Overload protection: Built-in, automatic reset, thermal overload protection.
5. Noise rating: Quiet.
6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B.
7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, roof curbs, equipment supports, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Division 15 Section "Vibration Controls."

1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

a. Installation of roof curbs per Manufacturer’s written instructions.

2. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.03 CONNECTIONS

A. Duct installations and connections are specified in other Division 15 sections. Make final duct connections with flexible connections.

B. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 16.

2. Temperature control wiring and interlock wiring are specified in Division 15 Section "Electrical Control Systems."
3. Temperature control wiring and interlock wiring are specified in Division 15 Section "Pneumatic Control Systems."
4. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

3.05 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.06 COMMISSIONING

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, and other moving parts with factory-recommended lubricants.
6. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
2. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.07 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout" and Division 15 Section "Basic Mechanical Requirements."

B. Schedule training with at least 7 days' advance notice.

END OF SECTION

SECTION 15891
METAL DUCTWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Division-15 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. Exterior insulation of metal ductwork is specified in other Division-15 sections, and is included as work of this section.

C. Refer to other Division-15 sections for exterior insulation of metal ductwork; not work of this section.

D. Refer to other Division-15 sections for ductwork accessories; not work of this section.

E. Refer to other Division-15 sections for fans and air handling units; not work of this section.

F. Refer to other Division-15 sections for testing, adjusting, and balancing of metal ductwork systems; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment

Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

D. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Shop Drawings: Submit 1/4" scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how these modifications ensure that free area, materials, and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 1.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS:

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials that are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations.

2.02 MISCELLANEOUS DUCTWORK MATERIALS:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch takeoff connections. Where 90-degree branches are indicated, provide conical type tees.

C. Duct Liner: Fibrous glass, complying with Thermal Insulation Manufacturers Association (TIMA) AHC-101; of thickness indicated.

D. Duct Liner Adhesive: Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation".

E. Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards, Article S2.11.

F. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. As manufactured by RCD Corporation.

G. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork. As manufactured by RCD Corporation.

H. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

I. Flexible Ducts: Either spiral-wound spring steel with flameproof vinyl sheathing, or corrugated aluminum; complying with UL 181.

1. Where installed in unconditioned spaces other than return air plenums, provide 1" thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

2.03 FABRICATION:

A. Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Pre-assemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop fabricate ductwork of gages and reinforcement complying with SMACNA

"HVAC Duct Construction Standards".

C. Shop fabricate ductwork of gages and reinforcement complying with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction".

D. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

E. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-15 section "Ductwork Accessories" for accessory requirements.

F. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

2.04 FACTORY-FABRICATED LOW PRESSURE DUCTWORK:

A. General: At installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

B. Material: Galvanized sheet steel complying with ASTM A 527, lock-forming quality, with ASTM A 525, G90 zinc coating, mill phosphatized.

C. Gage: 28-gage minimum for round and oval ducts and fittings, 4" through 24" diameter.

D. Elbows: One-piece construction for 90 degrees and 45 degree elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

E. Divided Flow Fittings: 90-degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork that may be incorporated in the work include, but are not limited to, the following:

G. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following:

1. Semco Mfg., Inc.
2. United Sheet Metal Div., United McGill Corp.
3. Or approved equal.

2.05 FACTORY-FABRICATED HIGH PRESSURE DUCTWORK:

A. General: At Installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.

B. Round Ductwork: Construct of galvanized sheet steel complying with ASTM A 527 by the following methods and in minimum gages listed.

Diameter	Minimum Gage	Method of Manufacture
3" to 14"	26	Spiral Lockseam
15" to 26"	24	Spiral Lockseam
27" to 36"	22	Spiral Lockseam
37" to 50"	20	Spiral Lockseam
51" to 60"	18	Spiral Lockseam
Over 60"	16	Longitudinal Seam

1. Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.
2. Fittings and Couplings: Construct of minimum gages listed. Provide continuous welds along seams.

Diameter	Minimum Gage
3" to 36"	20
38" to 50"	18
Over 60"	16

C. Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ASTM A 527, of spirl lockseam construction, in minimum gages listed.

Maximum Width	Minimum Gage
Under 25"	24
25" to 48"	22
49" to 70"	20
Over 70"	18

1. Fittings and Coupling: Construct of minimum gages listed. Provide continuous weld along seams.

Maximum Width	Minimum Gage
Under 37"	20
37" to 50"	18
Over 50"	16

D. Double Wall Ductwork: Construct with outer pressure shell, 1" thick insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ASTM A 527, of spiral lockseam construction, use longitudinal seam for over 59", in minimum gages listed.

Nomimal Duct Diameter	Outer Shell	Inner liner
3" to 12"	26 ga.	24 ga.
13" to 24"	24 ga.	24 ga.
25" to 34"	22 ga.	24 ga.
35" to 48"	20 ga.	24 ga.
49" to 58"	18 ga.	24 ga.
Over 59"	16 ga.	20 ga.

1. Fittings and Couplings: Construct of minimum gages listed. Provide continuous weld along seams of outer shell.

Nominal Duct Diameter	Outer Shell	Inner Liner
3" to 34"	20 ga.	20 ga.
36" to 48"	18 ga.	20 ga.
Over 48"	16 ga.	20 ga.

2. Inner Liner: Perforate with 3/32" holes for 22% open area or solid metal. Provide metal spacers welded in position to maintain spacing and concentricity.

E. Optional Ducts and Fittings: At Installer's option, provided that certified tests by Manufacturer show that rigidity and performance is equivalent to SMACNA and/or ASHRAE standard gage ductwork, provide ducts and fittings as follows:

1. Ducts: Construct of Manufacturer's standard gage, with spiral lock seam and intermediate standing rib.
2. Fittings: Construct by fabricating with spot welding and bonding with neoprene-base cement in lieu of continuous weld seams.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory-fabricated ductwork which may be incorporated in the work include, but are not limited to, the following:

G. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following:

1. Semco Mfg., Inc.
2. United Sheet Metal Div., United McGill Corp.
3. Approved Equal

PART 3 - EXECUTION

3.01 INSPECTION:

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

B. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

D. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

E. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

F. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

1. Where ducts pass through fire-rated floors, walls, or partitions, provide fire-stopping between duct and substrate, in accordance with requirements of Division-7 Section "Fire-stopping".

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

3.03 INSTALLATION OF DUCT LINERS:

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

3.04 INSTALLATION OF FLEXIBLE DUCTS:

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 10'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA's, "HVAC Duct

Construction Standards, Metal and Flexible".

3.05 FIELD QUALITY CONTROL:

A. Leakage Tests: After each duct system, which is constructed for duct classes over 3”, is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than 1% of system design airflow.

3.06 EQUIPMENT CONNECTIONS:

A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.07 ADJUSTING AND CLEANING:

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

C. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

D. Balancing: Refer to Division-15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION

SECTION 15900
BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 General

A. All work of this Division shall be coordinated and provided by the single Building Automation System (BAS) Contractor.

B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15 Sections for details.

C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.

D. If the BAS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

E. Refer to attached requirements from the Orange County Information Systems and Services (ISS) division for all Orange County hardware, software, and network requirements.

1.2 BAS Description

A. The Building Automation System (BAS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BAS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

C. The work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

D. The BAS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be

specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BAS.

E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

F. Manage and coordinate the BAS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

G. The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions.
2. Enterprise-level information and control access.
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
4. Diagnostic monitoring and reporting of BAS functions.
5. Offsite monitoring and management access.
6. Energy management
7. Standard applications for terminal HVAC systems.

H. Acceptable Manufacturers (NO SUBSTITUTIONS)

1) Reliable Controls
2) Honeywell
3) Johnson Controls
4) Automated Logic Controls
5) The Trane Company

1.3 Quality Assurance

A. General

1. The Building Automation System Contractor shall be the primary manufacturer-owned branch office or primary installer of said manufacturer that is regularly engaged in the engineering, programming, installation and service of total integrated Building Automation Systems.
2. The BAS Contractor shall be a recognized national installer and service provider of BAS.
3. The BAS Contractor shall have a branch facility within a 3-hour response time of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
4. As evidence and assurance of the contractor’s ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last six (6) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.

5. The Building Automation System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Automation Systems, and shall be the manufacturer's latest standard of design at the time of bid.

6. Single source responsibility of supplier shall be the complete installation and proper operation of the BAS and control system and shall include debugging and proper calibration of each component in the entire system both existing and new.

7. The Building Automation System contractor shall provide the Owner with 24 months of future software system upgrades as part of their package. The upgrade period shall begin once the final completion has been signed off by the engineer of record for each project.

B. Workplace Safety And Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.

2. The BAS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.

3. The Contractor and its employees and subtrades shall comply with federal, state and local safety regulations.

4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.

5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.

6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.

7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.

8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.

9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BAS Contractor. At a minimum, the Project Manager shall:

Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.

Manage the financial aspects of the BAS Contract.

Coordinate as necessary with other trades.

Be responsible for the work and actions of the BAS workforce on site.

1.4 Work By Others

Note: Include responsibility matrix as required for project coordination and common practice of the specifier.

A) The demarcation of work and responsibilities between the BAS Contractor and other related trades shall be as outlined in the BAS RESPONSIBILITY MATRIX

BAS RESPONSIBILITY MATRIX				
WORK	FURNISH	INSTALL	Low Volt. WIRING/TUBE	LINE POWER
BAS low voltage and communication wiring	BAS	BAS	BAS	N/A
BAS conduits and raceway	BAS	BAS	BAS	BAS
Automatic dampers	BAS	15	N/A	N/A
BAS Current Switches.	BAS	BAS	BAS	N/A
BAS Control Relays	BAS	BAS	BAS	N/A
All BAS Nodes, equipment, housings, enclosures and panels.	BAS	BAS	BAS	BAS
Smoke Detectors	16	16	16	16
Fire/Smoke Dampers	15	15	16	16
Fire Dampers	15	15	N/A	N/A
Fire Alarm shutdown relay interlock wiring	16	16	16	16
Fire Alarm smoke control relay interlock wiring	16	16	BAS	16
Fan Coil Unit controls	BAS	BAS	BAS	16
Unit Heater controls	BAS	BAS	BAS	16
Packaged RTU space mounted controls	15*	BAS	BAS	16
Packaged RTU factory-mounted controls	15*	15	BAS	16
Packaged RTU field-mounted controls	BAS	BAS	BAS	16
Starters, HOA switches	16	16	N/A	16
Control damper actuators	BAS	BAS	BAS	16

1.5 Submittals

A. Shop Drawings, Product Data, and Samples

1. The BAS contractor shall submit its qualifications to the Orange County's Representative after bidding has been completed but prior to the submittal of shop drawings. These qualifications shall be submitted within 15 days of contract award.

2. Once the BAS contractor receives approval from the Owner for their qualifications, the BAS contractor shall submit a list of all shop drawings with submittals dates within 45 days of contract award.

3. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.

4. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BAS work.

5. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BAS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.

6. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

7. The BAS Contractor shall correct any errors or omissions noted in the first review.

8. At a minimum, submit the following:

   a. BAS network architecture diagrams including all nodes and interconnections.
   b. Systems schematics, sequences and flow diagrams.
   c. Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
   d. Samples of Graphic Display screen types and associated menus.
   e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
   f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
   g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
   h. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address

i. Details of all BAS interfaces and connections to the work of other trades.
j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.8 Record Documentation

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BAS provided:
   a. Table of contents.
   b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings on the latest version of AUTOCADD shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
   c. Manufacturers product data sheets or catalog pages for all products including software.
   d. System Operator’s manuals.
   e. Archive copy of all site-specific databases and sequences.
   f. BAS network diagrams.
   g. Interfaces to all third-party products and work by other trades.
2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.9 Warranty

A. Standard Material and Labor Warranty:

1. Provide a two-year labor and material warranty on the BAS.
2. If within twenty-four (24) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the cost of the BAS Contractor.
3. Maintain an adequate supply of materials within 50 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BAS Contractor’s normal business hours.

2. PART 2 - PRODUCTS

2.1 Network Area Controllers (NAC)

A. The Network Area Controller (NAC) shall provide a thin-client, Graphical User Interface (GUI) to the Building Automation System (BAS).

1. Local Access. The NAC shall be installed upon the owner's Local Area Network (LAN) and shall support local operator access using standard web browsers including at a minimum Microsoft Internet Explorer 8.

2. Remote Access. A high-speed connection from the NAC to the Wide Area Network (WAN) shall be provided and maintained by the owner to facilitate remote operator access to the BAS using the standard web browsers including at a minimum Microsoft Internet Explorer 8.

B. The NAC(s) shall meet or exceed the requirements of a BACnet® Operator Workstation (B-OWS) and a BACnet® Building Controller (B-BC).

C. The NAC(s) shall not require any hardware, software or firmware licensing agreements.

D. The NAC(s) shall support the following hardware characteristics as a minimum:

1. One (1) ISO-8802.3 Ethernet Port – 10/100 Mbps

2. One EIA-232 Port – 115.2 Kbps maximum

3. Two EIA-485 Ports – 76.8 Kbps maximum

4. Local onboard and/or expandable hardware inputs/outputs (I/O)

   a. Expandable to a minimum of 96 Inputs and 64 Outputs

5. 8 MB operating RAM

6. 1 MB non-volatile RAM

7. 128 MB Flash EEPROM

E. The NAC(s) shall support the following communication protocols at a minimum:

1. ASHRAE 135-2008 BACnet®

   a. Point-to-Point (PTP)

   b. Master Slave/Token Passing (MS/TP)

   c. Ethernet

   d. BACnet® IP (B/IP)

2. Modbus

   a. RTU (master or slave)

   b. TCP (master or slave)

3. Simple Mail Transfer Protocol (SMTP)

4. Simple Network Management Protocol (SNMP)

5. Hyper Text Transfer Protocol (HTTP)

6. Short Message Service (SMS) – for GSM / GPRS modems

F. The NAC database and all necessary Graphical User Interface (GUI) resources including animations are to be stored on the NAC. Web-enabled applications that require system graphics to be stored on the client machines will not be acceptable.

G. The NAC shall support unlimited access by five (5) simultaneous clients

H. Multiple NAC devices shall be capable of being installed on the same BACnet® internetwork without any separate server applications, separate network management or additional licensing.

1. Browser clients shall have the ability to access any NAC on the internetwork directly

I. The NAC shall provide native BACnet® communications directly with all BACnet® devices on the BACnet® internetwork. Applications that require translation of data, gateways, or mapping of any kind shall not be acceptable.

1. The NAC shall provide BACnet® client and server functionality on all data links without any additional modules or licensing

J. Real-time values displayed on the web browser shall update automatically without requiring a manual “refresh” of the web page.

K. HTML programming shall not be required to create or display system graphics or data on a web page.

L. A new point displayed on a B-OWS graphic screen shall appear automatically on the identical graphic screen served by the NAC with no further programming or file transfer required.

M. The NAC shall be capable of automatically uploading any changes to existing GUI images or animations.

N. The NAC shall support operator interface via the web browser the following at a minimum:

1. Password Protection

a. Multiple-level password access protection shall be provided.

b. Passwords may be exactly the same for all software applications provided to communicate with the internetwork including the web-

based browser interface. Passwords and access credentials shall be able to be imported from the B-OWS to the NAC.

c. A minimum of three (3) levels of access shall be supported with a configurable matrix of operator actions allowed for each access level, broken down into at least 20 possible operator actions

d. A minimum of 128 passwords shall be supported at each NAC

e. Operators will be able to perform only those commands available for their respective passwords.

f. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving an NAC browser interface in an unsupervised logged-in state.

g. The NAC shall be configurable to provide read-only access without requiring log-on

h. Unencrypted passwords shall not be transmitted between the NAC and the client browser

2. Alarming and Event Notification

a. NAC shall be capable of generating configurable automatic and dynamic alarm notification that is presented on-top of any current browsing screens in the form of a pop-up message

b. NAC shall be capable of e-mail and telephonic test message notification of system alarms configurable to include notification class, recipient, inclusive and exclusive times and days as well as transition states (to alarm, to fault, return to normal). Systems that use e-mail and/or text message as the exclusive means of annunciating alarms are not acceptable.

c. System shall provide log of notification messages.

d. Alarm messages shall be in user-definable text and shall be entered either at the B-OWS terminal or via remote communication

e. An alarm summary shall be available to show all alarms including but not limited to whether or not they have been acknowledged

f. System shall provide ability to prioritize and differentiate communications for at least 255 different levels of alarms

g. Alarm messages shall be fully customizable in size, content, behavior and sound.

3. Weekly, Annual and Special Event Exception Scheduling

a. Provide ability to view and modify the schedule for the calendar week and up to 255 special events in a graphical format. Each calendar day and special event shall provide at least six time/value entries per day.

b. Provide the ability for the operator to select scheduling for binary, analog, or multi-state object values.

c. Provide the ability for the operator to designate days, date ranges, or repeating date patterns as exception schedules.

d. Provide the capability for the operator to define special or holiday schedules and to link the BACnet schedule to a BACnet calendar, thereby over-riding weekly schedule programming on holidays defined in the BACnet calendar.

e. There shall be a provision with proper password access to manually override each schedule.

f. Provide the capability to designate any exception schedule to be "Executed Once" then automatically cleared.

g. Provide the ability to name each exception schedule with a user defined term to describe each special event.

4. Trend Log Graphing

a. All data points (both hardware and software) system-wide shall be assignable to a historical trending program by gathering configurable historical samples of object data stored in the local controller (B-BC, B-AAC, B-ASC).

b. All trend log information shall be displayable in text or graphic format. All information shall be able to be printed in black & white or color and exported directly to a Microsoft Excel Spreadsheet.

5. Runtime Log Information

a. B-OWS Software shall be capable of displaying Runtime and On/Off Cycle data of all Binary data points (both hardware and software) system-wide. Runtime logs shall provide the following at a minimum:

1) Total Accumulated Runtime

2) Accumulated Starts Today

3) Total Accumulated Starts

4) Timestamp each Start/Stop and duration of each on/off cycle

5) Monitor equipment status and generate maintenance messages based upon user designated run time

6. Ability to Manually Override any Database point

a. All hardware and software points may be temporarily overridden for a user adjustable configured time period

7. Custom navigation file tree

8. Color Graphical User Interface (GUI)

a. All color graphic displays shall be dynamic with current point data automatically updated from the BACnet internetwork to the browser without operator intervention. Manual operator intervention shall use the same methodology as on the B-OWS application.

b. Depending upon configured access level; the operator shall be able to manually adjust digital, analog or calculated values in the system, adjust values of control loops, override points or release points to automatic mode.

O. The NAC shall provide the capability to create individual user (as determined by the log-on user identification) home pages. Provide the ability to limit a specific user to a defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

P. The NAC shall include an Audit Trail feature that automatically records the time, date, and user, and action associated with all user changes made via Web Browser clients.

Q. The NAC shall store complete help files describing system configuration, and use of the browser interface, the help files shall be served on-line as part of the browser interface.

1. The web browser interface shall include tool tips to describe the functionality of the interface.

2.2 Advanced Applications Controllers (AAC)

A. General

1. Provide a micro-processor based, networkable, custom programmed, BACnet® Advanced Application Controller for each heat pump, packaged rooftop unit, etc, wall-mounted where shown on floor-plans. Each AAC shall include an LCD user interface and all input/output points required to monitor and control each unit as a stand-alone system, according to the specified sequence of operation. In addition AAC's shall allow monitoring and remote control via a supervisory network (BACnet) with a WEB-Based Browser-accessible front end.

2. Provide a 5 year standard manufacturer's warranty for the AAC

B. Network Protocol and Operator Connections

1. The AAC's shall allow direct connection to a host network using BACnet® MS/TP (EIA-485) protocol. The network communication speed shall be operator selectable up to 76.8 kbps.

2. Each AAC shall be BTL tested, and listed to meet the B-AAC Standard Device Profile including BIBBs for this level of device. A Protocol Implementation Conformance statement for the AAC proposed shall be submitted along with shop drawings. Network points to be viewable on each AAC are listed in the sequence of operation, however provide a minimum of 32 Read/Write objects per AAC.

3. Each AAC shall include an externally mounted port allowing operators to connect a laptop computer directly to the AAC for network configuration, custom programming, and trouble-shooting.

C. Hardware Components

1. Provide the following hardware input points at minimum in each AAC:
   a. Room temperature sensor, local or remote 10K thermistor with an accuracy of +/- 0.1 Deg C
   b. User set-point adjustment control with programmable set-point limits
   c. On-board room humidity sensor, with replaceable CMOSense element, overall accuracy of +/- 1.8 % over 10 – 90 % range
   d. On-board room passive infra-red occupancy sensor, with a maximum detection distance of 5m (16.4 ft), and 64 detection zones
   e. In addition to the above, provide 4 user-definable universal inputs capable of accepting 0 -5 VDC, 4 – 20 mA, 10K thermistor, or dry contacts. Refer to the sequence of operation for specific input point requirements.

2. Provide hardware analog and digital output points as required by the sequence of operation, however include the following point types at minimum to allow for future expansion:
   a. Six universal outputs, user-definable as analog or digital
   b. Two additional digital output points
   c. Digital output points shall be dry contacts capable of switching 0.5 Amps at 24 VAC.
3. Provide a large LCD screen for display and adjustment of AAC points and mapped network points. Security codes MUST be provided to prevent unauthorized access from the local LCD screen. Minimum LCD size shall be 128 x 64 pixels. The screen shall be back-lit, however the light may be configured to shut off after a programmable inactive time.

4. Provide push-buttons on the panel face to facilitate navigation, point adjustment, data entry, and switching of operational modes (password protected).

5. AAC memory shall include a minimum 64 Kb RAM for logs and temporary data, and 512 kb flash EEPROM for non-volatile storage of firmware configuration and custom database. Provide a 24 hour clock and 365 day calendar on-board. Clock accuracy shall be +/- 1 second over 24 hours, and system time shall be retained during power outages exceeding 7 years.

6. Provide a software configurable buzzer which shall be set-up to trigger on the occurrence of selected alarms, and shall be audible and acknowledgeable either to all users, or only to those users with sufficient password authority.

7. AAC's shall be capable of monitoring and controlling at least 4 networked, remote temperature sensors, each with adjustable set-point and outputs for zone controls. These networked sensors shall not consume input/output points in the AAC.

D. Custom Configuration

1. Each AAC shall allow custom setup of the primary user interface screen; definition of all points to be monitored, controlled and displayed; alarms; schedules; trends; password access; and programmed sequence of operation as required to optimize the AAC for the specific requirements of this project, and also to allow future modification by the owner. AAC's using canned programs for pre-determined HVAC applications are not acceptable.

2. Each AAC shall allow the following custom set-up at minimum:
   a. Primary User Interface screen set-up, including display of time, system mode, fan mode, primary temperature display, and display of up to 3 additional operator-defined AAC or network points.
   b. ALL physical Inputs AND Outputs of the controller MUST be able to be overridden at the LCD screen for technician checkout of the system locally.
   c. Seven additional user defined point groups, each including up to six AAC or network points per group, to be displayed and adjusted by system users with sufficient password authority. Each group, and each individual point shall be defined to allow/disallow editing and manual override by users, and the password level required. Point definition shall also determine if units are to be displayed, and whether point names are displayed as text, or alternatively using an icon chosen from an on-board list of industry standard symbols.
   d. custom programs of 2000 bytes each, using a BASIC control language, with source code stored on board.
   e. The AAC may be defined with full access by all users without password protection, or with three levels of password protected

access. Each level of access shall be enabled by entering a 4 digit password via the front panel keys. AAC's that require removal of the faceplate to unlock the keyboard are not acceptable.

f. Alarm states shall be defined using AAC custom programming, with the definition including the password level required to acknowledge, reset, and clear alarms. When an AAC alarm condition exists, an alarm icon shall be displayed on all screens.

g. 48 user-definable program-driven variables, with selectable ranges and standard or custom units.

h. user-definable PID controls loops

i. user-definable trend logs, each with 150 samples of 6 points each, and programmable sampling times

j. 8 user-definable runtime logs to accumulate the run-times of selected digital points, and record the time and date of the last 100 changes of state

k. 2 user-definable system groups, 50 points per group, allowing related points to be grouped together on one display for use in network graphics

l. 1 user-definable weekly schedule, including 4 on/off pairs for each weekday, and two additional daily schedules triggered by the annual schedule or by custom programming

m. Override of the unoccupied schedule for a programmed period of time shall be triggered via a front panel button

n. 1 annual schedule, allowing pre-programming of holidays 365 days in advance

2.3 Input Devices

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

2. Outside Air Sensors

   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.

   b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.

   c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

3. Duct Mount Sensors

   a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.

   b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

   c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

4. Averaging Sensors

a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

5. Acceptable Manufacturers: Setra or approved equal.

B. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Veris Industries, and Mamac.

C. Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:
   a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
   b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
   c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
   d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Building Differential Air Pressure Applications (-1” to +1” w.c.)

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
◊ -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
◊ 4-20 mA output.
◊ Maintain accuracy up to 20 to 1 ratio turndown.
◊ Reference Accuracy: +0.2% of full span.
c. Acceptable Manufacturers: Setra or approved equal.

3. Low Differential Air Pressure Applications (0” to 5” w.c.)
a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
◊ (0.00 - 1.00” to 5.00”) w.c. input differential pressure ranges. (Select range appropriate for system application.)
◊ 4-20 mA output.
◊ Maintain accuracy up to 20 to 1 ratio turndown.
◊ Reference Accuracy: +0.2% of full span.
c. Acceptable Manufacturers: Setra or approved equal.

4. Medium Differential Air Pressure Applications (5” to 21” w.c.)
a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
◊ Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
◊ Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
◊ Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
c. Acceptable manufacturers: Setra or approved equal.

D. Flow Monitoring
1. Air Flow Monitoring
a. Duct Air Flow Measuring Stations
◊ Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of

fundamentals, as well as in the Industrial Ventilation Handbook.

◊ Airflow measuring stations shall be fabricated of 14-gauge galvanized steel welded casing with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.

◊ The total pressure measurement side (high side) will be designed and spaced to the Industrial Ventilation Manual 16th Edition, Page 9-5. The self-averaging manifolding will be manufactured of brass and copper components.

◊ The static pressure sensing probes (low side) shall be bullet-nosed shaped, per detailed radius, as illustrated in Industrial Ventilation Manual 16th Edition, Page 9-5.

◊ The main take-off point from both the total pressure and the static pressure manifolds must be symmetrical.

◊ Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.

◊ Installation Considerations

(i) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065" w.c. at 1000 feet per minute, or .23" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. – GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area.

(ii) The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated.

(iii) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.

(iv) Where control dampers are shown as part of the airflow measuring station, opposed blade precision controlled volume dampers integral to the station and complete with actuator, pilot positioner, and linkage shall be provided.

(v) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.

◊ Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ebtron, and Dietrich Standard.

b. Static Pressure Traverse Probe

◊ Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.

◊ Acceptable manufacturers: Cleveland Controls

c. Shielded Static Air Probe

◊ A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

E. Power Monitoring Devices

1. Current Measurement (Amps)

a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.

b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.

◊ Operating frequency – 50 - 400 Hz.

◊ Insulation – 0.6 Kv class 10Kv BIL.

◊ UL recognized.

◊ Five amp secondary.

◊ Select current ration as appropriate for application.

◊ Acceptable manufacturers: Veris Industries

c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:

◊ 6X input over amp rating for AC inrushes of up to 120 amps.

◊ Manufactured to UL 1244.

◊ Accuracy: +.5%, Ripple +1%.

◊ Minimum load resistance 30kOhm.

◊ Input 0-20 Amps.

- ◊ Output 4-20 mA.
- ◊ Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
- ◊ Acceptable manufacturers: Veris Industries or approved equal.

F. Status and Safety Switches

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

b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
c. Acceptable manufacturers: Cleveland Controls or approved equal.

6. Low Temperature Limit Switches
   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.4 Output Devices

A. Actuators

1. General Requirements
   a. Damper and valve actuators shall be electronic as specified in the System Description section.

2. Electronic Damper Actuators
   a. Electronic damper actuators shall be direct shaft mount.
   b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
   c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
   d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick

acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

e. Acceptable manufacturers: Belimo or approved equal.

B. Control Dampers

1. The BAS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BAS Contractor or as specifically indicated on the Drawings.

2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.

4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.

5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Ruskin CD50 and Vent Products 5650.

6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Ruskin CD36 and Vent Products 5800.

7. Multiple section dampers may be jack-shafted to allow mounting of direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. Control Relays

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.

b. Mounting Bases shall be snap-mount.

c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.

d. Contacts shall be rated for 10 amps at 120VAC.

e. Relays shall have an integral indicator light and check button.

f. Acceptable manufacturers: Lectro or approved equal.

2. Lighting Control Relays

a. Lighting control relays shall be latching with integral status contacts.
b. Contacts shall be rated for 20 amps at 277 VAC.
c. The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
d. Lighting control relays shall be controlled by:
   ◊ Pulsed Tri-state Output – Preferred method.
   ◊ Pulsed Paired Binary Outputs.
   ◊ A Binary Input to the Facility Management System shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
e. The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

D. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BAS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Acceptable manufacturers: Advanced Control Technologies or approved equal.

E. External Manual Override Stations

1. External manual override stations shall provide the following:
   a. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
   b. A status input to the Facility Management System shall indicate whenever the switch is not in the automatic position.
   c. A Status LED shall illuminate whenever the output is ON.
   d. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.
   e. Contacts shall be rated for a minimum of 1 amp at 24 VAC.

2.5 Miscellaneous Devices

A. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.

4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

3. PART 3 – EXECUTION

3.1 BAS Specific Requirements

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .

B. Custom Reports:

1. Provide custom reports as required for this project:

C. Actuation / Control Type

1. Primary Equipment
   a. Controls shall be provided by equipment manufacturer as specified herein.
   b. All damper and valve actuation shall be electric.
2. Air Handling Equipment
   a. All air handlers shall be controlled with a HVAC-DDC Controller
   b. All damper and valve actuation shall be electric.
3. Terminal Equipment:
   a. Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.
   b. All Terminal Units shall be controlled with HVAC-DDC Controller)

3.2 Installation Practices

A. BAS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.

3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.

4. Class 2 Wiring

   a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.

   b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.

5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.

6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B. BAS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Automation System shall be taken from panel boards and circuit breakers provided by Division 16.

2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.

3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BAS Raceway

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".

2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

1. Provide fire stopping for all penetrations used by dedicated BAS conduits and raceways.

2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.

4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

.

E. BAS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

   Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BAS Panel Installation

1. The BAS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

2. The BAS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation

2. Locate components of the BAS in accessible local control panels wherever possible.

H. HVAC Input Devices – Genera1

1. All Input devices shall be installed per the manufacturer recommendation

2. Locate components of the BAS in accessible local control panels wherever possible.

3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.

4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.

5. Outside Air Sensors

   a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.

   b. Sensors shall be installed with a rain proof, perforated cover.

6. Medium to High Differential Water Pressure Applications (Over 21" w.c.):

   a. Air bleed units, bypass valves and compression fittings shall be provided.

7. Building Differential Air Pressure Applications (-1" to +1" w.c.):

   a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.

b. The interior tip shall be inconspicuous and located as shown on the drawings.

8. Air Flow Measuring Stations:
   a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
   b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
9. Duct Temperature Sensors:
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
   b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
   c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
   d. The sensor shall be mounted to suitable supports using factory approved element holders.
10. Space Sensors:
   a. Shall be mounted per ADA requirements.
   b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
11. Low Temperature Limit Switches:
   a. Install on the discharge side of the first water or steam coil in the air stream.
   b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
12. Air Differential Pressure Status Switches:
   a. Install with static pressure tips, tubing, fittings, and air filter.

I. HVAC Output Devices

1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Automation System is to be connected to an external control system as an input (such as a chiller control panel), or is

to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 Training

A. The BAS contractor shall provide the following training services:

1. A minimum of one and a half days (12 hours total) of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BAS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.
2. Operational training of the BAS shall include at a minimum: changing set points, overrides, starting and stopping equipment, log in to field controllers when the server or PC is down. The BAS contractor shall be required to develop a training outline for this procedure. The training outline, including the lesson plans and course materials, shall be reviewed and approved by the engineer of record through the submittal process.

3.4 Sequence of Operations

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

ATTACHMENT I

DMZ SECURITY STANDARD

1.0 Purpose - The purpose of this document is to establish requirements that will better manage and secure all platforms within the Orange County Government Board of County Commissioners (OCGBCC). The DMZ is a secure environment with limited access to the OCGBCC internal network.

2.0 Scope - The scope of this document applies to all platforms located within the OCGBCC DMZ.

3.0 Policies

3.1 Activity - Any and all activity within and through the OCGBCC DMZ shall require direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.2 Web Servers - All internal ISS-ESU policies apply to the OCGBCC DMZ and are augmented by the DMZ Security Standard. The following differences are noted:

3.2.1 Microsoft Internet Information Server (IIS) version 5.0 or higher shall be the only platform within the OCGBCC DMZ to run as a Web or FTP server.
3.2.2 All platforms within the OCGBCC DMZ shall be patched immediately upon the release and testing by the ISS-ESU.

3.3 Administrative Rights - ISS-ESU shall be the only group with administrative rights to servers in the DMZ.

3.4 Production Servers - The OCGBCC DMZ shall host production servers only.

3.5 Remote Access - Remote Access to the OCGBCC DMZ shall be allowed only using Microsoft Terminal Services or Microsoft Remote Desktop protocols.

3.6 Traffic

3.6.1 Internet Activity - HTTP/HTTPS/FTP/SMTP/IMAPS are the only protocols allowed from the Internet into the DMZ.
3.6.2 Internal Activity - Traffic using the following protocols from the DMZ to the internal network shall not be allowed: Kerberos, NetBIOS, Microsoft-DS, Microsoft's Well Known Ports (88, 135, 137, 138, 139, 389, 445, 464, 530, 543, 544, 636, 749, 3389), LDAP, RPC, SMB, RDP, HTTP, HTTPS, DNS, JOLT.
3.6.3 Routing

3.6.3.1 All approved access from the DMZ to the internal network shall be routed through a proxy server residing in the DMZ.
3.6.3.2 The Enterprise DMZ proxy server shall only use firewall conduits to access approved resources within the OCGBCC network.

3.7 Data

3.7.1 Any data accessible within the OCGBCC DMZ or directly accessible from it should be encrypted.

3.7.2 Any data accessible within the OCGBCC DMZ or directly accessible from it meeting the following criteria shall be encrypted: Name, addresses, phone numbers, email addresses, birthdates, federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information.

3.7.3 The OCGBCC DMZ shall not have access to data containing bank information.

3.7.4 The OCGBCC DMZ shall not have access to social security information.

3.7.5 The OCGBCC DMZ shall have read only access to live data, if such data is also used by applications residing in the internal OCGBCC network.

4.0 Guidelines

4.1 Should databases in policy 3.7.4 need to receive updates by the OCGBCC DMZ, the write operations should be made to a physically separate “staging” data repository. This separate data repository should contain only updates for the specific records being changed. An application server within the internal network should be used to apply the changes in the staging data repository to the live database.

4.2 The DMZ should access data repositories in the internal OCGBCC network using SQL database calls.

5.0 Enforcement - Any server found within the OCGBCC DMZ that does not met the above criteria shall be immediately disconnected from the OCGBCC DMZ. Any employee found to have violated this policy may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
Bank Information	Checking account numbers, credit card numbers, or any unique number from a bank institution.
HTTP	HyperText Transfer Protocol – The underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions web servers and browsers should take in response to various commands.
HTTPS	HyperText Transfer Protocol over Secure Socket Layer (SSL) – By convention, URLs that require an SSL connection start with https: instead of just http:.
FTP	File Transfer Protocol – The protocol for exchanging files over the Internet. FTP works in the same way as HTTP for transferring web pages from a server to a user's browser and SMTP for transferring electronic mail across the Internet in that, like these technologies, FTP uses the

	Internet's TCP/IP protocols to enable data transfer. FTP is most commonly used to download a file from a server using the Internet or to upload a file to a server.
SMTP	Simple Mail Transfer Protocol – A protocol for sending e-mail messages between servers. In addition, SMTP is generally used to send messages from a mail client to a mail server.
IMAPS	Internet Message Access Protocol – A protocol for retrieving e-mail messages. With IMAP4, you can search through your e-mail messages for keywords while the messages are still on mail server and, then, choose which messages to download to your machine.
LDAP	Lightweight Directory Access Protocol – A set of protocols for accessing information directories.
DNS	Domain Name System (or Service or Server) – An Internet service that translates domain names into IP addresses. Because domain names are alphabetic, they're easier to remember. The Internet however, is really based on numeric IP addresses. Every time you use a domain name, therefore, a DNS service must translate the name into the corresponding IP address.
SQL	Structured query language – SQL is a standardized query language for requesting information from a database.
DMZ	Demilitarized Zone – A computer term used for a protected network that sits between the Internet and the corporate network.
SSL	Secure Sockets Layer – A protocol for transmitting private documents via the Internet. SSL uses a cryptographic system that uses two keys to encrypt data - a public key known to everyone and a private or secret key known only to the recipient of the message.

ATTACHMENT II
ENCRYPTION AND CERTIFICATION AUTHORITIES

1.0 Purpose - The purpose of this document is to ensure that all Orange County Government Board of County Commissioner's (OCGBCC) sensitive data is secured by using strong encryption algorithms that have received substantial public review and have been proven to work effectively. Orange County Information Systems and Services Enterprise Security unit (ISS-ESU) provides access to a variety of Encryption Services and Enterprise Certification Authorities (CA).

2.0 Scope - This document applies to all data transmitted and stored within the OCGBCC information systems. It applies to all OCGBCC employees, consultants, and all other affiliated third parties operating within the OCGBCC information systems and networks.

3.0 Policies

3.1 Activity

3.1.1 Any and all activity within and through the OCGBCC information systems involving encryption shall require direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.1.2 The ISS-ESU shall approve the storage and transfer of any data containing personal information and/or residing in the DMZ.

3.2 Encryption Algorithms

3.2.1 One of the following standard encryption ciphers shall be used to encrypt data. The key length for these algorithms shall be no less than 128bits:

- Triple-DES (3DES)
- Rijndael (AES)
- RSA
- Blowfish
- Twofish
- CAST

3.2.2 PGP is an approved encryption standard provided that the PGP private key used to encrypt and /or sign data has been generated using a cipher meeting the requirements in section 3.2.1.

3.3 Data Hashing - The following standard data hashing algorithms shall be used to hash data. The key length for the algorithms shall be no less than 128bits.

- MD5
- SHA-1
- SHA-2

3.4 SSL Certificates - Web Server, SSH, IMAPS, SMTPS SSL certificates should have key lengths of no less than 128bits.

3.5 Sensitive Data - Any data containing sensitive information, including, but not limited to: name, addresses, phone numbers, email addresses, birthdates,

federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information, should be encrypted when stored and during network transfers.

3.6 DMZ

3.6.1 Any and all activity within and through the OCGBCC DMZ shall require direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).
3.6.2 Any data accessible within the OCGBCC DMZ or directly accessible from it should be encrypted.
3.6.3 Any data accessible within the OCGBCC DMZ or directly accessible from it meeting the following criteria shall be encrypted: name, addresses, phone numbers, email addresses, birthdates, federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information.

3.7 Data Backups

3.7.1 Any backup of OCGBCC should be encrypted. Sensitive data as listed in 3.5 of this document shall be backed up using encryption algorithm standards found in 3.2.

3.8 Laptops and Removal Devices

3.8.1 All laptop hard drives should be encrypted.
3.8.2 Any sensitive data (see section 3.5 of this document) stored on laptops and removable devices shall be encrypted.
3.8.3 All individuals who work with sensitive data (see section 3.5 of this document) shall have their laptop hard drives encrypted.

4.0 Guidelines

4.1 SSL certificates issued to servers and applications used by internet users should be provided by commercial CA authorities (i.e. Verisign, Thawte) to avoid security warnings from being presented to the end users.
4.2 SSL certificates issued to servers and applications used by internal OCGBCC resources should be issued by OCGBCC's Certification Authority.

5.0 Enforcement - Any employee found to have violated these policies may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
Encryption	Transforming understandable data into a form that is incomprehensible and that looks like random noise.
Hashing	An algorithm that takes an entire message and, through process of shuffling, manipulating, and processing the bytes using logical operations, generates a small message digest of the data.

DMZ	De-Militarized Zone – A computer term used for a protected network that sits between the Internet and the corporate network.

Certification Authority (CA) In cryptography, a certificate authority or certification authority (CA) is an entity which issues digital certificates for use by other parties.

ATTACHMENT III
ANTIVIRUS STANDARDS

1.0 Purpose - The purpose of this document is to establish requirements which must be met by all computers connected to the Orange County Government Board of County Commissioners (OCGBCC) network to ensure effective virus detection and prevention.

2.0 Scope - This document applies to all OCGBCC computers running any version of the Microsoft Windows Operating Systems. This includes, but is not limited to, all servers, desktop computers, laptop computers, PC-based printers and appliances.

3.0 Policy

3.1 Virus Software – Servers
Trend Micro Server Protect or Trend Micro OfficeScan shall be installed and enabled on all OCGBCC computers running any server version of the Microsoft Windows Operating Systems.

3.2 Virus Software – Workstations
Trend Micro OfficeScan shall be installed and enabled on all OCGBCC computers running any non-server version of the Microsoft Windows Operating Systems.

3.3 Virus Software – Exchange Servers
Trend Micro ScanMail shall be installed and enabled on all OCGBCC computers running Microsoft Exchange Server.

3.4 Virus Software – Internet Mail
All incoming and outgoing internet email shall be scanned by Trend Micro Interscan Messaging Security Suite before being delivered.

3.5 Virus scanning
Antivirus software shall be running at all times on the computers on which it is installed. Real-time scanning of incoming and outgoing files shall be enabled at all times. Antivirus scans of servers shall be executed on a weekly basis in accordance with the schedules set in Trend Micro Server Protect. Antivirus scans of workstations shall be executed on a weekly basis in accordance with the schedules set in Trend Micro OfficeScan.

4.0 Guidelines

- When employees receive unwanted and unsolicited emails, they should be deleted and should avoid replying to the sender. These messages should not be forwarded.
- Employees should never open any files or macros attached to an email from an unknown, suspicious or untrustworthy source. These attachments should be deleted immediately. These messages should not be forwarded.
- Employees should never download files from unknown or suspicious sources.

5.0 Enforcement - Trend Micro's antivirus products are installed on all servers and workstations during the initial installation of the operating systems, and are continuously monitored to ensure they are running. Any employee or temporary found to have willfully stopped and/or paused these programs will be considered to be violating these policies and may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
Virus	A program or piece of code that is loaded onto your computer without your knowledge and runs against your wishes. Viruses can also replicate themselves. All computer viruses are manmade. A simple virus that can make a copy of its self over and over again is relatively easy to produce. Even such a simple virus is dangerous because it will quickly use all available memory and bring the system to a halt. An even more dangerous type of virus is one capable of transmitting itself across networks and bypassing security systems.

ATTACHMENT IV

WEB SECURITY STANDARD

1.0 Purpose - The purpose of this document is to establish requirements that will better manage and secure all web server platforms within the Orange County Government Board of County Commissioners (OCGBCC).

2.0 Scope - The scope of this document applies to all web server platforms located within the OCGBCC.

3.0 Policies

3.1 Activity - Any and all web server installations, removals or modifications shall require the direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.2 Hardware

3.2.1 All hardware platforms operating as a web server shall abide by all standards, policies and guidelines of the OCGBCC Enterprise Systems unit.

3.2.2 All hardware platforms operating as a web server shall reside on server hardware. Any exception shall require a documented wavier by the Information Systems and Services Enterprise Security unit (ISS-ESU).

3.3 Software

3.3.1 Web Server Platforms

3.3.1.1 Microsoft - Microsoft's Internet Information Server (IIS) is the approved, supported web server platform for OCGBCC.

3.3.1.2 Apache Software Foundation - Apache Software Foundation's HTTP Server (Apache) is approved but is unsupported. Any production use of (Apache) shall include an appropriate support model that is approved by the ISS-ESU.

3.3.1.3 Other - Other web server platforms may qualify for use, but shall require an evaluation, approval and a documented wavier by the ISS-ESU.

3.3.2 Databases

3.3.2.1 Location - A database server shall not reside on the same hardware platform as a web server.

3.4 Security

3.4.1 General - All web servers shall comply with all other documented ISS-ESU standards to include, but not limited to: virus, patch and account management.

3.4.2 Account Management

3.4.2.1 Local Account Access - Only accounts with local administrator privileges shall be allowed to log on locally to a web server.

3.4.2.2 Process/Application Accounts - All web server processes and applications shall run only under a low privilege local account. Web server processes shall not run under an account with domain, power user or a local administrator privileges.

3.4.2.3 Web Server Anonymous Accounts - Web server anonymous accounts shall only have read and execute permissions to folders/files within the web server directories. Change and delete permissions to folders/files that are directly accessible via a web browser shall not be granted to web server anonymous accounts.

3.4.3 Permissions

3.4.3.1 Operating System Permissions - ISS-ESU shall secure the operating system's file/folder permissions and security policies of all web servers. These permissions are to be modified solely by ISS-ESU.

3.4.3.2 Vendor/Third Party Access - Local administrator privileges on web servers are for authorized personnel only. Access to vendors and any other third party shall be provided solely on a temporarily, case-by-case basis through ISS-ESU.

3.4.3.3 Developer Access - Developer access to web server content directories shall be available by WebDav or FrontPage server extensions only. Developers shall be granted "Author Pages" rights with the FrontPage Server Extensions

3.4.4 Java Server Engines - Java server engines are approved but are not supported. Any production use of a Java server engine shall include an appropriate support model that is approved by (ISS-ESU).

3.4.5 FTP - Web servers that also run an FTP server shall not map FTP directories to directories accessible via a web browser.

3.4.6 IIS Virtual Directories, Application Pools, Settings - Any and all creations, removals or modifications to IIS Settings, Virtual Directories, Application Directories, and Application Pools shall require the direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISS-ESU).

3.4.7 Other

- Shares are not allowed on any directory accessible via web browser.
- Microsoft Windows web servers and any web application shall not be installed on the same drive as the host operating system.
- Executable files (.exe, .com, .bat, .dll, etc) shall not be placed into directories accessible via a web browser without the direct involvement and documented approval by the Information Systems and Service Enterprise Security unit (ISSESU).

4.0 Guidelines - It is recommended that all web applications use the enterprise FTP and SMTP servers for all FTP/SMTP traffic.

5.0 Enforcement - Any web server not meeting the above criteria may be immediately disconnected from the OCGBCC network. Any employee found to have violated these policies may be subject to disciplinary action, up to and including termination of employment.

6.0 Definitions

Term	Definition
FTP	File Transfer Protocol – The protocol for exchanging files over the Internet. FTP works in the same way as HTTP for transferring Web pages from a server to a user's browser and SMTP for transferring electronic mail across the Internet in that, like these technologies, FTP uses the Internet's TCP/IP protocols to enable data transfer. FTP is most commonly used to download a file from a server using the Internet or to upload a file to a server.
WebDav	Web-based Distributed Authoring and Versioning – Extensions to HTTP that allows users to collaboratively edit and manage files on remote Web servers.
Front Page Extensions	A series of scripts that can be employed using Microsoft FrontPage, a visual HTML editor.
SMTP	Simple Mail Transfer Protocol – A protocol for sending e-mail messages between servers. In addition, SMTP is generally used to send messages from a mail client to a mail server.

ATTACHMENT V

STANDARDS SUMMARY

The following is a summary of key points in the Orange County Government Board of County Commissioners (OCGBCC) security standards. It is necessary for vendors to completely understand and follow these requirements in order for products or services to be considered for placement within the OCGBCC environment. Complete details about these standards can be found in the Orange County Government Standards and Guidelines packet.

WEB SERVERS

Web and Database Placement
A database server shall not reside on the same hardware platform as a web server.

Anonymous Accounts
Web server anonymous accounts shall only have read and execute permissions to folders/files within the web server directories. Change and delete permissions to folders/files that are directly accessible via a web browser shall not be granted to web server anonymous accounts.

DMZ

Web Server Platforms
Microsoft Internet Information Server (IIS) version 5.0 or higher shall be the only platform within the OCGBCC DMZ to run as a Web or FTP server.

Services and Protocols
Traffic using the following protocols from the OCGBCC DMZ to the internal network shall not be allowed: Kerberos, NetBIOS, Microsoft-DS, Microsoft's
Well Known Ports, LDAP, RPC, SMB, RDP, HTTP, HTTPS, DNS, JOLT.

Encrypted Data
Any data accessible within the OCGBCC DMZ or directly accessible from it meeting the following criteria shall be encrypted: Name, addresses, phone numbers, email addresses, birthdates, federal/state/local document numbers, account numbers, race or religious information, employee identification numbers and all HIPAA information. The OCGBCC DMZ shall not have access to data containing bank information. The OCGBCC DMZ shall not have access to social security information.

Data Access
The OCGBCC DMZ shall have read only access to live data, if such data is also used by applications residing in the internal OCGBCC network.

ANTIVIRUS

Virus scanning
Antivirus software shall be running at all times on the computers on which it is installed.

MICROSOFT SECURITY PATCHES

Patch Installation

MS Security patches may be applied immediately upon release by Microsoft. All vendors must support their applications in this environment.

ATTACHMENT VI

DESKTOP COMPUTING STANDARDS

AUTHORIZED PRODUCTS

1: HARDWARE

Dell Desktop minitower and small form factor (SFF) PC

- Dell GX960
  - Energy Smart system enabled
  - Intel Core 2 Duo processor or better
  - Minimum 2 Gb of Memory
  - Maximum 4 Gb Memory
  - USB Keyboard and Mouse
  - 160 GB SATA Hard drive
  - DVD+/- RW
  - 4 Year Basic Limited Warranty and 4 year Onsite Service
  - Intel vPro enabled

Dell Laptop

- Dell Latitude e6510
  - Intel Core 2 Duo processor or better
  - Minimum 2 Gb of Memory
  - Maximum 4 Gb of memory
  - CD-RW/DVD
  - 80 GB Hard Drive
  - 4 Year Limited Warranty and 4 year Onsite Service
  - Intel vPro enabled
- Dell Latitude e4300
  - Intel Centrino Core 2 Duo processor
  - Minimum 2 Gb memory
  - Maximum 4 Gb memory
  - CD-RW/DVD
  - 80 Gb Hard Drive
  - 4 Year Limited Warranty
  - Intel vPro enabled
    - *All PCs with 4yr limited warranty*

- PDAs- Blackberry Devices Only

2: OPERATING SYSTEMS and PROTOCOLS

Desktop/Laptop

- Microsoft Windows 7 Professional with IE 8 (for new PCs)
- Microsoft Windows XP Service Pack 3 (for existing PCs)
- Internet Explorer 8.0- *IE8 is current County Standard included with Windows 7. IE7 is available for backwards compatibility.*
  - *Application software may specifically require a certain Internet Explorer version. Contact ISS for assistance as needed.* *ServiceCenter@ocfl.net*

- Microsoft Office 2003 or greater (Standard or Professional Suite)

Portable Devices

- Blackberry OS

Network Connectivity

- Cisco Wireless Access Points, Cisco 802.11 LAN Card
- TCP/IP
- Sprint Wireless AirCard

3: CLIENT DATABASES

Desktop/Workstations Only, Single User Only

- Microsoft Access (user databases not supported)
- Oracle Client
- SQL Server Client

4: PERIPHERALS and ACCESSORIES

- HP LaserJet series
  - Black and White LaserJet
    - P1606dn < 4 users
    - P3015dn (supports secure printing – PIN)
    - P4015dn 8+ users (supports secure printing – PIN)
  - Color LaserJet
    - CP2025dn
    - CP4525dn 7+ users (supports secure printing – PIN)
    - 5550dn 15+ users (supports secure printing – PIN)
- *Desktop Copier and combo unit purchases directly connected to the PC must be reviewed and approved by ISS. Contact ServiceCenter@ocfl.net for more information and assistance.*

UNSUPPORTED PRODUCTS

1: HARDWARE

- Pre-Pentium class desktop systems
- Non-Dell PCs
- Non-Blackberry Smartphones

2: OPERATING SYSTEMS AND PROTOCOLS

- Microsoft Windows 2000
- Microsoft Windows NT 4.0
- Microsoft Windows 3.x, Windows 95 and 98
- MAC OS

3: CLIENT DATABASES

- Dbase
- RBASE
- Paradox
- FOXPRO

4: DESKTOP APPLICATIONS

Desktop/Workstation

- MS Office platforms prior to Office 2000
- ProComm
- Microsoft Internet Explorer, 4.x, 5.x
- McAfee Viruscan **Trend Micro is OCGOV standard*
- WordPerfect
- Quattro
- Hotmetal
- Freelance
- Harvard Graphics
- Lotus Suite
- Netscape, Opera, Firefox Browsers
- Rumba
- LAN Workplace
- Exceed
- Visio 3.x and older
- SHL Vision & Vision Express, WIN9x/WINNT/UNIX
- McAfee Remote Desktop32
- Reflection version 9 or lower
- PC Anywhere

5: PERIPHERALS AND ACCESSORIES

- HP LaserJet Series 4 and older printers
- Inkjet printers

PROHIBITED PRODUCTS

1: HARDWARE

- Personal (non-County) PCs
- Any network (voice or data) device not operated, administered or expressly approved by Orange County ISS.
- Any internet access device not operated, administered or expressly approved by Orange County ISS.

2: OPERATING SYSTEM AND PROTOCOLS

- Windows 9x
- Windows Vista
- 64 bit operating systems

Network Protocols

- NETBUI
- AppleTalk
- Token Ring
- Any network (voice or data) software or service not operated, administered or expressly approved by Orange County ISS.
- Any internet access service not operated, administered or expressly approved by Orange County ISS.

3: APPLICATIONS

- Any Alpha/Beta Software not operated, administered or expressly approved by Orange County ISS
- Anti-virus products other than Trend Micro
- Personal firewall products
- Network scanning tools
- Remote access software other than ISS authorized VPN
- User installed screen savers
- Games
- 3rd Party Desktops
- Disk Compression
- Non-Static BITMAP Backgrounds or screen savers
- iTunes (or other content sharing applications)
- P2P software

4: PERIPHERALS AND ACCESSORIES

- Portable music devices
- Personal (non-County) mass storage devices (hard drives, thumb drives, etc)
- Webcams

SECTION 15910
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including Division 1 Specification section apply to work of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Dampers:

    a. Low pressure manual dampers.
    b. Control dampers.

2. Fire dampers.
3. Turning vanes.
4. Duct hardware.
5. Duct access doors.
6. Flexible connections.

C. Refer to other Division 15 sections for testing, adjusting and balancing of ductwork accessories; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction
   Standards, Metal and Flexible".
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems" pertaining to installation of ductwork accessories.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction and installation instructions.

B. Shop Drawings: Submit manufacturers assembly type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts list for each type of duct accessory. Include this data, product data, and shop drawing in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS:

2.01 DAMPERS:

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

2.02 FIRE DAMPERS:

A. Fabricated Fire Dampers: Provide dampers constructed in accordance with SMACNA "Fire Dampers and Heat Stop Guide".

B. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casing of 11 ga. galvanized steel with bonded red acrylic enamel finish. Provide fusible link rated at 160 to 165 degrees F. (71 to 74 degrees C) unless otherwise indicated. Provide damper with positive lock in closed position, and with the following additional features.

1. Damper Blade Assembly: Single blade type.
2. Damper Blade Assembly: Multi-blade type.
3. Damper Blade Assembly: Curtain type.
4. Blade Material: Steel, match casing.
5. Blade Material: Stainless steel.

C. Fire/Smoke Dampers: Provide fire dampers, of types and sizes indicated. Construct casing of 11 ga. galvanized steel with bonded red acrylic enamel finish. Provide fusible link rated at 160 to 165 degrees F. (71 to 74 degrees C) unless otherwise indicated. Provide additional flangible link containing explosive charge, connected in series with fusible link. Provide stainless steel spring loaded leakage seals in sides of casing, and 36" long wire leads for connecting smoke link to smoke detector, and the following additional features:

1. Damper Blade Assembly: Single blade type.
2. Damper Blade Assembly: Multi-blade type.
3. Damper Blade Assembly: Curtain type.
4. Blade Material: Steel, match casing.

5. Blade Material: Stainless steel.
6. Factory installed electric damper actuator (normally closed).

2.03 TURNING VANES:

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

B. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set at 2" o.c., and set into side strips suitable for mounting in ductwork.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusions with perforated faces and fiberglass fill.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering turning vanes which may be incorporated in the work include, but are not limited to the following:

1. Aero Dyne Co.
2. Airsan Corp.
3. Anempstat Products Div.; Dynamics Corp. of American
4. Barber -Coleman Co.
5. Duro Dyne Corp.
6. Environmental Elements Corp.; Subs. Koppers Co., Inc.
7. Hart & Cooley Mfg. Co.
8. Register & Grille Mfg. Co., Inc.
9. Souther, Inc.

2.04 DUCT HARDWARE:

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to, the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.
3. Crown Products Inc.
4. Approved Equal

2.05 DUCT ACCESS DOORS:

A. General: Provide where indicated, duct access doors of size indicated.

B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle type latch for doors 12" high and smaller, 2 handle type latches for larger doors.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct access doors which may be incorporated in the work include, but are not limited to the following:

1. Air Balance, Inc.
2. Duro Dyne Corp.
3. Register & Grille Mfg. Co., Inc.
4. Ruskin Mfg. Co.
5. Ventfabrics, Inc.
6. Zurn Industries, Inc.; Air Systems Div.

2.06 FLEXIBLE CONNECTIONS:

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene coated flameproof fabric crimped into duct flanges for attachment to duct equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering flexible connections which may be incorporated in the work include, but are not limited to, the following:

1. American/Elgen Co.; Energy Div.
2. Duro Dyne Corp.
3. Flexaust (The) Co.
4. Ventfabrics, Inc.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES:

A. Install ductwork accessories in accordance with manufacturer's installation instruction, with applicable portions of details of construction as shown in SMACNA Standards, and in accordance with recognized industry practices to

ensure that products serve intended functions.

B. Install turning vanes in square or rectangular 90 degree elbows in supply and exhaust air systems and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL:

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.04 ADJUSTING AND CLEANING:

A. Adjusting ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

1. Label access doors in accordance with Division 15 section "Mechanical Identification".
2. Final positioning of manual dampers is specified in Division 15 section 'Testing, Adjusting and Balancing".

B. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch up paint.

3.05 EXTRA STOCK:

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION

SECTION 15932
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 DESCRIPTION OF WORK:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of air outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall Registers and grilles.

C. Refer to other Division 15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division 15 sections for balancing of air outlets and inlets; not work of this section.

1.03 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.04 CODES AND STANDARDS:

A. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

B. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

C. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

D. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.

E. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating System".

1.05 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size and accessories furnished.
2. Data sheet for each type of air outlet and inlet and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Samples: Submit 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 CEILING AIR DIFFUSERS:

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffuser where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have as minimum, temperature and velocity traverses, throw and drop, and noise criteria rating for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each

type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Diffuser Faces:

a. Panel (PL): Square or rectangular aluminum housing extended to form panel to fit in ceiling system module, core of square or rectangular concentric louvers, round duct connection.
b. Linear (R): Extruded aluminum continuous slot, single or multiple.

2. Diffuser Mountings:

a. Flush (FL): Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
b. Lay-In (L-I): Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

3. Diffuser Patterns:

a. Fixed (FX): Fixed position core with concentric rings or louvers for radial airflow around entire perimeter of diffuser.

4. Adjustable (ADJ): Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical air flow.

E. Diffuser Dampers:

1. Opposed Blade (OBD): Adjustable opposed blade damper assembly, key operated from face of diffuser.

F. Diffuser Accessories:

1. Operating Keys (OP-KY): Tools designed to fit through diffuser face and operate volume control device and/or pattern adjustment.

G. Diffuser Finishes:

1. Aluminum Enamel (A-E): Air-dried aluminum enamel prime finish.

H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to the following:

1. Titus Products Div.; Philips Industries, Inc.
2. Price Companies
3. Metal Air Industries, Inc.

2.02 WALL OR CEILING REGISTERS AND GRILLES:

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall or ceiling systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

D. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

E. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register and Grille Materials:

    a. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Register and Grille Faces:

    a. ½” x ½” x ½” aluminum egg crate pattern core.
    b. Horizontal Straight Blades (H-S): Horizontal blades, individually adjustable, at manufacturer's standard spacing.

3. Register and Grille Dampers:

    a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of register.

4. Register and Grille Accessories:

    a. Operating Keys (OP-KY): Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustment.
    b. Filters: 1” frame for mounting 30% efficiency filter media. Provide hinged face grille for filter access.

5. Register and Grille Finishes:

a. Aluminum Enamel (A-E): Air-dried aluminum enamel prime finish.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering registers and grilles which may be incorporated in the work include, but are not limited to the following:

1. Titus Products Div.; Philips Industries, Inc.
2. Price Companies
3. Metal Air Industries, Inc.

2.03 LOUVERS

A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide louvers that have minimum free area, and maximum pressure drop for each type as listed in manufacturer's current data, complying with louver schedule.

C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

D. Materials: Construct of aluminum extrusions, ASTM B 221, Allou 6063-T52. Weld units or use stainless steel fasteners.

E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering louvers which may be incorporated in the work include, but are not limited to the following:

1. Arrow United Industries
2. Airolite Co.
3. Dowco Corp.
4. Industrial Louvers, Inc.
5. Louvers & Dampers, Inc.
6. Penn Ventilator Co., Inc.
7. Ruskin Mfg. Co.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be

installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans" or as shown on HVAC drawings. Unless otherwise indicated, locate unite in center of acoustical ceiling modules.

3.03 SPARE PARTS:

A. Furnish to owner, with receipt, operating keys for each type of air outlet and inlet that require them.

END OF SECTION

ORANGE COUNTY – FS #31
HVAC REPLACEMENT

SECTION 15990
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Related Sections:

1. General requirements for testing agencies are specified in the Division-1 Section Quality Control Services.
2. Other Division-15 Sections specify balancing devices and their installation, and materials and installations of mechanical systems.
3. Individual Division-15 system sections specify leak testing requirements and procedures.

1.02 SUMMARY:

A. This Section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

B. Test, adjust, and balance the following mechanical systems:

1. Supply air systems;
2. Return air systems;
3. Exhaust air systems;
4. Verify temperature control system operation.

C. Test systems for proper sound and vibration levels.

D. This Section does not include:

1. Specifications for materials for patching mechanical systems;
2. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.

1.03 DEFINITIONS:

A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

1. The balance of air distribution;
2. Adjustment of total system to provide design quantities;
3. Electrical measurement;
4. Verification of performance of all equipment and automatic controls;
5. Sound and vibration measurement.

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

D. Balance: To proportion flows within the distribution system submains, branches, and terminals according to specified design quantities.

E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

G. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

H. Main: Duct or pipe containing the system's major or entire fluid flow.

I. Submain: Duct containing part of the systems' capacity and serving two or more branch mains.

J. Branch main: Duct serving two or more terminals.

K. Branch: Duct serving a single terminal.

1.04 SUBMITTALS:

A. Agency Data:

1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

B. Engineer and Technicians Data:

1. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and

balancing procedures and agenda proposed to be used for this project.

D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1 and Section 15010.

E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the AABC are proposed.

F. Sample Forms: Submit sample forms, if other than those standard forms prepared by the NEBB are proposed.

G. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

    a. General Information and Summary
    b. Air Systems
    c. Temperature Control Systems
    d. Special Systems
    e. Sound and Vibration Systems

4. Report Contents: Provide the following minimum information, forms and data:

    a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and

signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.

H. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.05 QUALITY ASSURANCE:

A. Test and Balance Engineer's Qualifications: A Professional Engineer (either on the installer's staff or and independent consultant), registered in the State in which the services are to be performed, and having at least 3-years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.

B. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB as a Test and Balance Engineer.

C. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
2. An independent testing, adjusting, and balancing agency certified by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by AABC as a Test and Balance Engineer.

D. Codes and Standards:

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
2. AABC: "National Standards For Total System Balance".
3. ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

E. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect/Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.06 PROJECT CONDITIONS:

A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.07 SEQUENCING AND SCHEDULING:

A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS

A. Not Used.

PART 3 - EXECUTION

3.01 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:

A. Before operating the system, perform these steps:

1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
2. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.
3. Compare design to installed equipment and field installations.
4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
5. Check filters for cleanliness.
6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
7. Prepare report test sheets for both fans and outlets. Obtain manufacturer's

outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

8. Determine best locations in main and branch ductwork for most accurate duct traverses.
9. Place outlet dampers in the full open position.
10. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
11. Lubricate all motors and bearings.
12. Check fan belt tension.
13. Check fan rotation.

3.02 MEASUREMENTS:

A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

B. Provide instruments meeting the specifications of the referenced standards.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.

G. Take all reading with the eye at the level of the indicated value to prevent parallax.

H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

I. Take measurements in the system where best suited to the task.

3.03 PERFORMING TESTING, ADJUSTING, AND BALANCING:

A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation, ductwork, and housings, using materials identical to those removed.

D. Seal ducts and piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.04 TESTING FOR SOUND AND VIBRATION:

A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

3.05 RECORD AND REPORT DATA:

A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.

B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.06 DEMONSTRATION:

A. Training:

1. Train the Owner's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with the Owner's personnel, the information contained in the Operating and Maintenance Data specified in Division 1 and Section 15010.
2. Schedule training with Owner through the Architect/Engineer with at least 7 days prior notice.

END OF SECTION

ORANGE COUNTY – FS #31
HVAC REPLACEMENT

SECTION 16010
GENERAL PROVISIONS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The work covered under this Division of the Specifications is intended to include the furnishing of all materials, equipment and labor necessary for or reasonably incidental to, the installation of a complete and fully operative electrical system as indicated on the drawings and specified in this section.

1. The work shall consist generally of, but is not limited to, the following major items:

a. Conduit and Wiring.
b. Lightning Protection.

B. Work Not Included:

The following work is not included in this Section:

1. Temperature controls and related wiring.

C. Fees and Permits:

1. Obtain all permits required for his/her work and include the cost of same in his/her bid.
2. The contractor shall also include in his/her bid the cost for the power company service.

D. Certificate of Inspection:

The Contractor shall, at his/her expense, have a final inspection made of the complete electrical installation and shall deliver a certificate of approval of the complete work to the Owner before receiving his/her final payment.

1.02 SUBMITTALS

A. Submit properly identified manufacturer's literature and technical data before commencing work.

B. Shop Drawings:

1. Submit copies of manufacturer's drawing of lighting fixtures, main distribution boards, safety switches, panelboards, conduit, wire, wiring devices, fire alarm and voice evacuation system, lighting control system and any other special electrical equipment to be installed, and shall receive the Project Architect's acceptance before ordering the same for installation.

2. All shop drawings shall be submitted in 3-ring binders with each specification

section indicated with tabs.

3. If shop drawings are submitted intermittingly and not in 3-ring binders, they will not be reviewed and will be returned to contractor for proper submittal.

4. Accepted Equivalent:

Any manufacturer and/or catalog number listed on the drawings or in the Project Manual shall be construed to mean "or accepted equivalent".

a. Any substitutions to be considered as "Accepted Equivalent" shall be submitted with both the cut of the proposed substitution and a cut of the specified equipment to the Project Architect in writing, and returned to the Contractor at least ten days prior to bid opening.

b. No substitutions shall be submitted or will be allowed after the contract has been awarded.

1.03 QUALITY ASSURANCE

A. Qualifications of manufacturers, materials and equipment:

1. Material and equipment, except as herein otherwise noted, shall be new and conform to standards specified herein defined to include conduits, cable, wiring materials and devices, panelboards, and the like.

2. Materials and equipment shall be of an approved design.

a. Similar materials shall be of one manufacturer wherever possible.

3. Equipment offered under these Specifications shall be limited to products regularly produced and recommended for service ratings in accordance with manufacturer's catalogs, engineering data, or other comprehensive literature made available to the public and in effect at the time of opening of bids.

4. Install equipment in strict accordance with manufacturer's instruction for type, capacity and suitability of each piece of equipment used.

a. Obtain these instructions that shall be considered a part of these Specifications.

B. Qualifications of supervisor, workmanship and installers:

1. The Contractor shall have a Master Electrician constantly supervising the work covered by these Specifications, and so far as possible shall keep the same foreman on the job from start to finish.

a. The workmanship of the entire job shall be first class in every way and only experienced and competent workers shall be employed for the work.

1.04 CODES AND REGULATIONS

A. Work shall be installed in accordance with the regulations and requirements of the National Electrical Code NFPA No. 70; Life Safety Code NFPA No. 101, Standard Building Code as well as all rules, state and local codes regulations and requirements of the telephone and power companies.

B. Where conduits and/or cables penetrate fire rated walls, ceilings or floors, the penetrations shall be firestopped in accordance with chapter 10, section 1001 of the standard building code.

1. The above shall be ascertained and fully coordinated before the installation of any material, equipment, and the like, and any discrepancy shall be immediately brought to the attention of the Project Architect in writing, and the Contractor shall receive a disposition of same before proceeding with the work.

2. Furnish, without additional charge, any additional materials and labor that may be required for compliance with these codes, law, rules, regulations or requirements even though the work is not mentioned in these Specifications or shown on the Drawings.

C. Material and equipment shall bear the label of approval of the National Board of Fire Underwriters Laboratory.

1.05 INSPECTIONS

A. All work and materials covered by these Specifications and shown on the Drawings shall be subject to inspection at any and all times by representatives of the Project Architect or Owner.

B. If the Project Architect or Owner's inspectors find that any material does not conform with these Specifications, the Contractor shall within three days after being notified by the Project Architect or Owner, remove the material from the premises, and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.

C. Tests:

The Owner reserves the right to inspect and test any portion of the equipment during the progress of this work.

1. The Contractor shall test the entire system in the presence of the Owner or the Owner's representative when the work is completed to insure that all portions are free from short circuits and grounds.

2. All equipment, material and labor necessary to conduct the above tests shall be furnished at the Electrical Contractor's expense.

1.06 PRODUCT HANDLING

A. Protection of Equipment, Material and Work: The Contractor shall effectively protect, at his/her own expense, much of his/her work, materials or equipment, as is liable to injury during the construction period.

1. Openings into any part of the conduit system as well as associated fixtures, equipment, and the like, both before and after being set in place, shall be securely covered or otherwise protected to prevent obstruction of the conduit, or injury due to carelessness or maliciously dropped tools or materials, grit, dirt, or any foreign matter.

a. The Contractor will be held responsible for all damage done until his/her work is fully and finally accepted.

2. Cover conduit ends with capped bushings.

B. Repair of damage: In the event of damage, repair shall be made immediately, to the Project Architect's satisfaction and at no additional cost to the Owner.

C. Special Handling: Special care, storage and handling of new and existing lighting fixtures shall be taken to minimize breakage of lenses and lamps shipped with fixtures.

1. Immediately replace any breakage with the exact lens or lamp. Used material is not an acceptable replacement.

1.07 JOB CONDITIONS

A. Accuracy of Data: The data given herein and on the Drawings are as exact as could be secured.

1. The Specifications and Drawings are for the assistance and guidance of the Contractor.

2. Exact locations, distances, levels, and the like, will be governed by the building field conditions and the Contractor shall use the data contained herein with this understanding.

B. Drawings:

1. The electrical drawings are diagrammatic, but shall be followed as closely as actual construction and work of other Contractors will permit.

2. Deviations from drawings required to make the work of the Contractor conform to the building as constructed, and to the work of other contractors, shall be made by the Contractor at his/her expense.

3. The branch circuit wiring and arrangements of home runs have been worked out for maximum economy consistent with adequate sizing for voltage drop, and the like. Maximum number of single phase branch circuits per home-run conduit shall be (3) three.

4. Install the wiring circuits arranged exactly as shown on the drawings.

5. It is not the intention of the drawings or specifications to indicate each piece of conduit, fittings, and the like, required for the satisfactory operation of the installation and whereby one is indicated, but not specified, or specified but not indicated on the drawings, it shall be considered to be both specified and indicated.

C. Measurements:

1. Review the Contract Drawings and Specifications and visit the job site to ascertain all conditions, including conduit runs, interfacing, interferences, conflicts, discrepancies, etc., and shall report the same to the Engineer for clarification ten days prior to submittal of the bid.

2. Failure to comply with this condition shall constitute an acceptance of the conditions and any necessary changes will be at Contractor's expense.

3. The Contractor shall make all measurements necessary for his/her work and shall assume responsibility for their accuracy.

4. Install necessary pull boxes, manholes and junction boxes as may be required to accomplish the distribution system indicated on the riser diagram.

D. Structural difficulties: Should any structural difficulties prevent the setting of cabinets, running conductors, and the like, at points indicated on the drawings, the necessary deviation therefrom, as determined by the Project Architect will be permitted and shall be made without additional cost.

E. Cooperation with Other Contractors

1. The Contractor shall arrange all parts of his/her work in proper relation to the work of other contractors.

2. Where interferences occur, the Contractor shall, before installing the work involved, consult with the Project Architect as to exact location and level of his/her work.

3. The Project Architect's decision will be final.

4. The Contractor shall be responsible for arrangement of his/her work and equipment and maintenance of proper headroom under this work.

5. Should work installed by him/her require any modifications to avoid interference with the other work, such changes shall be made without additional cost.

6. The Architect's decision as to determination or allocation or responsibility where conditions require changing of work, shall be final.

7. If any work of the Contractor is dependent for its proper execution on contiguous work, examine such work and report in writing any defect thereon or conditions rendering it unsuitable.

8. The beginning of work, without making such report, shall constitute an acceptance of such work, and any defects in his/her own work consequently shall be his/her responsibility.

1.08 TEMPORARY SERVICE

A. Temporary power: Provide, maintain and remove after construction is completed, a temporary lighting, receptacle and power system in accordance with the progress schedule.

1. Lighting: An average of one hundred watt bulb every 200 square feet and a duplex receptacle every 500 square feet.

2. Receptacles: Ground fault interrupter type.

3. Three Phase Power for Testing Motors: Provided at all necessary points.

B. Temporary telephone service: Each respective trade shall be responsible for providing and maintaining their telephone services.

1.09 CLEANING

A. Keep the premises free of debris and unusable materials resulting from the work, and immediately upon completion of the work remove such debris and material from the site and leave floors broom clean in areas affected by the work.

1.10 GUARANTEE

A. Leave the electrical installation in proper working order and without charge, replace any work or materials which develop defects within one year from date of final inspection and acceptance by the Owner.

1.11 WARNING SIGNS

A. Provide at each Electrical equipment room with a laminated plastic sign, red face with white letters.

1. Place the sign on the entry side of the door, 5'-0" above floor and hold in place with adhesive and six tamper-proof stainless steel screws.
2. Letters: Minimum 1-1/4" high by .060 wide.
3. Sign shall read:

ELECTRICAL ROOM
DANGER
HIGH VOLTAGE

1.12 DEFINITIONS

A. In this Division "provide" is used as a term contraction meaning "to furnish, install and connect up completely in the specified or in an approved manner for the item and/or material described".

PART 2 - PRODUCTS Not Used

PART 3 - EXECUTION Not Used

END OF SECTION

SECTION 16110
RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. This section is a Division 16 Basic Electrical Materials and Methods section, and is part of each Division 16 section making reference to electrical raceways specified herein.

1.02 DESCRIPTION OF WORK

A. Extent of raceway work is indicated by drawings and schedules.

B. Types of raceway specified in this section include the following:

1. Rigid metal conduit.
2. Intermediate metal conduit.
3. PVC coated metal conduit.
4. Flexible metal conduit.
5. Liquid tight flexible metal conduit.
6. Electrical metallic tubing (EMT).
7. Rigid nonmetallic conduit (PVC).
8. Surface Metal Raceway

C. Electrical nonmetallic tubing (ENT) is not acceptable.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Contractor shall submit a letter during submittal phase stating that all installers have a minimum of 5 years experience in the installation of their work.

1.04 CODES AND STANDARDS

A. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.

B. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL listed and labeled.

C. NEC Compliance: Comply with applicable requirements of NFPA-70 pertaining to construction and installation of raceway systems.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions for each type of raceway system required. Include data substantiating that materials comply with requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide raceways and fittings, of types, sizes, and weights (wall thickness) for each installation indicated. Where types are not indicated, provide proper selection determined by installer to fulfill installation requirements and comply with applicable portions of NFPA-70 for raceways.

B. All conduits and fittings shall bear the U.L. label or seal.

C. Minimum trade size raceway shall be 1/2".

D. Where conduit size is not indicated on plan, size conduit in accordance with NFPA-70, except no conduit smaller than 3/4" shall be embedded in concrete or masonry or installed below grade.

2.02 RIGID METAL CONDUIT

A. Provide zinc coated or hot-dipped galvanized type rigid steel conduit conforming to Federal Specification WW-C-581, ANSI C80 and U.L.6.

B. Provide threaded type zinc plated or hot-dipped galvanized malleable iron or steel fittings conforming to Federal Specification W-F-408.

1. Use Type 1 fittings for raintight connections.
2. Use Type 2 fittings for concrete tight connections.
3. Use Type 3 fittings for other miscellaneous conditions.

C. Provide insulated bushings on all rigid steel conduits terminating in panels, boxes, wire gutters, or cabinets.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.03 INTERMEDIATE METAL CONDUIT

A. Provide zinc coated or hot-dipped galvanized type intermediate steel conduit conforming to Federal Specification WW-C-581 and U.L. 1242.

B. Provide threaded type zinc plated or hot-dipped galvanized, malleable iron or steel

fittings.

C. Provide insulated bushings on all intermediate steel conduits terminating in panels, boxes, wire gutters, or cabinets.

D. Provide zinc plated or hot-dipped galvanized malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.04 PVC COATED METAL CONDUIT

A. Provide hot-dipped galvanized type rigid steel conduit with external PVC coating (20 mil. thick) conforming to Federal Specification WW-C-581, ANSI C80.1, U.L. 6, and NEMA RN1.

B. Provide threaded type zinc plated or hot-dipped galvanized, malleable iron or steel fittings with external PVC coating (20 mil. thick).

C. Provide insulated bushings on all PVC coated metal conduits terminating in panels, boxes, wire gutters, or cabinets.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.05 FLEXIBLE METAL CONDUIT

A. Provide flexible steel conduit formed from continuous length of spirally wound, interlocked zinc coated strip steel and conforming to Federal Specification WW-C-56 and U.L. 1.

B. Provide threadless hinged clamp type fittings for use with flexible steel conduit.

1. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, male threaded end provided with locknut, and insulated throat connections for terminations.
2. 45 deg. Or 90 deg. Angle Terminal Connectors: Two piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, male threaded end provided with locknut, and insulated throat connections for terminations.

2.06 LIQUID TIGHT FLEXIBLE METAL CONDUIT

A. Provide liquid tight flexible metal conduit constructed from a continuous, flexible, interlocked, single strip and double wrapped steel, galvanized inside and outside, coated with liquid tight jacket of flexible polyvinyl chloride (PVC), and conforming to U.L. 360.

B. Provide compression type cadmium plated, malleable iron fittings with neoprene gasket sealing rings, and complying with ANSI/NEMA FB1 and U.L. 5148.

C. Provide insulated throat connectors for terminations.

2.07 ELECTRICAL METALLIC TUBING

A. Provide galvanized steel tubing conforming to Federal Specification WW-C-563, ANSI C80.3, and U.L. 797.

B. Provide set screw or compression type zinc plated or hot-dipped galvanized, malleable iron or steel fittings conforming to Federal Specification W-F-408.

1. Use Type 1 fittings for raintight connections.
2. Use Type 2 fittings for concrete tight connections.
3. Use Type 3 fittings for miscellaneous connections.

C. Provide insulated throat connectors for terminations.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.08 RIGID NONMETALLIC CONDUIT

A. Provide rigid nonmetallic conduit conforming to Federal Specification WC1094A, NEMA TC-2 and U.L. 651.

1. Heavy Wall Conduit: Schedule 40, 90C, U.L. rated, constructed of polyvinyl chloride, for direct burial or normal above ground use.
2. Extra Heavy Wall Conduit: Schedule 80, U.L. rated, constructed of polyvinyl chloride, for direct burial or above ground use.

B. Provide fittings which mate and match to conduit type and material and comply with NEMA TC-3 and U.L. 514.

C. Provide threaded terminal adapters on all rigid nonmetallic conduits terminating in panels, boxes, wire gutters, or cabinets. Adapters to have male threads on one end, socket end on other.

D. Provide zinc plated or hot-dipped galvanized, malleable iron conduit bodies with removable cover, corrosion resistant screws, threaded hubs and complying with ANSI/NEMA FB1.

2.09 EXPANSION FITTINGS

A. Expansion fittings shall be:

1. U.L. Listed, hot-dipped galvanized inside and outside, providing a 4" expansion chamber, external braided grounding and bonding jumper with approved clamps and U.L. listed for the application.
2. U.L. Listed, polyvinyl chloride, providing a 6" expansion chamber, and meet requirements for rigid nonmetallic conduit.

2.10 Available Conduit Bodies Manufacturers: Subject to compliance with requirements, manufacturers offering conduit bodies which may be incorporated in the work include, but are not limited to the following:

A. Appleton Electric; Div. of Emerson Electric Co.
B. Arrow Hart Div.; Crouse Hinds Co.
C. Bell Electric Div.; Square D Co.
D. Killark Electric Mfg. Co.
E. O-Z/Gedney Div.; General Signal Co.
F. Spring City Electrical Mfg. Co.

2.11 SURFACE METAL RACEWAY

A. Provide one-piece steel surface raceway which bears U.L. label or seal, size as required for each application, and finish as indicated on drawings or as directed by Architect.

B. Manufacturers:

1. Wiremold System 500 or 700 as required.
2. Or approved equal.

C. Provide insulating bushings on all surface metal raceways terminating in panels, boxes, wire gutters, or cabinets.

D. Provide fittings and boxes from manufacturers standard accessories which mate and match for a complete system installation. Minimum box depth shall be 1-3/4".

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NFPA-70, and NECA's "Standards of Installation".

B. Coordinate with other work including wires/cables, boxes and panel work, as necessary to interface installation of electrical raceways and components with other work.

C. Install conduits concealed in either wall, slabs, or above hung ceilings. Where conduits cannot be concealed, route conduits exposed on wall or ceiling.

D. Mechanically fasten together metal conduits, enclosures and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.

E. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

F. Install miscellaneous fittings such as reducers, chase nipples, 3 piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200' linear run or wherever structural expansion joints are crossed.

G. Use roughing-in dimensions of electrically operated unit furnished by supplier. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.

H. Provide nylon pull cord in all empty conduits. Test conduits required to be installed, but left empty, test with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.

3.02 CONDUIT INSTALLATION

A. Use electrical metal tubing conduit in mechanical equipment rooms, electrical equipment rooms and for main feeder circuits.

B. Use EMT in offices, corridors and toilets for branch circuits.

C. Use flexible metal conduit in movable partitions and from outlet boxes to recessed lighting fixtures, and final 24" of connections to motors, or control items subject to movement or vibration and in cells of precast concrete panels.

D. Use liquid tight flexible metal conduit where subject to one or more of the following conditions:

1. Exterior location.
2. Moist or humid atmosphere where condensate can be expected to accumulate.
3. Corrosive atmosphere.
4. Subjected to water spray or dripping oil, water or grease.

E. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.

F. Field bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

G. Size conduits to meet NFPA-70, except no conduit smaller than 3/4" shall be embedded in concrete or masonry or install below grade.

H. Where penetrating grade or floor in an exposed location from underground or in slab, a black mastic coated or PVC coated galvanized rigid steel conduit shall be used.

I. Provide rigid 90 degree elbows when turning conduit up in slab or turning conduit up above grade.

J. Fasten conduit terminations in sheet metal enclosures by 2 metal locknuts, and

terminate with bushing. Install locknuts inside and outside enclosure.

K. Conduits are not to cross pipe shafts, or ventilating duct openings.

L. Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

M Support riser conduit at each floor level with clamp hangers.

N. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3 piece union or split coupling.

O. Complete installation of electrical raceways before starting installation of cables/wires within raceway.

3.03 CONCEALED CONDUITS

A. Raceways installed underground or in floors, or outside shall be PVC Schedule 40.

B. For floors-on-grade, install conduits under concrete slabs.

C. Install underground conduits minimum of 24" below finished grade.

D. Where penetrating a floor in a location concealed in a block wall and acceptable by applicable codes, PVC Schedule 40 rigid non-metallic raceways may be used up to the first outlet box, provided outlet height above finished floor does not exceed 48".

3.04 CONDUITS IN CONCRETE SLAB

A. Place conduits between bottom reinforcing steel and top reinforcing steel.

B. Place conduits either parallel, or at 90 deg. to main reinforcing steel.

C. Separate conduits by not less than diameter of largest conduit to ensure proper concrete bond.

D. Conduits crossing in slab must be reviewed for proper cover by Engineer.

E. Embedded conduit diameter is not to exceed 1/3 of slab thickness.

F. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or sidewalls.

3.05 EXPOSED CONDUITS

A. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.

B. Install exposed conduit work as not to interfere with ceiling insets, lights, or ventilation ducts or outlets.

C. Support exposed conduits by use of hangers or clamps. Support conduits on each side of bends and on spacing not to exceed following: up to 1": 6'-0"; 1-1/4" and over: 8'-0".

D. Exposed conduits shall be painted to match the color of walls, ceilings, canopies, etc., as indicated on drawings, or as directed by the Architect.

3.06 NON-METALLIC CONDUITS

A. Make solvent cemented joints in accordance with recommendations of manufacturer.

B. Install PVC conduits in accordance with NFPA-70 and in compliance with local utility practices.

3.07 CONDUIT FITTINGS

A. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.

B. Insulated bushing for terminating conduits smaller than 1-1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.

C. Insulated bushings for terminating conduits 1-1/4" and larger are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.

D. Bushing off or insulated type to have screw type grounding terminal.

E. Miscellaneous fittings such as reducers, chase nipples, 3 piece unions, split couplings, and plugs to be specifically designed for their particular application.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. This section is a Division 16 Basic Electrical Materials and Methods section and is part of Division 16 section making reference to electrical wires and cables specified herein.

1.02 DESCRIPTION OF WORK

A. Extent of electrical wires and cable work is indicated by drawings and schedules.

B. Types of electrical wire, cable, and connectors specified in this section include the following:

1. Copper conductors.
2. Service entrance cable.
3. Split-bolt connectors.
4. Wirenut connectors.

C. Applications of electrical wire, cable, and connectors required for project are as follows:

1. For power distribution circuits.
2. For lighting circuits.
3. For appliance and equipment circuits.
4. For motor branch circuits.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Contractor shall submit a letter during submittal phase stating that all installers have a minimum of 5 years experience in the installation of their work.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements as applicable to construction, installation and color-coding of electrical wires and cables.

D. UL Compliance: Comply with applicable requirements of UL Std. 83, "Thermoplastic Insulated Wires and Cables" and Std. 486A, "Wire Connectors and Soldering for Use With Copper Conductors".

E. UL Compliance: Provide wiring/cabling and connector products which are UL listed and labeled.

F. NEMA/ICEA Compliance: Comply with NEMA/ICEA Std. Pub/No's WC5, Thermoplastic Insulated Wires and Cable for the "Transmission and Distribution of Electrical Energy", and WC30, "Color Coding of Wires and Cables", pertaining to electrical power type wires and cables.

G. IEEE Compliance: Comply with applicable requirements of IEEE Stds. 82, "Test Procedures for Impulse Voltage Tests on Insulated Conductors", and Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to wiring.

H. ASTM Compliance: Comply with applicable requirements of ASTM B1, 2, 3, 8, and D-573. Provide copper conductors with conductivity of not less than 98% at 20 degrees C. (68 deg. F.).

I. FOIST Compliance: Comply with Federal Specifications J-C-30, "Electrical Cable and Wire (Power, Fixed, Installation)", and W-S-610, "Splice Conductor".

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical wires, cables, and conductors.

B. DELIVERY, STORAGE, AND HANDLING:

1. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.
2. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
3. Handle wire and cable carefully to avoid abrasing, puncturing, and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to the following:

1. Wire and Cable:

a. Apex Wire and Cable Corp.
b. American Insulated Wire Corp.
c. American Wire and Cable Co.
d. Anaconda-Ericson Inc., Wire and Cable Div.
e. Beldon Div.; Cooper Industries.

f. Brand-Rex Div.; Pyle National Co.
g. Cerro Wire and Cable Corp.
h. Cleveland Insulated Wire Co.
j. Phelps Dodge Cable and Wire Co.
k. Rome Cable Corp.
l. Southwire Corp.
m. Triangle PWC, Inc.

2. Connectors;

a. AMP, Inc.
b. Appleton Electric Co.; Emerson Electric Co.
c. Burndy Corporation.
d. Brand-Rex Div.; Pyle National Co.
e. Electrical Products Div.; Midland Ross Corp.
f. General Electric Co.
g. Ideal Industries, Inc.
h. Leviton Mfg. Company.
i. 3M Company.
j. O-Z/Gedney Co.
k. Southport Industries Inc.
l. Square D Company.
m. Thomas and Betts Corp.

2.02 WIRES, CABLES, AND CONNECTORS

A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20 degrees C (68 degrees F.).

B. Building Materials: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by installer to comply with project's installation requirements, NFPA-70 and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements.

1. Type THWN: For dry or wet locations; max. operating temperature 75 deg. C. (167 deg. F.). Insulation, flame retardant, moisture and heat resistant, thermoplastic; outer covering, nylon jacket; conductor, annealed copper.
2. Type THHN: For dry and damp locations; max. operating temperature 90 deg. C. (194 deg. F.). Insulation, flame retardant, heat resistant thermoplastic conductor, annealed copper.

2.03 CONNECTORS

A. General: Provide Ul type factory fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NFPA-70 and NEMA standards. Select

from the following, those types, classes, kinds and styles of connectors to fulfill project requirements:

1. Type: Pressure.
2. Type: Crimp.
3. Type: Threaded.
4. Class: Insulated.
5. Kind: Copper (for CU to CU connection).
6. Style: Butt connection.
7. Style: Elbow connection.
8. Style: Combined "T" and straight connection.
9. Style: "T" connection.
10. Style: Split-bolt parallel connection.
11. Style: Tap connection.
12. Style: Pigtail connection.
13. Style: Wirenut connection.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wire and wiring connectors as indicated, in compliance with applicable requirements of NFPA-70, NEMA, UL, and NECA's "Standard of Installation" and in accordance with recognized industry practices.

B. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.

C. Install UL type wiring in conduit, for feeders and branch circuits.

D. Pull conductors simultaneously where more than one is being installed in same raceway.

E. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulator.

F. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceways.

G. Keep conductor splices to a minimum.

H. Install splices and tapes which possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

I. Use splice and tap connectors which are compatible with conductor material.

J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B.

3.02 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 16135
ELECTRICAL BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. This section is a Division 16 Basic Electrical Materials and Methods section, and is a part of each Division 16 making reference to electrical wiring boxes specified herein.

1.02 DESCRIPTION OF WORK

A. Extent of electrical box work is indicated by drawings and schedules.

B. Types of electrical boxes specified in this section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. In-ground hand hole.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical boxes, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Contractor shall submit a letter during submittal phase stating that all installers have a minimum of 5 years experience in the installation of their work.

C. NFPA-70 Compliance: Comply with NFPA-70 as applicable to construction and installation of electrical wiring boxes.

D. UL Compliance: Comply with applicable requirements of UL 50, UL 514 Series, and UL 886 pertaining to electrical boxes which are UL listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Std. Pub. No.'s OS1, OS2, and Pub.250 pertaining to outlets and device boxes, covers and box supports.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical boxes and fittings.

PART 2 - PRODUCTS

2.01 FABRICATED MATERIALS

A. Outlet Boxes: Provide galvanized coated flat rolled sheet steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code compliance option.

B. Device Boxes: Provide galvanized coated flat rolled sheet steel gangable or non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cable clamps, and for equipment type grounding.

1. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is installer's code compliance option.
2. Manufacturers: Subject to compliance with requirements, provide interior outlet boxes of one of the following:

a. Adalet-PLM Div., Scott Fetzer Co.
b. Appleton Electric; Emerson Electric Co.
c. Bell Electric; Square D Company.
d. Midland-Ross Corp.
e. OZ/Gedney; General Signal Co.
f. Pass and Seymor, Inc.
g. RACO Div; Harvey Hubbell Inc.
h. Thomas and Betts Co.

C. Raintight Outlet Boxes: Provide corrosion resistant cast metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast metal face plates with spring-hinged watertight caps suitably configurated for each application, including face plate gaskets and corrosion resistant plugs and fasteners.

1. Manufacturers: Subject to compliance with requirements, provide raintight

outlet boxes of one of the following:

a. Appleton Electric; Emerson Electric Co.
b. Arrow Hart Div.; Crouse-Hinds Co.
c. Bell Electric; Square D Co.
d. Harvey Hubbell, Inc.
e. OZ/Gedney; General Signal Co.
f. Pass and Seymor, Inc.

D. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes, and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

1. Manufacturers: Subject to compliance with requirements, provide junction and pull boxes of one of the following:

a. Adalet-PLM Div.; Scott Fetzer Co.
b. Appleton Electric; Emerson Electric Co.
c. Arrow Hart Div.; Crouse Hinds-Co.
d. Bell Electric; Square D Company.
e. OZ/Gedney Co.; General Signal Co.
f. Spring City Electrical Mfg. Co.

E. Knockout Closures: Provide corrosion resistant box knockout closures of types and sizes, to suit respective installation requirements and applications.

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

a. Adalet-PLM Div.; Scott Fetzer Co.
b. AMP, Inc.
c. Arrow Hart Div.; Crouse-Hinds Co.
d. Appleton Electric Co.; Emerson Electric Co.
e. Bell Electric; Square D Co.
f. Midland Ross Corp.
g. Midwest Electric; Cooper Industries, Inc.
h. OZ/Gedney Co.; General Signal Co.
i. RACO Div.; Harvey Hubbell, Inc.
j. Thomas and Betts Co. Inc.

F. In-ground Hand Hole: Provide concrete hand hole with knockouts, sump, pull eyes, ground rod hole, and cast iron ring with cover. Cover shall read “Electric”. Refer to drawings for size.

1. Manufacturers: Subject to compliance with requirements, provide in-ground hand hole of one of the following:

a. Brooks Products.
b. or accepted equivalent.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NFPA-70 and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

F. Avoid installing boxes back-to-back in walls. Provide not less than 6" (150mm) separation.

G. Avoid installing aluminum products in concrete.

H. Position recessed outlet boxes accurately to allow for surface finish thickness.

I. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

J. Provide electrical connections for installed boxes.

K. Subsequent to installation of boxes, protect boxes from construction debris and damage.

L. Install in-ground hand hole on 6" gravel base. Provide 3/4" x 10'-0" long ground rod in box and connect to counterpoise. Connect cover to ground rod with 96" long #4 AWG minimum. Install cover flush with finished grade.

3.02 GROUNDING

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION

SECTION 16142
ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. This section is a Division 16 Basic Electrical Materials and Methods section, and is part of each Division 15 and 16 sections making reference to electrical connections for equipment specified herein.

1.02 DESCRIPTION OF WORK

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following, but not limited:

1. From electrical source to motor starters.
2. From motor starters to motors.
3. To lighting fixtures.

C. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division 15 and other Division 16 sections, and are work of this section.

D. Refer to Division 15 sections for motor starters and controller furnished integrally with equipment; not work of this section.

E. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division 16 sections, and are work of this section.

F. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 16 sections, and are work of this section.

G. Refer to Division 15 sections for control system wiring; not work of this section.

H. Refer to sections of other Divisions for specific individual equipment power requirements, not work of this section.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and rating required, and ancillary connection materials, including

electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Contractor shall submit a letter during submittal phase stating that all installers have a minimum of 5 years experience in the installation of their work.

C. NFPA-70 Compliance: Comply with applicable requirements of NFPA-70 as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters and disconnect switches.

D. IEEE Compliance: Comply with Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

E. ANSI Compliance: Comply with applicable requirement of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

F. UL Compliance: Comply with UL Std.486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL listed and labeled.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of product):

1. Adalet-PLM Div., Scott and Fetzer Co.
2. Allen-Stevens Conduit Fittings Corp.
3. AMP Incorporated.
4. Appleton Electric Co.
5. Arrow Hart Div., Crouse Hinds Co.
6. Burndy Corp.
7. General Electric Co.
8. Harvey Hubbell Inc.
9. Ideal Industries, Inc.
10. Pyle National Co.
11. Reliable Electric Co.
12. Square D Company.
13. Thomas and Betts Corp.

2.02 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cables ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

2.03 METAL CONDUIT, TUBING AND FITTINGS

A. General: Provide metal conduit, tubing, and fittings of types, grades, sizes, and weights (wall thickness) indicated for each type service. Where types and grades are not indicated, provide proper selection to fulfill wiring requirements, and comply with NFPA-70 requirements for raceways. Provide products complying with Division 16 basic electrical materials and methods section "Raceways" and in accordance with the following listing of metal conduit, tubing and fittings.

1. Rigid metal conduit.
2. Rigid metal conduit fittings.
3. Electrical metallic tubing (EMT).
4. EMT fittings.
5. Flexible metal conduit.
6. Flexible metal conduit fittings.
7. Liquid tight flexible metal conduit.
8. Liquid tight flexible metal conduit fittings.
9. PVC coated metal conduit.
10. PVC coated metal conduit fittings.

2.04 WIRES, CABLES AND CONNECTORS

A. General: Provide wires, cables, and connectors complying with Division 16 basic electrical materials and methods section "Wires and Cables".

B. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20 deg. C. (68 deg. F.)

C. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

D. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper

completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NFPA-70, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceways and equipment installation, as necessary to properly interface installment of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity ratings, than electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, bean-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

H. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

I. Provide liquid tight flexible conduit for connections of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:

1. Exterior location.
2. Moist or humid atmosphere where condensate can be expected to accumulate.
3. Corrosive atmosphere.
4. Subject to water spray or dripping oil, grease, or water.

J. Fasten identification markers to each electrical power supply wire/cable conductor

which indicates their voltage, phase and feeder number in accordance with Division 16 section "Electrical Identification". Affix markers on each terminal conductor, as close as possible to the point of connection.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. This section is a Division 16 Basic Electrical Materials and Methods section, and is a part of each Division 16 section making reference to electrical supporting devices specified herein.

1.02 DESCRIPTION OF WORK

A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other Division 16 sections.

B. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. C-clamps.
2. I-Beam clamps.
3. One-hole conduit straps.
4. Two-hole conduit straps.
5. Round steel rods.
6. Lead expansion anchors.
7. Toggle bolts.
8. Wall and floor seals.
9. Bridle Rings.

C. Conduit supporting devices of the spring or tension type, such as conduit clips manufactured by Caddy Corporation, are not acceptable.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Contractor shall submit a letter during submittal phase stating that all installers have a minimum of 5 years experience in the installation of their work.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements as applicable to construction and installation of electrical supporting devices.

D. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and

equipment mounting.

E. UL Compliance: Provide electrical components which are UL listed and labeled.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on supporting devices including catalog cuts, specifications, and installation instructions, for each type of support, anchor, sleeve and seal.

PART 2 - PRODUCTS

2.01 MANUFACTURED SUPPORTING DEVICES

A. General: Provide supporting devices which comply with manufacturer’s standard materials, design, and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirement, selection is Installer's option.

B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 pounds per 100 units.
2. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
3. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
4. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
5. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.
6. Round Steel Rod: Black steel; 1/2" dia.; approximately 67 pounds per 100 feet.
7. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

C. Anchors: Provide anchors of types, sizes, and materials indicated, with the following construction features:

1. Lead Expansion Anchors: 1/2"; approximately 38 pounds per 100 units.
2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.
3. Manufacturers: Subject to compliance with requirements, provide anchors of one of the following:

    a. Ideal Industries, Inc.
    b. Joslyn Mfg. and Supply Co.
    c. McGraw Edison Co.
    d. Star Expansion Co.
    e. U.S. Expansion Bolt Co.

D. Sleeves and Seals: Provide sleeves and seals of types, sizes and materials indicated, with the following construction features:

1. Wall and Floor Seals: Provide factory assembled watertight wall and floor seals, of types, and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and wall. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
2. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 12 gage hot dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel.

    a. Fixture hangers.
    b. Channel hangers.
    c. End caps.
    d. Beam clamps.
    e. Wiring studs.
    f. Thinwall conduit clamps.
    g. Rigid conduit clamps.
    h. Conduit hangers.
    i. U-bolts.

3. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:

    a. Allied Tube and Conduit Corp.
    b. B-Line Systems, Inc.
    c. Greenfield Mfg. Co., Inc.
    d. Midland Ross Corp.
    e. OZ/Gedney Div.; General Signal Corp.
    f. Power Strut Div.; Van Huffel Tube Corp.
    g. Unistrut Div.; GTE Products Corp.

2.02 FABRICATED SUPPORTING DEVICES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seam, or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20 gage; 4" to 6", 16 gage; over 6", 14 gage.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
3. Iron Pipe: Fabricate from cast-iron or ductile iron pipe; remove burrs.

PART 3 - EXECUTION

3.01 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves and seals as indicated, in accordance with

manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NFPA-70 for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacing indicated and in compliance with NFPA-70 requirements.

D Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Division 16 Basic Electrical Materials and Methods section apply to work specified in this section.

1.02 DESCRIPTION OF WORK

A. Extent of electrical identification work is indicated by drawings and schedules.

B. Types of electrical identification work specified in this section include the following:

1. Electrical power, control and communication conductors.
2. Operational instructions and warnings.
3. Danger signs.
4. Equipment/system identification signs.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Contractor shall submit a letter during submittal phase stating that all installers have a minimum of 5 years experience in the installation of their work.

C. NFPA-70 Compliance: Comply with NFPA-70 as applicable to installation of identifying labels and markers for wiring and equipment.

D. UL Compliance: Comply with applicable requirements of UL Std.969, "Marking and Labeling Systems" pertaining to electrical identification systems.

E. NEMA Compliance: Comply with applicable requirements of NEMA Std. No's. WC-1 and WC-2 pertaining to identification of power and control conductors.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical identification materials and products.

B. Samples: Submit samples of each color, lettering style and other graphic

representation required for each identification material or system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):

1. Alarm Supply Co., Inc.
2. Brady, W.H. Co.
3. Calpico Inc.
4. Cole Flex Corp.
5. Direct Safety Co.
6. George Ingraham Corp.
7. Griffolyn Co.
8. Ideal Industries, Inc.
9. LEM Products, Inc.
10. Markal Co.
11. National Band and Tag Co.
12. Panduit Corp.
13. Seton Name Plate Co.
14. Tesa Corp.

2.02 ELECTRICAL IDENTIFICATION MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard product of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Color Coded Plastic Tape:

1. General: Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.

C. Cable/Conductor Identification Bands:

1. General: Provide manufacturer's standard vinyl cloth self adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

D. Baked Enamel Danger Signs:

1. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20 gage steel, of standard red, black, and white graphics; 14" x 10" size except where 10" x 7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

E. Engraved Plastic Laminate Signs:

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thickness indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/16" except as otherwise indicated.
3. Thickness: 1/8" except as otherwise indicated.
4. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.
5. Fasteners: Self tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.03 LETTERING AND GRAPHICS:

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical system and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NFPA-70.
2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:

1. General: Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply color coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

C. Cable/Conductor Identification:

1. General: Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded

conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

D. Operational Identification and Warnings:

1. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets, and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

E. Danger Signs:

1. General: In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.
2. High Voltage: Install danger signs wherever it is possible under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.

F. Equipment/Systems Identification:

1. General: Install engraved plastic-laminate signs on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/ control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:

a. Panelboards, electrical cabinets and enclosures.
b. Access panel/doors to electrical facilities.
c. Major electrical switchboard.
d. Fire alarm control panel.
e. Disconnect switches

G. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

END OF SECTION

ORANGE COUNTY – FS #31
HVAC REPLACEMENT

SECTION 16450
GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

B. Division 16 Basic Materials and Methods sections apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Extent of grounding work is indicated by drawings and schedules.

B. Types of grounding specified in this section include the following:

1. Solid Grounding.

C. Applications of grounding work in this section include the following:

1. Underground metal water piping.
2. Grounding electrodes.
3. Grounding rods.
4. Service equipment.
5. Enclosures.
6. Equipment.
7. Ground Test Well.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cables, copper brain and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Contractor shall submit a letter during submittal phase stating that all installers have a minimum of 5 years experience in the installation of their work.

C. NFPA-70 Compliance: Comply with NFPA-70 requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL listed and labeled.

D. UL Compliance: Comply with applicable requirements of UL Standards Nos.467 and 869 pertaining to electrical grounding and bonding.

E. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

1.04 SUBMITTAL

A. Product Data: Submit manufacturer's data on grounding systems and accessories.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

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

1. B-Line Systems, Inc.
2. Burndy Corp.
3. Crouse-Hinds Co.
4. Electrical Components Div.; Gould, Inc.
5. General Electric Supply Co.
6. Ideal Industries, Inc.
7. Thomas and Betts Corp.
8. Western Electric Co.

2.02 GROUNDING SYSTEMS

A. Materials and Components:

1. General: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes, and plate electrodes, bonding jumper braid, surge arrestors, and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products complying with NFPA-70, UL, IEEE, and established industry standards for applications indicated.
2. Provide raceways, and electrical boxes and fittings complying with Division 16 Basic Materials and Methods sections "Raceways" and "Electrical Boxes and Fittings", in accordance with the following listing:
   a. Rigid steel conduit.
   b. Electrical metallic tubing.
   c. Flexible metal conduit, Type 2.
   d. Liquid-tight flexible metal conduit.
   e. Rigid metal conduit fittings.
   f. EMT Fittings, Type 1.
   g. Flexible metal conduit fittings.
   h. Liquid-tight flexible metal conduit fittings.

B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NFPA-70.

C. Bonding Jumper Braid: Copper braided tape, constructed of 30-gage bare copper wires and properly sized for indicated applications.

D. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gage bare copper wire; 3/4" wide, 9-1/2" long; 48,250 cm. Protect braid with copper bolthole ends with holes sized for 3/8" dia. bolts.

E. Ground Rods: Steel with copper welded exterior. Each ground rod shall consist of a 40 ft. ground rod, 5/8” driven vertically. Top of ground rod shall be at least one (1) foot deep below grade.

F. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.

G. Ground Test Well: Plastic 10" diameter x 10" high body with two pipe slots; plastic snap-lock cover with lifting holes and shall read “Ground”. Provide test well at each ground rod location. Cover shall be flush with grade.

H. Grounding Bars: Ground bars shall be copper of the size and description as shown on the drawings, or shall be 1/4" x 2" bus grade copper, spaced from wall on insulating 1" high supports, of 6" or greater O.A. length, allowing 2" length per lug connected thereto.

PART 3 - EXECUTION

3.01 GENERAL

A. Grounding conductors shall be provided with every circuit.

B. Grounding conductors shall; be so installed as to permit shortest and most direct path from equipment to ground; be installed in metal conduit with both conductor and conduit bonded at each end; have connections accessible for inspection and made with approved solderless connectors brazed (or bolted) to the equipment or structure to be grounded. The main grounding electrode conductor shall be exothermically welded to ground rods and water pipe.

C. All contact surfaces shall be thoroughly cleaned before connections are made to insure good metal-to-metal contact.

D. All exterior grade mounted equipment shall have their enclosures grounded directly to a separate driven ground at the equipment in addition to the building ground connection.

3.02 BONDING

A. Where available on the premises, bond the following items together:

1. Metal water pipe.
2. Building metal frame.

B. A main ground, bare copper conductor, NEC sized but in no case less than #2/0, shall be run in conduit from the Main Switchgear of each building to the building steel in respective building. This ground conductor shall also be run individually and be bonded to the main water service ahead of any union in pipe and must be metal pipe

of length as acceptable by authorities having jurisdiction. Provide properly sized bonding shunt around water meter and/or dielectric unions in the water pipe. Also required is the same size ground wire to minimum 5/8" x 20 ft. copperweld driven ground rod.

C. Install ground bushings on all conduits entering enclosures where the continuity of grounding is broken between the conduit and enclosure (i.e. conduit stub-up into a motor control center enclosure). Provide an appropriately sized bond jumper from the ground bushing to the equipment ground bus.

3.03 INSTALLATION AND METHODS - 120 THROUGH 480 VOLT SYSTEMS

A. Except as otherwise indicated, each feeder raceway on the load side of the service entrance shall contain a ground conductor sized as indicated and where not shown shall be sized in accordance with Table 250-95 of the NEC. Conductor shall be connected to the equipment grounding bus in switchboards and panelboards, to lighting fixtures, motors and other types of equipment and outlets. The ground shall be in addition to the metallic raceway and shall be properly connected thereto, using a lug device located within each item enclosure at the point of electric power connections to permit convenient inspection.

B. Each feeder metallic conduit shall be bonded at all discontinuities, including at switchboards and all sub-distribution and branch circuit panels with conductors in accordance with Table 250-95 of NEC for parallel return with respective interior grounding conductor.

C. Provide green insulated ground wire for all grounding type receptacles and for equipment of all voltages. In addition to grounding strap connection to metallic outlet boxes, a supplemental grounding wire and screw equal to Raco No. 983 shall be provided to connect receptacle ground terminal to the box.

D. All 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.

3.04 GROUNDING FOR LIGHTING FIXTURES SHALL BE AS FOLLOWS

A. All fixtures in building interior and exterior fixtures shall be provided with green grounding conductor, solidly connected to unit. Individual fixture grounds shall be with lug to fixture body, generally located at point of electrical connection to the fixture unit.

B. All suspended fixtures and those supplied through flexible metallic conduit shall have green ground conductor from outlet box to fixture. Cord connected fixtures shall contain a separate green ground conductor.

C. Except as otherwise indicated, freestanding, pole mounted, lighting fixtures shall each have a Copperweld, or equal, rod located within or adjacent to the concrete base and projecting a minimum of 4 feet below base bottom. An NEC sized grounding conductor shall be used to connect rod to pole base and an NEC sized conductor also shall be provided from pole to supply panel ground bus. Conductor shall be thermowelded to rod.

3.05 MOTORS AND EQUIPMENT

A. All motors, all heating coil assemblies, and all building equipment requiring flexible connections shall have a green grounding conductor properly connected to the frames and extending continuously inside conduit with circuit conductors to the supply source grounding bus with approved connectors regardless of conduit size or type. This shall include Food Service equipment, Laundry equipment, and all other "Equipment By Owner" to which an electric conduit is provided under this Division.

3.06 TRANSFORMER GROUNDING

A. Grounding of transformers and enclosures of 120/208V and 277/480V "separately derived systems" shall be to the nearest grounding electrode, grounded structural steel (when accessible), effectively grounded metal water pipe, or other approved electrodes when the former are not available as required by the N.E.C. (Where ground electrode per N.E.C. is the grounded structural steel, all additional ground wire (sized per N.E.C.) shall be connected to effectively grounded metal water pipe.

B. In addition, work shall include a conduit with an N.E.C. sized grounded conductor to main building ground system except where specifically rejected by Local Inspection Authority. Verify during construction procedures.

3.07 MISCELLANEOUS GROUNDING CONNECTIONS

A. Required connections to building steel shall be with approved terminals and bolted in accessible locations.

B. Where reinforced concrete is utilized for building grounding system (UFER ground), proper reinforced bonding shall be provided to secure low resistance to earth with "thermite" type devices, and #10AWG wire ties shall be provided to not less than ten (10) full length rebars which contact the connected rebar (by Division 16 contractor).

C. All surfaces to which grounding connections are made shall be thoroughly cleaned to maximum conductive condition immediately before connections are made thereto. Exposed bare metal at the termination point shall be painted.

D. Welded or Brazed Connections: Joints in ground conductors shall be welded or brazed. The welding or brazing processes shall be an exothermic type.

3.08 MAIN ELECTRICAL SERVICE GROUNDING AND BONDING (AS APPLICABLE)

A. Ground in accordance with Article 250 of the NEC. Artificial grounding electrodes shall be provided for the main service grounding in sufficient number and configuration to secure grounding resistance specified. Grounding system shall also be extended to the cold water entrance pipe and be grounded to the line side of any metering.

B. Provide counterpoise at service entrance of minimum of three driven ground rods of adequate length spaced 20 feet apart in a triangle, or as detailed. Conductor size between ground rods shall be in compliance with N.E.C. Connections to ground rods shall be thermowelded. Top of ground rods and conductors shall be minimum 24 inches below grade. Connect to building lightning protective counterpoise with #2/0 cable.

3.09 TESTING AND REPORTS

A. Raceway Continuity: Metallic raceway system as a component of the facilities ground system shall be tested for electrical continuity. Resistance to ground throughout the system shall not exceed NEC specified limits.

B. Ground resistance measurements shall be made on each grounding system utilized in the project. The ground resistance measurements shall include building structural steel, driven grounding system, and other approved systems as may be applicable. Ground resistance measurements shall be made in normally dry weather, not less than 24 hours after rainfall, and with the ground under test isolated from other grounds. Resistances measured shall not exceed specified limits.

C. Upon completion of testing, the testing conditions and results shall be certified by the Contractor and submitted in writing on Contractor's letterhead to the Architect/Engineer.

3.10 GROUND RESISTANCE

A. Grounding resistance measure at main service shall not exceed 10 ohms.

B. Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms, measured at motors, panels, grounding busses, cabinets, etc.

END OF SECTION