LEON COUNTY, FLORIDA
COURTHOUSE
AHU-11 & AHU-12 REPLACEMENT
[PEG #211-124]

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SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

RELATED DOCUMENTS

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

PROJECT DESCRIPTION

The Project consists of installing a complete HVAC system for the Leon County Courthouse, as shown on Contract Documents as prepared by Pinnacle Engineering Group, P.A., Consulting Engineers.

The Work includes purchasing, receiving, off-loading, storing, lifting & installing, new HVAC equipment, ductwork, piping, valves, controls, fire alarm devices, electrical components, and other components, equipment and materials as indicated.

The Contractor shall provide all labor, materials, and modifications in connection with the installation of HVAC equipment, ductwork, piping, valves, equipment, etc. The Contractor shall complete all work in accordance with the requirements of the specifications and shall comply with all applicable local and state codes and standards.

The Contractor shall verify all existing conditions and examine adjoining areas which in any way will affect the completion of this work. The Contractor shall report to the Engineer, in writing, any condition which will prevent the installation of any system or equipment in this building, minimum 7 days prior to bid.

The Work includes testing and inspections as identified in Florida Building Code and NFPA and adjustments and submission of reports.

The Work includes demolition and disposal of materials, equipment and items as indicated. Regular clean up and returning work areas to pre-work conditions or improved conditions as indicated is also required. Provide all shoring and bracing and protect all existing systems to remain. Protect existing roofs, floors, etc. to remain.

The Work involves coordinating with Authorities Having Jurisdiction for certifying compliance with all local and State requirements. The work includes obtaining all permits, paying all fees & costs, and filing all permit applications required by Authorities Having Jurisdiction.

The Work includes coordination with owner and all existing conditions so that all materials, equipment, parts, etc. are provided and installed in an organized and timely manner. The Contractor must schedule all work in advance with owner so as not to interfere with the daily routine of the Courthouse staff.

The Work includes removal, storage and reinstallation of ceiling, ceiling grids, light fixtures, etc. The work includes repairs to walls, ceilings, floors, etc that are disturbed as part of this work. All disturbed items shall be repaired to match as nearly as possible the finish, color, etc of the existing building components.

The Work includes expanding the existing Johnson Controls energy management and control system and installing new components as indicated in contract documents. The work includes providing, installing, testing and calibrating the expanded and new energy management control

system. The work also includes training the Owner's Maintenance Staff to operate the new control system. The work also includes associated electrical work. The work includes the installation of sensors and other necessary control components (material and labor) for a fully functional direct digital control system. Work includes installation of EMCS sensors, interface relays, surge suppression/isolation systems, and fiber optic interconnecting of all individual stand alone controllers to the existing central monitoring and control station. Work also includes updating computer graphics at the Central Workstation.

The Contractor shall visit the site and notify engineer in writing minimum 7 days prior to bid of any discrepancies or conflicts in performing work as indicated.

All work shall be accomplished using new materials except as specified herein. Guarantee on materials and workmanship shall be one year from day of acceptance.

The electrical portion of this project shall include all work shown in the Contract documents and required to meet Code for a fully operational HVAC system.

CONTRACTOR USE OF PREMISES

Facility Rules: The Contractor and sub-tier contractors shall at all times conform to all facility rules and regulations including but not limited to: Site access and Identification requirements, dress codes, smoking policies, non-fraternization, and safety requirements.

Contractor and subcontractor employees will have to be cleared by security (for badges, background checks, etc.) prior to beginning work.

General: Limit use of the premises to construction activities in areas indicated; allow for Owner occupancy and use by the public.

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

Keep driveways and entrances serving the premises clear and available to the Owner and staff traffic 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. These activities must be coordinated with Owner's facilities staff.

Burial of Waste Materials: Do not dispose of organic and hazardous material on site, either by burial or by burning. The Contractor will dispose of waste material off-site and in a lawful manner. Coordinate with Owner for disposal of reusable material and equipment.

The Contractor and sub-contractors shall not dispose of their waste in the Owner's waste disposal system.

Use of the Existing Buildings: Maintain the existing buildings in a weather-tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the buildings and their occupants during the construction period.

At no time shall the Contractor or sub-tier contractors create any conditions that diminish the life safety requirements of NFPA or the Florida Building Code.

OWNER OCCUPANCY

Full Owner Occupancy: The Owner will occupy the site and existing buildings during the entire construction period. Cooperate with and coordinate all work with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations. Include in the bid all costs associated with premium time; coordinate with Owner on work hours and scheduling and lead time required for relocation of clients, prior to submitting a bid.

MISCELLANEOUS PROVISIONS

A. Minor Materials and Work:

Minor materials and work not specifically mentioned herein but necessary for the proper completion of the specified work shall be furnished without additional cost to the Owner. It is the Contractor's responsibility to visit the site and examine all conditions affecting the work, and to include in the bid all costs associated with performing the work for a complete operational system.

B. Unforeseen Major Repairs:

Should deteriorated materials of a major nature be uncovered in the course of the work, it shall be brought to the attention of the Owner prior to initiating work. Repairs will be made by the Owner in a timely manner so as to prevent excessive delay in completion of the Contract. No allowance for additional Contract completion time shall be allowed in conjunction with said repairs. Should equipment prove to be beyond repair within the time constraints of the Contract, an adjustment will be requested by the Contractor as indicated in the General Conditions of the Contract and in accordance with the terms of the Contract.

C. Existing Work:

Where existing work is changed or removed, or where new work adjoins, connects or abuts existing work, the existing work shall be altered as necessary and connected in a substantial and workmanshiplike manner. All new work shall match, as nearly as practicable, the existing adjoining and/or adjacent similar work. Operations affecting existing work shall be conducted with care not to damage work in place; and all existing work damaged by such operations shall be rectified or replaced without additional expense to the Owner.

D. License:

All work shall be performed under direct supervisions of a licensed Contractor holding an active Florida license.

E. Welding:

No welding will be allowed inside the buildings of this project. Welding will be allowed in designated areas outside the building only. Soldering inside the building shall be kept to a bare minimum. Coordinate with Owner to disable fire alarm while soldering is in progress.

PROJECT IDENTIFICATION

A. Name of the project is “Leon County Courthouse, AHU-11 & AHU-12 Replacement, Tallahassee, FL.”

B. Contract Documents indicate work of Contract and related provisions of the project which may include, but are not necessarily limited to, the following:

- Existing conditions and restrictions.
- Coordination with existing work.
- Requirements for Owner to occupy facility during the construction phase. Down times must be coordinated with the Owner and must be held to the absolute minimum.
- Premium time may be required. The Contractor shall include in his bid the cost of all premium time. Coordinate with Owner for building and site access requirements, utility outage limitations and requirements, street closing requirements, and other issues which may necessitate off-hour work.

Phasing:

Insofar as possible, the Contractor shall phase and schedule the work so as to minimize interference with the Owner's activity. The site and buildings will be occupied during the course of the work. Prior to beginning any work, the Contractor shall meet with the Owner so that an approved schedule and sequence of work may be arranged. The Contractor's schedule of work submitted to the Owner shall show the sequence in which the work will be performed in accordance with the priorities and provisions specified below.

1. Interruption of Utility Services, HVAC, Electrical, and Fire Protection Systems:

   Interruptions shall be kept to a minimum and be at such times and durations as approved by the Owner. No interruption shall occur unless scheduled with the Owner and approved in advance as to time and duration of such interruption.

2. As approved by the Owner, certain work may be rescheduled to allow the Contractor unhindered access to equipment, mechanical rooms and other areas where work must be accomplished, provided that the Contractor forwards requests in advance. Contractor shall ensure prior to such request that all items and materials required for the work have been delivered to the site and stored there.

Project Coordination:

The Contractor is responsible for coordinating with all sub-tier contractors and suppliers, delegation of work/scope to same, to ensure all work requirements and responsibilities: equipment, materials, accessories, installation, hook-up, testing, reporting, and the like are distributed and performed and the cost of these responsibilities is included in the Bid to provide a complete, fully operating project installation.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01010

SECTION 01045 - CUTTING AND PATCHING

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

SUMMARY

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

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

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.

SUBMITTALS

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:

Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.

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.

List products to be used and firms or entities that will perform Work.

Indicate dates when cutting and patching is to be performed.

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.

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.

Approval by the Engineer to proceed with cutting and patching does not waive the Architect's/Engineer’s right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

QUALITY ASSURANCE

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.

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

Foundation construction.
Bearing and retaining walls.
Structural concrete.
Structural steel.
Lintels.
Timber and primary wood framing.
Structural decking.
Stair systems.
Miscellaneous structural metals.
Exterior curtain wall construction.
Equipment supports.
Piping, ductwork, vessels and equipment.
Structural systems of special construction in Division-13.

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.

Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:

Shoring, bracing, and sheeting.
Primary operational systems and equipment.
Air or smoke barriers.
Water, moisture, or vapor barriers.
Membranes and flashings.
Fire protection systems.
Noise and vibration control elements and systems.
Control systems.
Communication systems.
Conveying systems.
Electrical wiring systems.
Special construction specified by Division-13 Sections.

Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Engineer’s opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.
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:

Processed concrete finishes.
Stonework and stone masonry.
Ornamental metal.
Matched-veneer woodwork.
Preformed metal panels.
Window wall system.
Stucco and ornamental plaster.
Acoustical ceilings.

Terrazzo.

Finished wood flooring.
Fluid-applied flooring.
Carpeting.
Aggregate wall coating.
Wall covering.
HVAC enclosures, cabinets or covers.

PART 2 - PRODUCTS

MATERIALS

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. Use materials whose installed performance will equal or surpass that of existing materials.

Plaster: Comply with ASTM C 842.

Base Coat: Ready-mixed, sand aggregate gypsum plaster base.

Finish Coat: Ready-mixed gypsum finish plaster.

PART 3 - EXECUTION

INSPECTION

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.

Before proceeding, meet at the site with 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.

PREPARATION

Temporary Support: Provide temporary support of Work to be cut.

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.

Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

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.

PERFORMANCE

General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

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.

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.

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.

To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.

Cut through concrete and masonry using a cutting machine such as carborundum saw or diamond core drill.

Comply with requirements of applicable Sections of Division-2 where cutting and patching requires excavating and backfilling.

By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions 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.

Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

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.

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.

Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat.

Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated.

Unless otherwise indicated provide 3-coat Work.

Finish gypsum plaster with smooth-troweled finish. Sand lightly to remove trowel marks and arises.

Cut, patch, point-up and repair plaster to accommodate other construction and to restore cracks, dents and imperfections.

CLEANING

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 pipe covering to its original condition.

END OF SECTION 01045

SECTION 01200 – PROJECT MEETINGS

PART 1 - GENERAL

SUMMARY

This section specifies administrative and procedural requirements for meetings including but not limited to:

Pre-Construction Conference.
Progress Meetings.

PRE-CONSTRUCTION CONFERENCE

A pre-construction conference and organizational meeting will be held at the Project site. Required attendees will be notified as to the date and time. Minutes of the meeting shall be prepared and distributed by the Construction Manager (or Prime Contractor).

Attendees: The Owner, Construction Manager (or Prime Contractor), Engineer and their consultants, the Contractor and his superintendent, major subcontractors, equipment manufacturers or representatives and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

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

Construction schedule.
Work sequencing.
Designation of responsible personnel.
Procedures for processing field decisions and Change Orders.
Procedures for processing Applications for Payment.
Distribution of Contract Documents.
Submittal of Shop Drawings, Product Data and Samples.
Preparation of record documents.
Use of the premises.
Office, Work and storage areas.
Equipment deliveries and priorities.
Safety procedures.
First aid.
Security.
Special Conditions.
Dress Codes.
Rules and Regulations for Contractor and Subcontractors.
Housekeeping.
Working hours.

PROGRESS MEETINGS

The Contractor's Construction Manager (or Prime Contractor) will conduct progress meetings at the Project site at regularly scheduled intervals. The Construction Manager (or Prime Contractor) will schedule the meeting dates. Minutes of meeting will be prepared and distributed by the Construction Manager (or Prime Contractor).

Attendees: In addition to representatives of the Owner, Construction Manager (or Prime Contractor), and Engineer, each subcontractor, supplier or other entity concerned with current

progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the project and authorized to conclude matters relating to progress.

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.

Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the contractor's Construction Schedule, whether on time or ahead or behind schedule. 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.

Review the present and future needs of each entity present, including such items as:

Interface requirements.
Time.
Sequences.
Deliveries.
Off-site fabrication problems.
Access.
Site utilization.
Temporary facilities and services.
Hours of Work.
Hazards and risks.
Housekeeping.
Quality and Work Standards.
Change Orders.
Documentation of information for payment requests.

Reporting: No later than 10 days after each progress meeting the Construction Manager shall 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 of progress since the previous meeting and report.

Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

SUMMARY

This Section specifies administrative and procedural requirements for submittals required for performance of the Work, including;

Contractor's construction schedule.
Shop Drawings.
Product Data.
Special Reports.

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:

Permits.
Applications for payment.
Performance and payment bonds.
Insurance certificates.
List of Subcontractors.

Submittals for prior approval of alternate manufacturers shall be presented a minimum of 14 days prior to bid date. If alternate manufacturers are acceptable to Engineer, then an addendum will be issued. Requests submitted within 7 days of bid will be rejected.

SUBMITTAL PROCEDURES

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.

Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

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.

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

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.

Allow two weeks for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will promptly advise the Contractor when a submittal being processed must be delayed for coordination.

If an intermediate submittal is necessary, process the same as the initial submittal.

Allow two weeks for reprocessing each submittal.

No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

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.

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.

Include the following information on the label for processing and recording action taken.

Project name.
Date.
Name and address of Engineer.
Name and address of Contractor.
Name and address of subcontractor.
Name and address of supplier.
Name of manufacturer.
Number and title of appropriate Specification Section.
Drawing number and detail references, as appropriate.

Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.

On the transmittal Record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including all variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

CONTRACTOR'S CONSTRUCTION SCHEDULE

Schedule: Prepare a fully developed, Contractor's construction schedule. Submit within 5 days of the date established for "Commencement of the Work", but prior to the pre-construction conference.

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. This construction schedule must not interfere with instructional time of the college, be mutually agreeable with the owner, and any revisions to the schedule must also be agreed to by the owner.

Coordinate the Contractor's construction schedule with the subcontractors, submittal schedule, payment requests and other schedules.

Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Engineer’s procedures necessary

for certification of Substantial Completion.

Indicate periods of shutdowns. Coordinate with Owner.

Distribution: Print and distribute copies to the Engineer, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project area.

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.

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

SHOP DRAWINGS

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 Shop Drawings.

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

Dimensions.
Identification of products and materials included.
Compliance with specified standards.
Notation of coordination requirements.
Notation of dimensions established by field measurement.

Submittal: Submit 6 blue- or black-line prints for the Engineer’s review; five will be returned.

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

PRODUCT DATA

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, 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 Drawings."

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:

Manufacturer's printed recommendations.
Compliance with recognized trade association standards.
Compliance with recognized testing agency standards.
Application of testing agency labels and seals.
Notation of dimensions verified by field measurement.

Notation of coordination requirements.

Submittals: Submit 6 copies of each required submittal; the Engineer will retain one, and will return the other marked with action taken and corrections or modifications required.

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.

Do not proceed with installation until an applicable copy of Product Data is in the installer's possession.

Do not permit use of unmarked copies of Product Data in connection with construction.

ENGINEER'S ACTION

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

Compliance with specified characteristics is the Contractor's responsibility.

Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

Final Unrestricted Release: Where submittals are marked "Reviewed,/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.

Final-But-Restricted Release: When submittals are marked "Furnish as Corrected /No Resubmission Required," 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.

Returned for Resubmittal: When submittal is marked "Rejected or 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.

Do not permit submittals marked "Rejected" or "Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.

Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action Not Required".

SPECIAL REPORTS:

General: Except as otherwise indicated, submit special reports directly to the Owner within one day of occurrence requiring special report, with copy to others affected by occurrence.

Reporting Accidents: Prepare and submit reports of significant accidents, at site and anywhere

else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01300

SECTION 01700 - PROJECT CLOSEOUT

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

SUMMARY

This Section specifies administrative and procedural requirements for project closeout, including but not limited to:

Inspection procedures.
Submittal of warranties.
Final cleaning.

Closeout requirements for specific construction activities are included in the appropriate Sections of the specifications.

SUBSTANTIAL COMPLETION

Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following: (List exceptions in the request).

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

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.

Advise Owner of pending insurance change-over requirements.

Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include operating certificates and similar releases.

Submit record drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

Deliver tools, spare parts, extra stock, and similar items.

Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.

Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractor of unfilled requirements. The Engineer 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.

The Engineer will repeat inspection when requested and assured that the Work has been substantially completed. The contractor will be responsible for the engineer's fee for all final inspections requested except for the first final inspection.

Results of the completed inspection will form the basis of requirements for final acceptance.

FINAL ACCEPTANCE

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

Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

Submit an updated final statement, accounting for final additional changes to the Contract Sum.

Submit a certified copy of the Engineer'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 Engineer. Submit consent of surety to final payment.

Submit a final liquidated damages settlement statement.

Submit evidence of final, continuing insurance coverage complying with insurance requirements.

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

Upon completion of reinspection, the Engineer will prepare a certificate 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.

If necessary, reinspection will be repeated. The contractor will be responsible for the cost of all reinspections.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

CLOSEOUT PROCEDURES

Operating and Maintenance Instructions: Arrange for each installer of equipment that requires

regular maintenance to meet with the Owner's personnel to provide instruction in proper

operation and maintenance. Provide instruction by manufacturer's representatives. Include a detailed review of the following items:

Maintenance manuals.
Record documents.
Spare parts and materials.
Tools.
Lubricants.
Identification systems.
Control sequences.
Hazards.
Cleaning.
Warranties and bonds.
Maintenance agreements and similar continuing commitments.

As part of instruction for operating equipment, demonstrate the following procedures:

Start-up.
Shutdown.
Emergency operations.
Safety procedures.
Economy and efficiency adjustments.
Effective energy utilization.

Provide to the Engineer a written record of the training including date of training, personnel present, equipment reviewed and topics discussed.

Provide to the Owner one electronic copy of O&M manuals (pdf format) and five (5) hard copies.

FINAL CLEANING

General: General cleaning during construction is required.

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.

Remove labels that are not permanent labels.

Clean the site of rubbish, litter and other foreign substances. Sweep areas broom clean; remove stains, spills and other foreign deposits.

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

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.

Where extra materials of value remain after completion of associated Work and have become the Owner's property, arrange for disposition of these materials as directed by the owner.

END OF SECTION 01700

SECTION 01720 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

SUMMARY

This Section specifies administrative and procedural requirements for Project Record Documents.

The contractor shall provide a complete set of as-built documents.

As a minimum the following project Record Documents are required:

Marked-up copies of Shop Drawings.
Newly prepared Drawings.
Record information on Work that is recorded only schematically.
Product data

Specific record copy requirements that expand requirements of this Section are included in the individual Sections of the specification.

General project closeout requirements are included in Section "Project Closeout."

In addition to other requirements, complete record drawings shall be provided in AutoCAD 2010 format on CD rom disk.

Maintenance of Documents: Store record documents apart from Contract Documents used for construction. Do not permit Project Record Documents to be used for construction purposes. Maintain record documents in good order, and in a clean, dry, legible condition. Make documents available at all times for inspection by the Engineer.

RECORD DRAWINGS

Mark-up Procedure: During the construction period, maintain a set of blue- or black-line white-prints of Shop Drawings for Project Record Document purposes.

Mark these Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:

Dimensional changes to the Drawings.
Revisions to details shown on the Drawings.
Revisions to routing of conduits and control wiring.
Revisions to electrical circuitry.
Actual equipment locations.
Locations of concealed internal utilities.
Changes made by Change Order.
Details not on original Drawings.

Mark completely and accurately record prints of Shop Drawings, whichever is most capable of showing actual conditions.

Mark record sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of the Work at the same location.

Mark important additional information which was either shown schematically or omitted from original Drawings.

Note construction change directive numbers, alternate numbers, Change Order numbers and similar identification.

Responsibility for Markup: Where feasible, the individual or entity who obtained record data, whether the individual or entity is the installer, subcontractor, or similar entity, is required to prepare the mark-up on record Drawings.

Accurately record information in an understandable Drawing technique.

Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.

At time of Substantial Completion, submit record Drawings to Engineer for Owner's records. Organize into sets, bind and label sets for Owner's continued use.

Newly Prepared Record Drawings: Prepare new Drawings instead of following procedures specified for preparation of record Drawings where new Drawings are required by a Change Order issued as a result of acceptance of an alternate, substitution, or other modification, and the Engineer determines that the Shop Drawings are not suitable to show the actual installation.

RECORD PRODUCT DATA

During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.

Mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site, and changes in manufacturer's instructions and recommendations for installation.

Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

Note related Change Orders and mark-up of record Drawings, where applicable.
Upon completion of mark-up, submit a complete set of record Product Data to the Engineer for the Owner's records.

Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual, instead of submittal as record Product Data.

In addition to the above deliverables, this contractor shall provide (minimum 5 sets) As-Built drawings, approved shop drawings and maintenance manuals in CD (Compact Disk) format to the Engineer.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

RECORDING

Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project. The Engineer will periodically review record documents to assure compliance with this requirement.

END OF SECTION 01720

SECTION 01730 - OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

SUMMARY

This Section specifies administrative and procedural requirements for operating and maintenance manuals including the following:

Preparation and submittal of operating and maintenance manuals for equipment;

Instruction of the Owner's operating personnel in operation and maintenance of equipment.

Special operating and maintenance data requirements for specific pieces of equipment or building operating systems are included in the appropriate Sections of the specification.

General closeout requirements are included in Section "Project Closeout."

QUALITY ASSURANCE

Maintenance Manual Preparation: In preparation of Maintenance Manuals, use personnel thoroughly trained and experienced in operation and maintenance of the equipment or system involved.

Instructions for the Owner's Personnel: For instruction of the Owner's operating and maintenance personnel, use experienced instructors thoroughly trained and experienced in the operation and maintenance of the building equipment or system involved.

SUBMITTALS

Submittal Schedule: Comply with the following schedule for submittal of operating and maintenance manuals.

Before Substantial Completion, when the installation is nominally complete, submit two draft copies of each manual to the Engineer for review. Include a complete index or table of contents of each manual.

The Engineer will return one copy of the draft with comments within fifteen days of receipt.

Submit one copy of data in final form at least fifteen days before final inspection. This copy will be returned within fifteen days after final inspection, with comments.

After final inspection make corrections or modifications to comply with the Engineers comments. Submit the specified number of copies (minimum 5 sets) of each approved manual to the Engineer within fifteen days of receipt of the Engineer's comments.

Form of Submittal: Prepare operating and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel.

Binders: For each manual, provide heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2" by 11" paper. Provide a clear plastic sleeve on the spine, to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.

Dividers: Provide heavy paper dividers with celluloid covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.

Text Material: Where written material is required as part of the manual use the manufacturer's standard printed material, or if it is not available, specially prepared data, neatly typewritten, on 8-1/2" by 11".

Drawings: Where drawings or diagrams are required as part of the manual, provide reinforced punched binder tabs on the drawings and bind in with the text.

If drawings are too large to be used practically as a fold-out, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents and drawing location at the appropriate location in the manual.

Electronic: Scan or convert operating and maintenance manual materials to PDF format in addition to five (5) hard paper copies. PDF files shall be copied onto compact discs, arranged in a way that mirrors the hard copy.

MANUAL CONTENT

In each manual include information specified in the individual Specification Section, and the following information for each major component of building equipment and its controls:

General equipment description
Design factors and assumptions
Copies of applicable Shop Drawings and Product Data

Equipment identification, including:
- Name of manufacturer
- Model number
- Serial number of each component
- Operating instructions
- Emergency instructions
- Complete wiring diagrams and schematics
- Complete troubleshooting guide
- Inspection and test procedures
- Maintenance procedures and schedules
- Precautions against improper use and maintenance
- Copies of warranties
- Repair instructions including spare parts listing
- Sources of required maintenance materials and related services
- Manual Index

Organize each manual into separate Sections for each piece of related equipment. As a minimum each manual shall contain a title page, a table of contents, copies of Product Data, supplemented by drawings and written text, and copies of each warranty, bond and service Contract issued.

Title Page: Provide a title page in a transparent plastic envelope as the first sheet of each manual. Provide the following information:

Subject matter covered by the manual
Name and address of the Project
Date of submittal
Name, address, and telephone number of the Contractor
Name and address of the Engineer

Table of Contents: After the Title Page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.

General Information: Provide a general information Section immediately following the Table of Contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the Subcontractor or installer, and the maintenance contractor. List a local source for replacement parts and equipment.

Product Data: Where manufacturer's standard printed data is included in the manuals, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one item in a tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation and delete references to information that is not applicable.

Written Text: Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data included in the manual, prepare written text to provide necessary information. Organize the text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure.

Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems, or to provide control or flow diagrams. Coordinate these drawings with information contained in Project Record Drawings to assure correct illustration of the completed installation.

Do not use original Project Record Documents as part of the Operating and Maintenance Manuals.

Warranties, Bonds and Service Contracts: Provide a copy of each warranty, bond or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to be followed in the event of product failure. List circumstances and conditions that would affect validity of the warranty or bond.

EQUIPMENT MAINTENANCE MANUAL

Submit three copies of each completed manual on equipment in final form, to the Engineer for distribution. Provide one compact disc with drawings and manual information in PDF format.

Refer to Specification Sections for additional requirements on operating and maintenance of the various pieces of equipment.

Equipment: Provide the following information for each piece of equipment.

Description: Provide a complete description of each unit and related component parts, including the following:

Equipment
Operating characteristics
Limiting conditions
Performance curves
Engineering data and tests
Complete nomenclature and number of replacement parts

Manufacturer's Information: For each manufacturer of a piece of equipment provide the following:

Printed operating and maintenance instructions.

Assembly drawings and diagrams indicating all components within the system. List of items recommended to be stocked as spare parts.

Include name, address and phone number of local vendor, local service representative and technical support organization.

Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:

Routine operations
Trouble-shooting guide
Disassembly, repair and reassembly
Adjusting and checking

Operating Procedures: Provide information on equipment operating procedures, including the following:

Start-up procedures
Equipment or system break-in
Routine and normal operating instructions
Regulation and control procedures
Instructions on stopping
Shut-down and emergency instructions
Required sequences for electric or electronic systems
Special operating Instructions

Schedule: Provide complete information in the equipment manual on products specified in Division 16.

INSTRUCTIONS OF THE OWNER'S PERSONNEL

Prior to final inspection, instruct the Owner's personnel in operation, adjustment, and maintenance of products and equipment. Provide instruction at mutually agreed upon times.

Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

All training shall be conducted at the facility. If training is to be conducted at any other facility, the contractor shall pay all costs associated with sending the facility's personnel to the training facility to include meals, lodging and transportation costs.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01730

SECTION 15010 – MECHANICAL REQUIREMENTS

PART 1 - GENERAL

This section applies to all Division 15 specifications and trades.

Cooperate with all other trades and install work as fast as the progress of the job will permit.

Use only mechanics skilled in the work they are to perform and have a competent representative on the job when any work is being done.

No work shall be done unless the Superintendent of the Contractor is on the job site. Work shall be properly protected, all rubbish removed promptly, and exposed work shall be carefully cleaned prior to final acceptance.

In decisions arising from discrepancies, interpretation of Drawings, and Specifications, substitutes, and other pertinent matters, the decision of the Owner's representative shall be final unless the Contractor seeks relief per the General Conditions.

QUALITY ASSURANCE

Applicable welding certifications, procedures, and testing shall comply with ANSI Standard B31.9 – Standard Code for Building Services Piping, and The American Welding Society, Welding Handbook.

WARRANTY

Contractor shall provide a one year parts and labor warranty on all equipment provided on this project. Warranty shall start on the date of substantial completion. Contractor shall purchase manufacturer's warranty for all HVAC equipment as indicated in specifications.

RELATED DOCUMENTS

Work herein shall conform to all applicable laws, ordinances, codes, regulations and local utility companies' rules. The general conditions and all requirements of the contract documents shall apply to all work of this section. Work shall be in accordance with the latest requirements and addendums as of the date of this specification unless otherwise noted:

NFPA 13 – Installation of Sprinkler Systems
NFPA 70 – National Electrical Code
NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
NFPA 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
NFPA 92A –Standard for Smoke Control Systems
NFPA 101 – Life Safety Code
NFPA 105 – Recommended practice for the Installation of Air Conditioning and Ventilating Systems
NFPA 170 – Fire Safety Symbols
NFPA 241 – Standard for Safeguarding Building Construction and Demolition Operations.
NFPA 251 – Standard Methods of Fire Testing of Building Construction and Materials Tests of Door Assemblies
NFPA 252 – Standard Methods of Fire Test of Door Assemblies NFPA 257 - 2000, Standard for Fire Tests of Window Assemblies

NFPA 701 – Standard Methods of Fire Tests for Flame Resistant Textiles and Films
NFPA 703 – Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials
2007, The State Fire Prevention Code (with 2009 Revisions)
2007 Florida Building Code (with 2009 Supplements)
State of Florida, Department of Environmental Protection Rules
State of Florida, State Fire Marshal, Rules and Regulations
SMACNA, HVAC Duct Construction Standards
Americans with Disabilities Act
Florida Accessibility Code for Building Construction

DEFINITIONS

Furnish: Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.

Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, start-up and similar requirements.

Provide: Furnish and install, complete and ready for intended use.

Installer: Entity (firm or person) engaged to install work by Contractor, subcontractor or sub-subcontractor. Installers are required to be skilled experts in work they are engaged to install.

Specification Text Format: Any underscoring facilitates scan reading, no other meaning. Imperative language is directed at Contractor, unless otherwise noted.

SPECIFICATIONS AND DRAWINGS

Plans show locations of equipment and are intended to depict the general intent of the work in scope, layout and quality of workmanship. They are not intended to show in minute detail every or all accessories intended for the purpose of executing the work, but it is understood that such details are a part of this work.

Where Drawings and Specifications conflict, it shall be the responsibility of this Contractor to bring such conflict to the attention of the Architect/Engineer for clarification. If the contractor fails to bring the conflict to the Engineer's attention, the most stringent (most costly) requirements apply. All changes from the Drawings necessary to make the work conform with the building as constructed and to fit the work of other trades or to conform to the rules of authorities having jurisdiction, shall be made by the Contractor at his own expense.

Keep a record of the locations of concealed work and of any field changes in Contract Drawings and Specifications for each trade and, upon completion of the job, supply "As-Built" Drawings and Specifications showing, in pencil on sepia reproducibles, any deviations from the original Drawings indicating in the Specifications each manufacturer's name underlined or inserted whose product was used on the job. These Drawings shall indicate dimensions of buried utility lines from building walls. One set of sepia reproducibles of the original tracings will be furnished upon request for this purpose. Provide record documents in accordance with the General Conditions.

Where equipment is used other than manufacturers specified, the Contractor shall request approval to substitute materials and/or products in accordance with the General Conditions.

The Contractor shall lay out all the work as required by the drawings and be held responsible for damage, if any is incurred, due to incorrect layout of work. The Contractor shall establish all

building lines, bench marks, and levels from which all trades can work, and take necessary measures to keep the marks in visible evidence throughout all stages of the work.

The Contractor shall comply with all rules and regulations of the Florida Industrial Commission, the State and Federal Departments of Commerce and Labor, EPA regulations, and the OSHA Laws, as they may apply to the work. The Contractor shall also comply with all Owner policies while on-site.

By submitting a bid for equipment other than the "Design Basis Equipment" (i.e., which is shown on the Contract Drawings), the Contractor:

1. Represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified and complies with all the requirements set forth in the General Conditions;

2. Certifies that the cost data presented is complete and includes all related costs under this Contract but excludes costs under separate contracts, and excludes the Engineer's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent;

3. Will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects; and,

4. Certifies that the proposed equipment meets the requirements of the Contract Documents.

PERMITS, FEES, AND INSPECTIONS

The Contractor shall give all necessary notices, obtain all permits and pay all government fees, and other costs, and file all permit applications required by all governmental departments having jurisdiction.

Obtain all required certificates of inspection for work and deliver them to the Owner before requesting acceptance and final payment for the work.

The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations.

The Contractor shall inform the Owner of any work or materials which conflict with any of the applicable codes, standards, laws and regulations before submitting his bid.

GENERAL

Materials or products specified herein and/or indicated on drawings by trade name, manufacturer's name and/or catalog number shall be provided as specified. Substitutions will not be permitted except as described herein and in the General Conditions.

All materials shall be new and of quality as specified, and when required, be clearly labeled and/or stamped as manufactured in the United States.

A list of all materials and equipment which the Contractor proposes to furnish shall be submitted for approval within ten (10) days after the contract has been awarded. Data shall be complete in all respects.

RENOVATION WORK

Areas under renovation which are adjacent to occupied areas shall be sealed off and maintained under a negative pressure during construction. If existing exhaust fans are used then the ducts shall be cleaned after construction is complete but before final test and balance.

SHOP & ERECTION DRAWINGS

Submit shop drawings for all components in the proposed system for review by Owner's representative before ordering or installing any equipment or material. Equipment or material ordered or installed before Owner's representative review may not be accepted and will have to be removed from the project.

Shop drawings shall consist of manufacturer's scale drawings, cuts or catalogs, including descriptive literature which shall clearly indicate the construction, material, physical dimensions, wiring diagrams and complete operating data clearly marked for each item. Data of general nature will not be accepted.

Submit shop drawings in accordance with the General Conditions.

COORDINATION DRAWINGS

Prepare coordination drawings when alternate manufacturers are proposed of space containing air handling units, pumps, chillers, water heaters or similar large mechanical equipment detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Drawings shall be prepared at a scale of 1/4" - 1'0" or larger. Indicate locations of access and where sequencing and coordination of installations are of importance to the efficient flow of the Work.

Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following: Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance; Equipment connections and support details; Exterior wall and foundation penetrations; Fire-rated wall and floor penetrations; concrete pads and bases.

Floor plans, elevations, and details shall indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

MECHANICAL EQUIPMENT CLEARANCES

Maintain three (3) feet clearance in front of mechanical equipment requiring maintenance. Pay close attention to access doors of new and existing equipment.

ROUGH-IN

For all piping and equipment field verify final locations for rough-ins with actual field measurements and with the requirements of the actual equipment to be connected.

EXPERIENCE

The Contractor performing this work shall be a Florida licensed, reputable firm, regularly performing the type of work incorporated in this project and who also maintains, as part of the firm, a service department with qualified personnel who regularly perform this type of work. The

Contractor shall, upon request, show evidence of at least two jobs of similar scope and size either completed or under contract within the preceding two years.

ELECTRICAL WORK FOR MECHANICAL SYSTEMS

All electrical components shall be UL listed. All wiring components and devices shall conform to the National Electrical Code.

WIRING FOR MECHANICAL EQUIPMENT

All power wiring for mechanical equipment shall be provided by Division 16.

All control wiring for mechanical equipment shall be provided by Division 15. Control wiring shall be defined as all wiring not in the direct path of supplying power to the mechanical equipment.

MOTORS

All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. Motors shall be rated explosion proof when located in hazardous atmospheres.

Unless indicated otherwise, motors shall be NEMA Design B with a service factor of 1.15 with total temperature rise of 50°C (resistance measured) in 40°C ambient when powered from the system voltage feeding the motor. TEFC motors shall have class F insulation and ODP motors shall have class B insulation. Motors located in areas exceeding 40 degrees C. ambient shall be factory rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Design N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less shall be P-S-C motors. Inverter duty motors shall be provided if connected to a variable frequency drive.

All motors supplied on this project one (1) HP and larger shall have an efficiency which meets or exceeds the efficiency shown in Table 1 tested in accordance with IEEE Standard 112, Test Method B, and shall have a power factor not less than 85 percent under rated load conditions. Power factor of less than 85 percent shall be corrected to at least 90 percent under rated load conditions. Power factor corrective devices, installed to comply with this requirement, shall be switched with the utilization equipment.

Table 1

Motor Horsepower	Open Motors Minimum Nominal Efficiency	Enclosed Motors Minimum Nominal Efficiency
1	82.5	82.5
1.5	84.0	84.0
2	84.0	84.0
3	86.5	87.5
5	87.5	87.5
7.5	88.5	89.5
10	89.5	89.5
15	91.7	91.7
20	92.4	92.4
25	92.4	92.4
30	93.0	93.0
40	93.6	93.6
50	93.6	93.6
60	93.6	93.6
75	94.1	94.1
100	94.1	94.5
125	94.5	94.5
150	95.0	95.0

REMOVAL OF RUBBISH

Contractor shall keep premises free from accumulations of waste material or rubbish caused by his employees or work. At completion of work, he shall remove all his tools, scaffolding, surplus materials, and rubbish from building and site. He shall leave premises and his work in a clean orderly condition acceptable to the Owner's representative.

QUIET OPERATION AND VIBRATION

All equipment provided under this section shall operate under all conditions of load free of abnormal sound and vibration. Sound and vibration conditions considered abnormal shall be corrected in an approved manner at no additional cost to the owner.

EXAMINATION OF EXISTING CONDITIONS

Visit and carefully examine those portions of the site and/or present buildings affected by this work so as to become familiar with existing conditions and difficulties that will affect the execution of the work before submitting proposals.

Submission of a proposal will be construed as evidence that such examination has been made and later claims for labor, equipment, or materials required because of difficulties encountered, which could have been foreseen had such examination been made, will not be recognized.

CLEANING AND ADJUSTMENTS

Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

Upon completion of work, Contractor shall clean and lubricate pumps, fans, motors, and other running equipment and apparatus which he has installed and make certain such apparatus and mechanisms are in proper working order and ready to test.

Scratched or damaged painting shall be touched up as necessary to return the painting to "new" condition and appearance.

All piping and equipment shall be thoroughly blown out under pressure and cleared of all foreign matter, wasting air, gas or water through temporary connections as long as necessary to thoroughly clean system before system is placed in operation. Use every precaution to prevent pipe compound, scale, dirt, welding, and other objectionable matter from getting into the piping system and equipment.

During blow out period, baskets from strainers shall be removed, traps and control valves, etc., shall be by-passed.

All cleaning shall be done prior to any pressure testing, flow balancing or equipment adjustment procedures.

DEMOLITION

Demolition shall be as shown on drawings or specified.

Schedule all demolition work with Owner to cause minimum downtime of any building service or function. No extra cost to the contract will be allowed for overtime work unless specifically authorized in advance by representative or Owner in writing.

During demolition and construction, protect from damage all existing equipment and services that are to remain. Repair or replace any damage to existing facilities at no extra cost to the contract.

Remove with care and deliver to a location designated by representative of the Owner all items designated to remain the property of the Owner.

Drawings are diagrammatic and show only major obstructions; coordinate with other trades for removal or relocation of pipes, conduits, hangers, etc., in path of work.

No columns, beams, joists, building foundations nor any other structural building component shall be cut, drilled, or disturbed in any way. Conflicts shall immediately be brought to the attention of the Owner's representative. Contractor shall not proceed until instructed in writing by the Owner's representative if conflicts between mechanical work and structural elements occur.

Temporary Removal: Carefully remove, store, clean, reinstall, reconnect, and make operational equipment indicated to be reused. Prior to removal Contractor shall inspect existing equipment and note any deficiencies and repairs needed. Failure to note deficiencies will require the Contractor to repair the equipment for no additional cost.

Demolish and remove inactive and obsolete piping, fittings, and specialties, equipment, ductwork, controls, fixtures, and insulation.

Piping and ducts embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations.
Demolish and remove obsolete and abandoned exposed piping and ducts to a point flush with floors and walls. Remove materials above accessible ceilings and below raised floors. Drain and cap piping and ducts allowed to remain.

CONNECTIONS TO EXISTING WORK

Plan installation of new work and connections to existing work to insure minimum interference with regular operation of existing facilities.

Submit to the Owner for approval, a schedule of necessary temporary shut-downs of existing services. All shutdowns shall be made at such times as will not interfere with regular operation of existing facilities and only after written approval of the Owner.

To insure continuous operation, make necessary temporary connections between new and existing work.

Connect new work to existing work in neat and approved manner. Restore disturbed existing work to original condition.

After completion of project clean the exterior surface of equipment included in this section, remove all concrete residues and touch up paint or completely repaint all damaged surfaces.

STORAGE OF MATERIALS

All materials stored on site shall be in a Contractor supplied trailer or enclosure and shall be properly protected from injury or deterioration. Materials shall not be stored in contact with ground or floor.

Do not remove manufacturer's packing materials until ready to install. Materials showing signs of corrosion, improper handling or storage shall be replaced at no cost to the Owner.
During construction protect all piping and equipment from damage and dirt. Cap the open ends of all piping and equipment.

Provide continuous protection for all equipment already installed.

WATERPROOFING

Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Owner before the work is done.

Provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight. Waterproof flashing materials shall be compatible with base materials.

TESTS

Contractor shall make all tests required to establish the adequacy, quality, safety, completed status, and satisfactory operation of all systems to the satisfaction of the Owner's representative. Provide all instruments, labor, and services necessary to conduct tests.

INSTRUCTIONS

Fully instruct Owner's personnel in the care and operation of mechanical systems and furnish a letter to the Owner's representative advising the particular person who has received such instruction.

END OF SECTION 15010

SECTION 15030 - ELECTRICAL REQUIREMENTS FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

RELATED DOCUMENTS

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

Related Sections: Other separate electrical components and materials required for field installation and electrical connections are specified in Division 16. Refer to other sections of Division 15 specifications for related work or requirements.

SUMMARY

This section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment or are separate electrical components provided for mechanical equipment. These components include, but are not limited to motors, starters, disconnect switches and variable frequency drives furnished either as a separate or integral part of packaged mechanical equipment as specified.

Specific electrical requirements (i.e., horsepower and electrical characteristics, etc.) for mechanical equipment are specified within the individual equipment specification sections.

REFERENCES

NEMA Standards MG 1: Motors and Generators.
NEMA Standards ICS 2: Industrial Controls Devices, Controllers, and Assemblies.
NEMA Standard 250: Enclosures for Electrical Equipment.
NEMA Standard KS 1: Enclosed Switches.
Comply with National Electrical Code (NFPA 70).

SUBMITTALS

Product Data: Submit manufacturer's technical product data and installation instructions for each material described in this section as is applicable. These submittals and shop drawings shall be in no less detail than the product, material and installation descriptions provided herein and on the drawings. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

QUALITY ASSURANCE

Electrical components and materials shall be UL labeled.

MOTOR STARTERS

Motor Starter Characteristics:

Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.

Type and size of starter shall be as recommended by the motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

Manual switches shall have:

Pilot lights and extra positions for multi-speed motors.

Overload protection: melting alloy type thermal overload relays.

Magnetic Starters:

Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

Trip-free thermal overload relays, each phase.

Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division - 15 Controls sections.

Built-in 120 volts control circuit transformer, fused from line side, where service exceeds 240 volts.

Externally operated manual reset.

Under-voltage release or protection.

DISCONNECTS SWITCHES

Fusible switches: Fused, each phase; general duty; horsepower rated; non-feasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "Open" position; arc quenchers; capacity and characteristics as indicated.

Non-fusible switches: For equipment 2 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating is indicated. For equipment larger than 2 horsepower, switches shall be the same as fusible type.

PART 3 - EXECUTION

GENERAL

Division 15 contractor shall provide all starters, contactors, and disconnects required to operate mechanical equipment provided by this Division 15 contractor unless specifically stated otherwise on the plans or in these specifications, including Division 16 plans and specifications.

WIRING FOR MECHANICAL EQUIPMENT

All power wiring for mechanical equipment shall be provided by Division 16 as required, unless stated otherwise in Division 15.

Wiring that is required as a part of Division 15 shall conform to the requirements for wiring methods and materials as stated in Division 16.

Provided detailed composite wiring diagrams for all control systems and equipment which may be required by Division 15. Verify electrical characteristics of equipment before ordering and finalize with Division 16. Reference electrical drawings for electrical characteristics of equipment specified herein and on the plans.

Division 15 shall be responsible for the correct functioning of all the control systems and equipment supplied by Division 15.

END OF SECTION 15030

SECTION 15050 – BASIC MATERIALS AND METHODS

PART 1 - GENERAL

SUMMARY

This Section specifies mechanical components and installation methods common to more than one section of Division 15 and shall apply to all Division 15 work as is applicable.

SUBMITTALS

Product Data: Submit manufacturer's technical product data and installation instructions for each material described in this section as is applicable. These submittals and shop drawings shall be in no less detail than the product, material and installation descriptions provided herein and on the drawings.

PART 2 - PRODUCTS

FIRE STOPS

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

Fire-Resistant Joint Sealers: Two-part foamed-in-place silicone sealant, intumescent putty, or one-part silicone elastomeric 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 provide fire-resistance ratings to three hours protection, 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.

Acceptable Manufacturers:

- 3-M Corporation
- Dow-Corning Corp.
- General Electric Co.
- Nelson Flame Seal
- Fire Stop V

Submit manufacturer's technical data for each produce used and include installation instructions, and material safety data sheets.

CEILING/WALL ACCESS DOORS

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.

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

For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
For gypsum wallboard or plaster: perforated flanges with wallboard bead.

For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

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.

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

Locking Devices: Flush, screwdriver-operated cam locks.

Available Manufacturers:

Bar-Co., Inc.
J.L.Industries
Karp Associates, Inc.
Milcor Div.
Inryco, Inc.
Nystrom, Inc.

PART 3 - EXECUTION

EXAMINATION

DELIVERY, STORAGE, AND HANDLING

Deliver fire stop materials and similar type items 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.

Store and handle all materials in compliance with the manufacturer's recommendations to prevent their deterioration and damage.

CONTROLS COORDINATION

The mechanical contractor shall install control valves/actuators, damper actuators, immersion wells, pressure sensor taps, flow meters, airflow stations, etc. which are to be furnished by the controls contractor. Coordinate with EMCS Contractor. Refer to Controls Specifications and Drawings.

MECHANICAL EQUIPMENT NAMEPLATE DATA

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 compliance, and similar essential data. Locate nameplates in an accessible location. Where equipment is insulated or otherwise concealed, nameplates shall be located so as to be visible with insulation installed.

IDENTIFICATION

Provide a complete identification system for all systems. All equipment, valves, controls and piping shall be identified and marked as specified below. All numbers and letters shall be manufacturer's standard block lettering.

Provide a typed index of all abbreviations and numbering systems used in the identification

system. Coordinate names, abbreviations and number with those used on the drawings.

Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering of finish, including valve tags in finished mechanical spaces, install identification prior to installation of acoustical ceiling and similar removable concealment.

VALVE IDENTIFICATION

General: Provide valve tag on every valve, cock and control device in each piping system; exclude check 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.

Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

EQUIPMENT IDENTIFICATION

Each unit furnished shall be identified by its system number and other appropriate designation as directed by the owner. Minimum requirements include engraved plastic laminate signs (1/8" thick) permanently attached to each piece of equipment. Equipment requiring identification shall include but not be limited to: pumps, chillers, cooling towers, controls, and other equipment as may be directed by the Owner's representative. The contractor shall submit proposed equipment identification system with shop drawings.

PIPING IDENTIFICATION

Provide plastic pipe markers for all new piping systems using plastic pipe markers specified below.

PLASTIC PIPE MARKERS

Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded (coordinate with owner), pressure-sensitive vinyl pipe markers, complying with ANSI A13.1. Band pressure-sensitive type pipe markers to pipe.

Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 deg.F (52 deg.C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

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

Adhesive lap joint in pipe marker overlap.

Laminated or bonded application of pipe marker to pipe (or insulation).

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".

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:

Laminated or bonded application of pipe marker to pipe (or insulation).

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".

Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

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.

Plastic Tape: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

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.
Color: Comply with ANSI A13.1, except where another color selection is indicated.

PIPING IDENTIFICATION INSTALLATION

General: Install pipe markers on each system provided and include arrows to show normal direction of flow:

Plastic pipe markers, with application system as indicated above. Install on pipe insulation segment where required for hot non-insulated pipes.

Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

Near each valve and control device.

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.

Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
At access doors, manholes and similar access points which permit view of concealed piping.

Near major equipment items and other points of origination and termination.

Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.

On piping above removable acoustical ceilings, except omit intermediately spaced markers.

VALVE TAGS

Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers ½" high, and 5/32" hole for fastener.
Provide 1-1/2" diameter tags, except as otherwise indicated.

Provide size and shape as specified or scheduled for each piping system.

Fill tag engraving with black enamel.

Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hold to allow attachment.

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.

Provide UL label on each fire-rated access door.

VALVE SCHEDULE FRAMES

General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

PLASTICIZED TAGS

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).

LETTERING AND GRAPHICS

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.

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).

DUCT SYSTEM IDENTIFICATION

General: Identify air supply, return, exhaust, intake, outside air, and relief ducts with duct markers or stenciled signs and arrows, showing duct system service and direction of flow. Locate in each space where ducts are exposed and where ducts are located above accessible

ceiling systems. Locate near points where duct enter the space and at maximum 50 foot intervals.

Identify the location of all fire and fire/smoke dampers. Identification tags shall be affixed to the ceiling/wall and shall be visible from the occupied space.

EQUIPMENT SUPPORTS

Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

Grouting: Place grout under supports for piping and equipment.

CUTTING, PATCHING, AND LAYOUT

Provide openings required for the installation of the work. Patch work as required. Finished work shall match the existing adjoining work.

Verify all conditions affecting the work to be performed under this contract.

Carefully verify measurements at the site, determine the exact location of chases and openings required. Provide sleeves, inserts, and hangers as required. No columns, beams, joists, building foundations or any other structural building component shall be cut, drilled or disturbed in any way. Conflicts shall immediately be brought to the attention of the Owner's representative.

Any damage incurred by the Contractor shall be repaired by the Contractor in a manner approved by the Owner's representative at no cost to the Owner and with no extension of time limitation.

APPLICATION OF JOINT SEALERS

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

Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.

Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

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

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.

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.

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.

INSTALLATION OF ACCESS DOORS

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

Adjust hardware and panels after installation for proper operation.

SMOKE DETECTORS

Install smoke detectors as indicated on drawings and comply with these specifications and the manufacturer's instructions. Install in an accessible area or provide access door if installed above a hard ceiling. Smoke detectors installed prior to the air handler shall be installed in the return air duct prior to mixing with outside air. Install level so sampling tube openings are directly exposed to air flow. Coordinate the following application considerations with the Division 16 contractor who will furnish smoke detectors.

Application Considerations:

Only one detector is required per location, regardless of volume of air, if:

The sampling tube extends at least 3/4 of the total width of the duct and is located approximately at the center of the vertical dimension of the duct, and

There is no air inlet to the duct upstream.

If, however, there is an inlet within a distance of six duct widths upstream:

Use one detector for each four feet of vertical height (lower sampling tube located two feet above the bottom of the duct and additional sampling tubes mounted four feet on center of vertical height).

For ducts wider than 12 feet use two detectors for each position, mounted on opposite sides of the duct.

The above recommended detector limits apply to both the return air and supply air locations as required.

PAINTING/PROTECTIVE COATINGS

Prime and paint (2 coats) all piping, insulation, unpainted equipment or steel, structural bases and supports provided in Division 15. Paint shall be industrial grade enamel; match existing color scheme or as directed by the Owner.

Uninsulated piping, bases, supports and other unfinished steel shall be thoroughly cleaned of all rust and dirt. Apply one coat of rust inhibiting primer and two finishing coats.

Insulated piping and equipment shall receive one coat of glue sizing and two finishing coats.

COMMISSIONING

Install strainers with start-up screens.

Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water. Sanitize domestic water systems. Perform initial chemical treatment of hydronic and systems.

Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

After operating system to remove solids, remove start-up screens and provide standard screen.

Before operating the system perform these steps:

Open valves to full open position. Close coil bypass valves.

Remove and clean strainers.

Check pump for proper direction of correct improper wiring.

Set automatic fill valves for required system pressure.

Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).

Set temperature controls so all coils are calling for full flow.

Check operation of automatic bypass valves.

Install minimum 30% efficient ASHRAE filters for start-up and install all new pre and final filters prior to test and balance.

Check and set operating temperatures of chillers to design requirements.

Lubricate motors and bearings.

Close drain valve, hydrants, and hose bibbs.

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.

Review data in Operating and Maintenance Manuals. Refer to Division 1 section "Project Closeout."

Schedule training with Owner through the Architect, with at least 7 days advance notice.

END OF SECTION 15050

SECTION 15055 - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

RELATED DOCUMENTS:

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

SUMMARY:

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.

Related Sections:

Division 15 Mechanical Requirements section applies to the work at this Section.

Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Divisions 2 and 15.

Valves are specified in a separate section and in individual piping system sections of Division 15.

Supports and Anchors are specified in a separate section of Division 15.

Mechanical Identification is specified in a separate section of Division 15.

Fire Barrier Penetration Seals are specified in Division 7 and/or Section 15050.

SUBMITTALS:

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

Product Data: Submit product data on the following items:

Escutcheons
Dielectric Unions and Fittings
Mechanical Sleeve Seals
Strainers

DELIVERY, STORAGE, AND HANDLING:

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.

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.

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

PART 2 - PRODUCTS

MANUFACTURERS:

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

Pipe Escutcheons:
- Chicago Specialty Mfg. Co.
- Sanitary-Dash Mfg. Co.
- Grinnell

Dielectric Waterway Fittings:
- Epco Sales, Inc.
- Victaulic Company of America

Dielectric Unions:
- Eclipse, Inc.
- Perfection Corp.
- Watts Regulator Co.

Strainers:
- Armstrong Machine Works.
- Hoffman Specialty ITT; Fluid Handling Div.
- Metraflex Co.
- R-P&C Valve; Div. White Consolidated Industries, Inc.
- Spirax Sarco.
- Trane Co.
- Victaulic Co. of America. (low pressure applications only)
- Watts Regulator Co.

PIPE AND FITTINGS:

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

JOINING MATERIALS:

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.

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.

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

LEAD SOLDER:

Contractor shall be responsible for the removal and replacement of any material used on the Project which contains lead solder.

Contractor shall provide a notarized statement addressed to the Owner stating that no lead solder material has been used or installed on the Project. This statement shall be submitted to the Engineer prior to authorization of Final Payment.

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.

PIPING SPECIALTIES:

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

Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service (i.e., over 80 PSI); hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

Dielectric Unions: Provide Class 250 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.

Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150-or 300 psig (1035kPA or 2070kPa) minimum pressure to suit system pressures.

Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

> Provide separate companion flanges and steel bolts and nuts for 150-or 300 psig (1035kPa or 2070kPa) minimum working pressure to suit system pressures.

Dielectric Couplings: Galvanized-steel coupling, having inert and non-corrosive, thermoplastic lining, with threaded ends and 300-psig (2070kPa) minimum working pressure at 225 deg. F (107 deg. C) temperature.

Dielectric Nipples: Electroplated steel nipple, having inert and non-corrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig (2070kPa) working pressure at 225 deg. F (107 deg. C) temperature.

Connections between PVC and flanged steel or cast-iron pipe shall be made with a ductile iron bolt-on adaptor flange, equal to Uni-Flange Corp. Series 900.

Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin.

Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per

square inch.

Provide strainers with 125 psi working pressure rating for low pressure applications, and 250 psi pressure rating for high pressure application.

Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.

Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.

Butt Welded Ends, 2-1/2" and Larger For Low Pressure Application: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.

Butt Welded Ends, 2-1/2" and Larger For High Pressure Application: Schedule 80 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.

Grooved Ends, 2-1/2" and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

Sleeves:

Sheet-Metal Sleeves: 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.

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

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.

Sleeves for Copper or Brass Pipe: Same material as pipe.

PART 3 - EXECUTION

PREPARATION:

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

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

INSTALLATIONS:

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.

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

Exterior Wall Penetrations: Use steel pipe sleeves for all penetrations smaller than 6" and 10 gauge sheet metal for all penetrations over 6".

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

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

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.

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

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.

Exterior Wall Penetrations (Sleeve Seals): 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.

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 and Section 15050 for special sealers and materials.

FITTINGS AND SPECIALTIES:

Use domestically manufactured fittings for all changes in direction and all branch connections.

Remake leaking joints using new materials.

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

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.

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

Install flexible connectors at inlet and discharge connections to pumps and other vibration producing equipment.

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

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

JOINTS:

Steel Pipe Joints:

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.

Pipe Larger Than 2":

Weld pipe joints in accordance with ANSI/AWS D10/12 - 89, Recommended Practices and Procedures for Welding Low Carbon Steel Pipe.

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.

Non-ferrous Pipe Joints:

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.

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.

Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

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

FIELD QUALITY CONTROL:

Testing: Refer to individual piping system specification sections.

END OF SECTION 15055

SECTION 15100 – VALVES

PART 1 - GENERAL

SUMMARY

This Section includes general duty valves common to most mechanical piping systems.

Special purpose valves are specified in individual piping system specifications.

SUBMITTALS

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

Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

QUALITY ASSURANCE

Single Source Responsibility: Valves of same type shall be provided by the same manufacturer.

American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

MANUFACTURERS

Manufacturers: Subject to compliance with requirements, provide products from one of the manufacturers listed below:

Armstrong
Crane
Grinnell
Hammond
Jenkins
Lunkenheimer
Milwaukee
Nibco
Powell
Stockham
Jomar

DELIVERY, STORAGE, AND HANDLING

Preparation For Transport: Prepare valves for shipping as follows:

Ensure valves are dry and internally protected against rust and corrosion.

Protect valve ends against damage to threads, flange faces, and weld-end preps.

Set valves in best position for handling. Set globe and gate valves closed to prevent rattling; set ball and plug valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.

Storage: Use the following precautions during storage:

Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.

Protect valves from weather; store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use hand wheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

VALVE FEATURES, GENERAL

Valve Design: Rising stem or rising outside screw and yoke stems.

Non-rising stem valves may be used where headroom prevents full extension of rising stems.

Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

Sizes: Same size as upstream pipe, unless otherwise indicated.

Operators: Provide the following special operator features:

Hand wheels, fastened to valve stem, for valves other than quarter turn.

Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves. Provide memory stops on valves used for balancing. Provide plug valves with square heads; provide one wrench for every 10 plug valves.

Chain wheel operators, for values 2-1/2 inch and larger, installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.

Gear drive operators, on quarter-turn valves 8-inch and larger.

Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

End Connections: As indicated in the valve specifications.

Threads: Comply with ANSI B1.20.1.

Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

Solder-Joint: Comply with ANSI B16.18.

Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

GATE VALVES

Cast bronze 2 Inch and Smaller: MSS-SP-80

- Class 125 and 150 - ASTM B-62 cast bronze body and union bonnet.
- Class 250 - ASTM B-61 cast bronze body and union bonnet.

Threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, malleable iron hand wheel. Do not use solder end valves for hot water heating or steam piping applications. Use where system temperature and pressure is applicable.

Iron 2-1/2 Inch and Larger: MSS-SP-70

- Class 125 and 250 - ASTM A-126 Class B body and bolted bonnet.
- Class 150 - ASTM A-395 Ductile iron body.

Iron body bronze mount, with raised face flanged ends, "Teflon" impregnated packing or Aramid fibers with graphite, and two-piece backing gland assembly.

GLOBE VALVES

Case Bronze 2-Inch and Smaller: MSS-SP-80

- Class 125 and 150 - ASTM B-62 cast bronze body and union bonnet.
- Class 250 - ASTM B-61 cast bronze body and union bonnet.

Threaded or solder ends, brase or replaceable composition disc, copper-silicon alloy stem, brass packing gland, Aramid fibers with graphite, and malleable iron handwheel.

Iron 2-1/2 Inch and Larger: MSS-SP-85

- Class 125 and 250 - ASTM A-126 Class B cast iron body and bolted bonnet.
- Class 150 - ASTM A-395 ductile iron body bolted bonnet.

Iron body bronze mount, raised face flanged ends, "Teflon" impregnated or Aramid fibers with graphite, and two-piece backing gland assembly.

CHECK VALVES

Swing Check Valves

Cast Bronze 2-Inch and Smaller: MSS-SP-80

- Class 125 and 150 - ASTM B-62 cast bronze body and bonnet.
- Class 250 - ASTM B-61 cast bronze body and bonnet.

Threaded or solder ends, horizontal swing, bronze disc, and Y-pattern. Provided valves capable of being reground while the valve remains in line.

ron 2-1/2 Inch and Larger: MSS-SP-71

- Class 125 and 250 - ASTM A-126 Class B cast iron body and bolted bonnet.
- Class 150 - ASTM A-395 ductile iron body and bolted bonnet.

Raised face flanged ends and horizontal swing. Provided valves are capable of being reground while the valve remains in line.

Wafer Check Valves 2-1/2 Inch and Larger:

Should be of non-slam design lapped and balanced twin flappers or lift type design as specified on the drawings, stainless steel trim and torsion spring. Provided valves designed to open and close at approximately one foot differential pressure.

BALL VALVES

1 Inch and Smaller: WW-V-35B

Bronze body conforming to ASTM B-62:

Rated for 150 saturated steam pressure, 400 psi WOG pressure; 2 or 3 piece construction; standard (or regular) port, chrome plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl-covered oval steel handle.

1-1/4 Inch to 2 Inch: WW-V-35

Bronze body conforming to ASTM B-62:

Same as 1-inch and smaller bronze body except conventional port.

2-1/2 Inch and Larger: MSS-SP-72

Carbon steel body conforming to ASTM A216:

Same as 1-1/4 inch to 2-inch carbon steel body except end are flanged.

All ball valves provide IPS ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low pressure steam.

Select valves with the following ends or types of pipe/tube connections:

Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.

Steel Pipe Sizes, 2-Inch and Smaller: threaded or grooved end.

Steel Pipe Sizes 2-1/2 Inch and Larger: flanged.

PLUG VALVES

Plug Valves, 2” and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.

Plug Valves – 2” and Smaller:

Lunkenheimer: 454

Plug Valves, 2-1/2“ and Larger: MSS SP-78; rated at 175 PSI WOG; lubricated plug type, with semi-steel body, single gland, wrench operated, and flanged ends.

Plug Valves - 2-1/2” and Larger:

Powell: 2201

BUTTERFLY VALVES

Provide butterfly valves with an end cap for dead end service. Drill and tap valves on dead end service or requiring additional body strength.

2-1/2” and Larger: MSS-SP-67

ASTM A-536 Ductile iron body or A126 Class B iron:

Provide valves with field replaceable EPDM sleeves nickel-plated ductile iron discs, stainless steel stem, and EPDM O-ring stem seals. Provide lug-type body. Provide lever operator with position indicator for sizes 2 through 6 inches and gear operators with position indicators for size 8 through 30 inches. All valves in manholes and vaults shall have working pressure of 250#.

PART 3 - EXECUTION

EXAMINATION

Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.

Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

Replace defective valves with new valves.

VALVE ENDS SELECTION

Select valves with the following ends or types of pipe/tube connections:

Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.

Steel Pipe Sizes, 2-Inch and Smaller: threaded end.

Steel Pipe Sizes 2-1/2 Inch and Larger: flanged.

VALVE INSTALLATIONS

General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

Install valves where indicated by and in accordance with equipment manufacturer's recommendations.

Install shut-off duty valves at each branch connection to supply mains, and elsewhere as indicated.

Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.

Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.

Install drain valves at low points in mains, risers, branch lines, and elsewhere as required to facilitate system balancing.

Install check valves on each pump discharge and elsewhere as required to control flow direction.

Install angle pattern globe valves on the supply side of each wall mounted terminal unit. If unit has an enclosure, install the valve within the enclosure.

Locate valves for easy access and provide separate support where necessary.

Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

Tag Valves with a metal tag attached with a metal chain.

Install valves in horizontal piping with stem at or above the center of the pipe.

Install valves in a position to allow full stem movement.

Installation of Check Valves: Install for proper direction of flow as follows:

Swing Check Valves: Horizontal position with hinge pin level.

Wafer Check Valves: Horizontal or vertical position, between flanges.

SOLDER CONNECTIONS

Cut tube square and to exact lengths. Ream interior of tubing.

Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.

Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

Open gate and globe valves to full open position.

Remove the cap and disc holder of swing check valves having composition discs.

Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

THREADED CONNECTIONS

Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

Align threads at point of assembly.

Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

FLANGED CONNECTIONS

Align flange surfaces parallel.

Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

FIELD QUALITY CONTROL

Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

ADJUSTING AND CLEANING

Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

VALVE SCHEDULES

VALVE	SIZE	CLASSIFICATION
Domestic Water, 125 Class:		
Gate	None	Use Butterfly or Ball Valve
Globe	1/2" to 2"	125# SWP Bronze Screwed
	3" to 4"	125# IBBM RF FLGD
Check	1/2 to 2"	125# SWP Bronze Screwed
	3" & 4"	125# Iron Body Swing Check
Ball Valves	1/2" to 2"	125# SWP Bronze Screwed
	2" & Up	Use Butterfly
Butterfly	3" to 4"	125#/200# LUG Pattern
Chilled Water, 150 Class*:		
Gate	1/2" to 2"	150# Screwed Bronze
	3" to 10"	Use Butterfly Valve
Globe	1/2" to 2"	150# SWP Bronze Screwed
	3" to 10"	150# IBBM FLGD RF
Check	1/2" to 2"	150# SWP Bronze Screwed
	3" to 10"	150# IBBM Swing Check
Ball Valves	1/2" to 2"	150# SWD Bronze Screwed
Butterfly Valves	3" to 30"	150#/250# Lug Pattern
Hot Water, 150 Class:		
Gate	1/2" to 2"	150# Screwed Bronze
	3" to 10"	125# IBBM FLGD RF
Globe	1/2" to 2"	150# SWP Bronze Screwed
	3" to 10"	150# IBBM FLDG RF
Check	1/2" to 2"	150# SWP Bronze Screwed
	3" to 10"	150# IBBM Swing Check
Ball Valves	1/2" to 2"	150# SWD Bronze Screwed
Butterfly Valves	None	Use Gate or Ball Valves

* Note: 250# rating required on valves in vaults and on Campus Utility System.

VALVE SCHEDULE LEGEND

OS&Y - OUTSIDE SCREW & YOKE
RF - RAISED FACE
RS - RAISED STEM
SWD - SOLID WEDGE DISC
SWP - STEAM WORKING PRESSURE
IBBM - IRON BODY, BRONZE MOUNTED

END OF SECTION 15100

SECTION 15135 - METERS AND GAGES

PART 1 - GENERAL

SUMMARY

This Section includes meters and gages used in mechanical systems.

SUBMITTALS

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

Product data for each type of meter, gage, and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.

Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

Maintenance data shall be included in the "Operating and Maintenance Manuals" specified in Division 1 Section "Project Closeout."

QUALITY ASSURANCE

Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

Design Criteria: The Drawings and specifications indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages and are based on the specific manufacturer types and models indicated.

PART 2 - PRODUCTS

MANUFACTURERS

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

Mercury-in-Glass Thermometers:
- Marshalltown Instruments, Inc.
- H.O. Trerice Co.
- Weiss Instruments, Inc.
- Weksler Instruments Corp.
- Marsh Instrument Company

Pressure Gages:
- Ametek, U.S. Gauge Div.
- Marsh Instrument Co.
- Marshalltown Instruments, Inc.
- H.O. Trerice Co.
- Weiss Instruments, Inc.
- Weksler Instruments Corp.

Test Plugs:
Flow Design, Inc.
MG Piping Products Co.
Peterson Equipment Co., Inc.
Sisco Co., Spedco, Inc.
H.O. Trerice Co.
Watts Regulator Co.

THERMOMETERS, GENERAL

Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

Scale range: Temperature ranges for services listed as follows:

Domestic Hot Water: 30 to 240 deg F with 2-degree scale divisions.

Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions.

Hot Water: 30 to 240 deg F with 2-degree scale divisions.

Condensed Water: 0 to 160 deg F with 2-degree scale divisions.

Chilled Water: 0 to 100 deg F with 2-degree scale divisions.

MERCURY-IN-GLASS THERMOMETERS

Case: Weather resistant, die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

Tube: Red reading, mercury filled, magnifying lens.

Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.

Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

Approved Manufacturers Are:
Marshalltown Instruments
H.O. Trevice
Weiss Instruments
Weksler Instruments.

THERMOMETER WELLS

Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap. Thermometer well shall be as provided with the thermometer from the manufacturer.

PRESSURE GAGES

Type: Industrial Grade, ASME B40.1, Grade A, 316 S.S. bourdon- tube type, bottom connection.

Case: Poly propylene safety case, solid front with blow out back, 4-1/2-inches diameter.

Connector: 316 S.S., 1/4-inch NPS, provide brass snubber.

Scale: White coated aluminum, with permanently etched markings, slotted adjustable micrometer pointer.

Accuracy: 1/2 of 1 percent of range span.

Range: Conform to the following:

Vacuum: 30 inches Hg to 15 psi.

All fluids: 1.5 times operating pressure.

Condenser water: -15 PSI to 1.5 times operating pressure.

PRESSURE GAGE ACCESSORIES

Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

Approved Manufacturers:

Ametek
.S. Gauge Div.
Marshalltown Instruments, Inc.
H.O. Trerice Co.
Weiss Instruments Co.
Weksler Instruments Corp.

PHOTOHELIC PRESSURE GAUGES

Differential pressure indicating transmitter shall be diaphragm operated with sensing element motion restrained by a calibrated spring affixed with a strain gauge transducer. Electrical signal shall be internally conditioned to a two wire standard 4-20 mA control loop output. Transmitter shall have local pointer dial indication of sensed pressure with white dial, black figures, and graduations and pointer zero adjustment. Transmitter shall be Dwyer Instruments, Inc., Catalog No. 605 or approved equal.

TEST PLUGS

Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.

Core Material: Conform to the following for fluid and temperature range:

Air, Water, Oil, and Gas, 20 to 200 deg F: Neoprene.
Air and Water, minus 30 deg to 275 deg F: EPDM.

Test Kit: Provide test kit consisting of 1 pressure gage adapter with probe, 2 bimetal dial thermometers, and carrying case.

Ranges of pressure gage and thermometers shall be approximately 2 times systems operating conditions.

Approved Manufacturers:
- MG Piping Products
- Peterson Equipment
- H.O. Trerice
- Watts Regulator

PART 3 - EXECUTION

METER AND GAGE APPLICATIONS

General: Where indicated, install meters and gages of types, sizes, and capacities.

METER AND GAGE INSTALLATION, GENERAL

Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.

THERMOMETER INSTALLATION

Install thermometers and adjust vertical and tilted positions.

Thermometer Wells: Install in vertical position in piping tees where thermometers are indicated.

Fill wells with oil or graphite and secure caps.

PRESSURE GAGE INSTALLATION

Install pressure gages in piping tee with pressure gage valve located on pipe at most readable position.

Pressure Gage Needle Valves: Install in piping tee with snubber.

TEST PLUG INSTALLATION

Install test plugs in piping tees where indicated, located on pipe at most readable position. Secure cap.

CONNECTIONS

Piping installation requirements are specified in other Division 15 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties.

Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.

Make electrical connections to power supply and electrically operated meters and devices.

ADJUSTING AND CLEANING

Calibrate meters according to manufacturer's written instructions, after installation.

Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 15135

SECTION 15145 - HANGERS AND SUPPORTS

PART 1 - GENERAL

SUMMARY

This Section includes hangers and supports for mechanical systems piping and equipment.

SUBMITTALS

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

Product data for each type of hanger and support.

Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.

Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

QUALITY ASSURANCE

NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.

Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.

> UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
>
> Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

PART 2 - PRODUCTS

MANUFACTURED UNITS

Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.

> Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
>
> Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

Thermal-Hanger Shield Inserts: 100-psi (690kPa) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

MISCELLANEOUS MATERIALS

Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.

Washers: ASTM F 844, steel, plain, flat washers.

Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.

Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.

Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.

Water: Potable.

Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

HANGER AND SUPPORT APPLICATIONS

Specific hanger requirements are specified in the Section specifying the equipment and systems.

Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

HANGER AND SUPPORT INSTALLATION

General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

Install the following pipe attachments:

Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.

Adjustable roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

Pipe roller complete - MSS Type 44 for multiple horizontal runs, 20 feet or longer, supported on a trapeze.

Spring hangers to support vertical runs.

Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size - In.	Steel Pipe	Copper Tube Max. Span - Ft.	Min. Rod Max. Span - Ft.	Dia. - In.
Up to ¾		7	5	3/8
1		7	6	3/8
1-1/4		7	7	3/8
1-1/2		9	8	3/8
2		10	8	3/8
2-1/2		11	9	1/2
3		12	10	1/2
3-1/2		13	11	1/2
4		14		5/8
5		15		5/8
6		15		3/4
8		15		7/8
10		15		7/8
12		15		7/8
14		15		1
16		15		1

Support vertical steel pipe and copper tube at each floor.

Support plastic pipe and tubing in accordance with manufacturer's recommendations.

Install Cast-Iron Pipe with piping supports located at end of each length of pipe in horizontal lines, at each bend, and vertical supports at maximum intervals of 14'. Locate supports near couplings, not in center of pipe.

Install supports with maximum spacing complying with MSS SP-69.

Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

Install concrete inserts in new construction prior to placing concrete.

Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight

concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

Support fire protection systems piping independent of other piping.

Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.

Insulated Piping: Comply with the following installation requirements.

Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.

Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.

Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees (3.1 rad) and have dimensions in inches (mm) not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4to3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

Pipes 8 Inches and Larger: Include wood inserts.

Insert Material: Length at least as long as the protective shield.

Thermal-Hanger Shields: Install with insulation of same thickness as piping.

EQUIPMENT SUPPORTS

Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

METAL FABRICATION

Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

Obtain fusion without undercut or overlap.
Remove welding flux immediately.

Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

ADJUSTING

Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

PAINTING

Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

FIELD QUALITY CONTROL

Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

END OF SECTION 15145

SECTION 15250 - MECHANICAL INSULATION

PART 1 - GENERAL

DESCRIPTION OF WORK

Extent of mechanical insulation required by this section is indicated on drawings and schedules, and by requirements of this section.

QUALITY ASSURANCE

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.

Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

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.

SUBMITTALS

Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation and its indented use. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

DELIVERY, STORAGE, AND HANDLING

Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

STANDARDS

2007 Florida Mechanical Code (with 2009 Revisions)
Fiberglass Piping Insulation: ASTM C 547.
Cellular Glass Insulation: ASTM C 552
Flexible Unicellular Insulation: ASTM C 534
Jackets for Insulation: ASTM C 921
Rigid Fiberglass Insulation ASTM C 612
Flexible Fiberglass Insulation: ASTM C 553

PART 2 – PRODUCTS

ACCEPTABLE MANUFACTURERS

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

Armstrong World Industries, Inc.
Babcock & Wilcox – Insulating Products Div.
CertainTeed Corp.
Knauf Fiber Glass GmbH.
Manville Products Corp.
Owens-Corning Fiberglas Corp.
Pittsburgh Corning Corp.
Rubatex Corp.

MISCELLANEOUS INSULATION ACCESSORIES AND COMPOUNDS:

General: Provide staples, bands wires, tape, anchors, corner angles, cement, adhesives, coatings, sealants, protective finishes, mastics, metal covers, wire netting, etc.as recommended by insulation manufacturer for application indicated.

Paper laminated jackets shall be permanently fire and smoke resistant. chemicals used for treating paper in laminated jacket shall not be water soluble and shall be unaffected by water and humidity.

PIPING SYSTEM INSULATION:

Fiberglass Pipe Insulation: Owens Corning ASJ/SSL-11 pipe insulation.Fittings to be fiberglass insulation inserts and PVC fitting covers. PVC fittings shall be Manville "Zeston 200" or Proto "Low-smoke."

Inorganic glass fibers, bonded with a thermosetting resin.Jacket shall be all-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant Kraft paper and aluminum foil having self-sealing lap. ASTM C 612, Class 2, semi-rigid foil scrim Kraft jacketed board.

Thermal Conductivity shall be 0.24 (BTU-in/hr - ft^2 - Deg F) average maximum, at 75 deg F mean temperature. Density, 6 pcf average. Adhesive produced under the UL classification and follow-up service.

Non-flammable, solvent-based, minus 20 to 180 deg F.

Vapor barrier sealant shall be flexible-elastomer-based, vapor-barrier sealant designed to seal fiberglass joints, water vapor permeance, 0.02 per maximum, minus 50 to 250 deg F, of a color gray.

Cellular Glass Insulation: Pittsburgh Corning "Foamglass" insulation for above grade pipe insulation and below grade pipe insulation on pipes 1-1/2" and smaller with conductivity of .40 BTU/SF/F at 75 deg.F and a permeability of 0.00 perms.

Finish for machine rooms and piping subject to heavy traffic, vaults and chilled or hot water piping exposed to weather shall include Pittcote 404 reinforced with white glass fabric of not less than 7.8 ounces per yard. Then apply a second coat of Pittcote 404 and brush lightly with a wet brush to a smooth finish. Elbows, valves, and fittings shall be finished with Pittcote 404 reinforced with white glass fabric.

Finish above ground concealed insulation with white Kraft or vinyl-foil laminated fire-rated all-service jacket, all joints and laps sealed with fire-rated adhesive. Finish elbows, values fittings, etc., with Pittcote 404 reinforced with white glass fabric.

General: Provide insulation of thickness and type indicated on the following schedule (Note: comply with schedules noted below and 2007 FBC (w/ 2009 Supplements), whichever is greater):

PIPE INSULATION SCHEDULE

INTERIOR DOMESTIC HOT WATER AND RECIRCULATED HOT WATER

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
1/2 TO 1-1/4	GLASS FIBER	1	NO	NONE
	FLEXIBLE ELASTORMERIC	1	NO	NONE
1-1/2 TO 4		GLASS FIBER	1 ½	NO NONE
	CELLULAR GLASS	1 ½	NO	NONE
	FLEXIBLE ELASTOMERIC	1 ½	NO	NONE

INTERIOR DOMESTIC COLD WATER PIPING

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
½ TO 1 ¼	FLEXIBLE ELASTOMERIC	1	YES	NONE
1 ½ TO 4	CELLULAR GLASS	1 ½	YES	NONE
5 TO 10	CELLULAR GLASS	1 ½	YES	NONE

INTERIOR HYDRONIC
(35 TO 100 DEG F) EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
1/2 TO 1-1/4	CELLULAR GLASS	1	YES	NONE
1-1/2 TO 4	CELLULAR GLASS	1-1/2	YES	NONE

INTERIOR HYDRONIC (100 TO 250 DEG F)
EXPOSED AND CONCEALED

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
1/2 TO 4	GLASS FIBER	1-1/2	NO	NONE
	CELLULAR GLASS	1-1/2	NO	NONE

ROOF DRAINS AND HORIZONTAL STORM WATER/ROOF DRAIN PIPING

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
2-12	GLASS FIBER**	1	NO	NONE
	CELLULAR GLASS	1 1/2	NO	NONE
	FLEXIBLE ELASTOMERIC	1 1/2	NO	NONE

**Do not use for cold condensate drain applications.

DUCT SYSTEMS INSULATION SCHEDULE

INTERIOR CONCEALED HVAC SUPPLY, RETURN, OUTSIDE AIR & EXHAUST DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
GLASS FIBER	WRAP	2 (1.5# Density)	YES	NONE

INTERIOR EXPOSED HVAC SUPPLY, RETURN, OUTSIDE AIR & EXHAUST DUCTS AND PLENUMS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
GLASS FIBER	BOARD-RECT.	2	YES	NONE

P = Paper
K = Kraft
A = Aluminum (0.02” Thick)
SS = Stainless Steel

CONDENSATE DRAINS (INCLUDING EXISTING ROOF DRAINS):

Insulate condensate drain piping above concealed spaced and mechanical equipment rooms with ¾” thick "AP" Armaflex or approved equal. Insulate all condensate lines located in return air plenums (in their entirety) with 1" fiberglass pipe insulation with all-service jacket.

Insulate existing roof drain bodies, traps, and all horizontal piping.

FLEXIBLE CONNECTIONS:

Provide 1" thick Armaflex insulation at all flexible connectors. Armaflex shall extend adequately beyond the foamglas or other rigid pipe insulation and secured by stainless steel bands.

COLD AND HOT EQUIPMENT, PUMPS, VALVES, ETC.:

Insulate with no less than 2" thick foamglas insulation. Secure with stainless steel wire or bands. Finish with Pittcote 404 reinforced with white glass fabric. Then apply a second coat of Pittcote 404 and brush lightly with a wet brush to a smooth finish. On components requiring periodic inspecting (pumps, suction diffusers, etc.), provide removable insulation which will not damage the adjacent insulation.

DUCTWORK:

Insulate all galvanized steel supply, return, outside air and exhaust air ductwork.

Duct wrap shall be specifically designed for wrapping heating and air conditioning ductwork and include 2" overlap facing tab to provide for continuous vapor seal. Duct wrap shall be 2" thick, 1.5 lb. density, foil-scrim-Kraft laminated vapor barrier facing, minimum installed R-value equal to 6.0, and a maximum flame spread/smoke development rating of 25/50 per ASTM E84.

AIR DEVICES:

Insulate all exposed metal surfaces on back and neck of ceiling diffusers with 2" thick fiberglass with vapor barrier.

ACCESSORIES AND ATTACHMENTS

Glass Cloth (for fiberglass insulation only): Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq.yd. (no tape allowed).

Cloth Standard: MIL-C-20079H, Type I.

Bands: 3/4-inch wide, in one of the following materials compatible with jacket:

Stainless Steel: type 304, 0.020 inch thick.

Galvanized Steel: 0.005 inch thick.

Aluminum: 0.007 inch thick.

Brass: 0.01 inch thick.

Nickel-Copper Alloy: 0.005 inch thick.

Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.

Corner Angles: 28-gage, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch Kraft paper.

Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

PART 3 - EXECUTION

INSPECTION:

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.

GENERAL:

Insulation shall be applied on clean, dry surfaces.

All insulation shall be continuous through floor, wall and ceiling openings (including sleeves).

Insulation on all cold surfaces were vapor barrier jackets are used must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces, must be adequately insulated and vapor sealed to prevent condensation.

PIPE INSULATION INSTALLATION, GENERAL

Tightly butt longitudinal seams and end joints. Bond with sealant or adhesive.

Stagger joints on double layers of insulation.

Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.

Apply insulation with a minimum number of joints.

Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer.

Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer.

Flanges, Fitting, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight; bond with adhesive.

Use same material and thickness as adjacent pipe insulation.

Overlap nesting insulation by 2 inches or 1-pipe diameter, which ever is greater.

Insulate elbows and tees with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.

Cover insulation except for metal jacketed insulation, with 2 layers of lagging adhesive to a minimum thickness of 1/16 inch. Install glass cloth between layers. Overlap adjacent insulation by 2 inches in both directions from joint with glass cloth and lagging adhesive.

Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install shields, as specified in Division 15 Section 15145 "Hangers and Supports."

Shields: Cover hanger shields with jacket material matching adjacent pipe insulation.

Apply insulation continuously through sleeves.

CELLULAR GLASS PIPE INSULATION INSTALLATION

Cellular Glass Insulation: Butter joints of foamglass insulation with Pittseal 444. Apply insulation to pipe and fittings with all joints tightly fitted. Secure with aluminum bands so that each length of insulation shall be secured with two bands (minimum). Insulation shall be applied with all joints fitted to eliminate voids. Voids shall be eliminated by refitting or replacing insulation. Do not fill voids with joint sealer.

Mastic finish application: Prior to application of the finish, the insulation shall be inspected for voids, cracked segments and open joints between segments. Cracked or broken segments, and open joints shall be refitted. Voids shall be filled with pieces of cellular glass insulation.

Cut the PC Fabric 79 to fit around the pipe or fitting allowing for 3" to 4" overlap. Using a glove

or trowel, apply a tack coat of PITTCOAT 404 Coating to a section of the insulation. The tack coat should be applied at a rate of 3-4 gal/sf.

Embed the PC Fabric 79 in the tack coat using a trowel, squeegee or glove to push the fabric in. Work the fabric into the coating until the appearance is uniform and there are no wrinkles or pinholes.

As an alternate method, the PC Fabric 79 may be applied to the insulation first and the tack coat of PITTCOTE 404 Coating troweled or gloved through the fabric.

Apply another section of mastic overlapping the previous section by 3" and embed PC Fabric 79 as described in the above step. Each successive fabric section should overlap the previous one 3".

Continue working following the procedure above, until the entire line has received the PITTCOTE 404 Coating tack coat and PC Fabric 79. Care should be taken to insure the mastic is pinhole free.

Allow the first coat to dry a minimum of 24 hours (a minimum of 48 hours when relative humidity is higher than 80%) prior to application of the second coat.

With a glove or trowel, apply a second coat of PITTCOTE 404 Coating at a rate of 2-3 gal/100 sf. Here again, it is important that the mastic be applied pinhole free.

INSTALLATION OF DUCTWORK INSULATION:

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.

Insulation shall be continuous throughout the duct length and shall comply with NFPA Bulletin 90A requirements for flame spread and smoke developments. Insulation shall be applied to the duct with a solid surface of fire retardant adhesive equal to Insul-Coustic 215 Sure-Stik. Insulation applied to the top surface of horizontal duct shall overlap the side pieces to provide maximum support. In addition, insulation shall be secured with pins and clips not to exceed 12" on center. All exposed edges of board shall receive brush coat of coating equal to Insul-Coustic 110.

Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

Install Blanket Wrap Insulation as Follows: Install tight and smooth. Secure to ducts having long sides or diameters as follows:

> Smaller Than 24 Inches: Bonding adhesive applied in 6-inch-wide transverse strips on 12-inch centers.
>
> 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.

Overlap joints 3 inches.

Seal joints, breaks, and punctures with glass fabric and mastic. (Tape is not allowed.)

INSTALLATION OF EQUIPMENT INSULATION:

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 purpose.

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.

Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

Do not apply insulation to equipment while hot.

Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

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.

INSULATION JACKETS:

Exterior Exposed Insulation: Install continuous aluminum jackets and seal all joints and seams with waterproof sealant.

Install aluminum (ASTM B209, 3003 alloy, H-14 temper 0.02” thick) jacket with 2-inch overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints and longitudinal joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with aluminum or stainless steel draw bands 12 inches on center and at butt joints. Jacket shall be continuous. Include screws or bands on elbows and other fittings as necessary.

Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2 inch laps at longitudinal joints and 3 inch wide butt strips at end joints.

Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

EXISTING INSULATION REPAIR:

Repair damaged sections of existing mechanical insulation damaged during this construction period.

PROTECTION AND REPLACEMENT:

Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

STANDARD OF PERFORMANCE / WARRANTY

If condensation occurs on the outside of insulated ducts, HVAC equipment, VAV Boxes, flex ducts, piping, etc., during construction, the Contractor shall take immediate corrective action. Substantial completion shall not be approved until corrections are agreed to in writing. The Contractor shall be required to rework the insulation until satisfactory if condensation occurs on any cold surface at any time during the warranty period.

END OF SECTION 15250

SECTION 15510 - HYDRONIC PIPING

PART 1 - GENERAL

SUMMARY

This Section includes piping systems for HVAC applications. Piping materials and equipment specified in this Section shall include domestically manufactured:

Pipes, fittings, and specialties;
Special duty valves;
Hydronic specialties.

DEFINITIONS

Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

SUBMITTALS

Product Data, including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions for each hydronic specialty and special duty valve specified.

Furnish flow and pressure drop curves for diverting fittings and calibrated plug valves, based on manufacturer's testing.

Maintenance Data for hydronic specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division-15 Section "Basic Mechanical Requirements."

Welders' certificates certifying that welders comply meet the quality requirements specified in Quality Assurance below for 4 inch pipe.

Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.

Reports specified in Part 3 of this Section.

QUALITY ASSURANCE

Regulatory Requirements: Comply with the provisions of the following:

ANSI/AWS D10/12 - 89, “Recommended Practices and Procedures for Welding Low Carbon Steel Pipe.” Safety valves and pressure vessels shall bear the appropriate ASME label.

ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators

2007 Florida Building Code (with 2009 Supplements)

EXTRA STOCK

Maintenance Stock: Furnish a sufficient quantity of chemical for initial system start-up and for preventative maintenance for one year from Substantial Completion. Chemical must be from same supplier as currently in use at the central plant.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one of the following:

Calibrated Globe Balancing Valves:
- Armstrong, Inc.
- Tour and Anderson
- Mepco

Calibrated Plug Valves and Balancing Valves:
- Bell & Gossett ITT; Fluid Handling Div.
- Taco, Inc.
- Griswold

Y-Pattern Strainers (also refer to Section 15055):
- Armstrong Machine Works.
- Hoffman Specialty ITT; Fluid Handling Div.
- Metraflex Co.
- Spirax Sarco.
- Trane Co.
- Victaulic Co. of America.
- Watts Regulator Co.

Air Vents:
- Armstrong Machine Works
- Bell & Gossett ITT; Fluid Handling Division
- Hoffman Specialty ITT; Fluid Handling Division
- Spirax Sarco

PIPING:

General: Where more than one piping product is listed for a system, it is the contractor's option to choose one of the products listed.

Above Ground, Pipe Size 2" and Smaller: Type ‘L’ hard drawn copper ASTM B42 with wrought copper solder joint fittings.

Above Ground, Pipe Size 10" and Smaller: Schedule 40 black steel ASTM A53 seamless or ERW pipe with class 150 malleable-iron threaded fittings for 2" and under, butt welded fittings for over 2". Elbows 2-1/2" and larger to be long radius. Weld-o-lets may be used on pipes 3 inches and smaller in lieu of tees.

CONDENSATE DRAIN PIPING

Type ‘L’ copper with wrought copper solder joint fittings. Provide clean out at all changes of direction. Piping shall be supported at 5’ intervals and pitched for complete drainage.

FITTINGS

Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection, and facing.

Material Group: 1.1.

End Connections: Butt Welding.

Facings: Raised face.

Flexible Connectors: Stainless steel bellows with woven flexible bronze wire reinforcing protective jacket; minimum 150 psig working pressure, maximum 250 deg F operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of 3/4 inch misalignment.

JOINING MATERIALS

Solder Filler Metals: 95-5 tin-antimony for heating water, chilled water, and make-up water and drain piping.

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.

Gasket Material: thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

SPECIAL DUTY VALVES

Calibrated Balancing Valves: 125 psig water working pressure, 250 deg F maximum operating temperature, bronze body, globe valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2 inches and smaller shall have threaded connections and 2-1/2 inch valves shall have flanged connections.

HYDRONIC SPECIALTIES

Manual Air Vent: Bronze body and nonferrous internal parts; 150 psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8 inch discharge connection and 1/2 inch inlet connection.

Chemicals shall be specially formulated to prevent accumulation of scale and corrosion in piping system and connected equipment, developed based on a water analysis of make-up water. Chemical must be from same supplier as currently in use at the central plant.

NOTE: Prior to construction, contractor shall hire existing campus chemical treatment vendor to test and submit report of existing CHW & HHW system water analysis. At the conclusion of work, the water treatment vendor shall retreat system to pre-construction levels and submit report of same. Contractor shall include all costs for this work.

PART 3 - EXECUTION

PIPING INSTALLATIONS

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

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

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.

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

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.

Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity.

Install piping at a uniform grade of 1 inch in 40 feet toward all drain points.

Install manual air vents at the high points in piping system.

Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.

Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

Install dielectric unions to join dissimilar metals.

Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment.

Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2 inch and larger.

Anchor piping to ensure proper direction of expansion and contraction.

HANGERS AND SUPPORTS

General: Hanger, supports, and anchors devices are specified in Division 15 Section 15145.

PIPE JOINT CONSTRUCTION

Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.

Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.
Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.

Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:

Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.

Align threads at point of assembly.

Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

Welded Joints: Comply with the requirement in ASME Code B31.9-"Building Services Piping."

Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

Grooved Joints: Assemble joints in accordance with fitting manufacturers written instructions.

VALVE APPLICATIONS

General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:

Shut-off duty: Use gate, ball, and butterfly valves.

Throttling duty: Use globe, ball, and butterfly valves.

Install shut-off duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.

Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.

HYDRONIC SPECIALTIES INSTALLATION

Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting.

FIELD QUALITY CONTROL

Preparation for testing: Prepare hydronic piping in accordance with ASME B 31.9 and as follows:

Leave joints including welds uninsulated and exposed for examination during the test.

Flush system with clean water. Clean strainers.

Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.

Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

Testing: Test hydronic piping as follows:

Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.

Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the that liquid.

Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.

Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix A of ASME B31.9, Code For Pressure Piping, Building Services Piping.

After the hydrostatic test pressure has been applied for at least 2 hours with no loss in pressure, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

ADJUSTING AND CLEANING

Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing. Submit Test Results.

COMMISSIONING

Fill system and perform initial chemical treatment.

Check expansion tanks to determine that they are not air bound and that the system is

completely full of water.

Before operating the system perform these steps:

Open valves to full open position.
Remove and clean strainers.

Check pump for proper direction of correct improper wiring.

Set automatic fill valves for required system pressure.

Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).

Set temperature controls so all coils are calling for full flow.

Check operation of automatic bypass valves.

Check and set operating temperatures of chillers to design requirements.

Lubricate motors and bearings.

END OF SECTION 15510

SECTION 15854 - CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

SUMMARY

This Section includes constant volume and variable volume central-station air-handling units with coils for indoor installations. The manufacturer is responsible for furnishing equipment that will fit the existing mechanical room space in the configuration shown. Access doors are required in all sections and shall open to allow full access to the air handler system components. AHU shall be configured and positioned in MER to allow for coil pull, filter replacement, motor servicing, etc.

SUBMITTALS

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

Product data for each central-station air-handling unit indicated, including the following:

Certified fan performance curves with system operating conditions indicated.

Certified fan sound power ratings.

Certified coil performance ratings with system operating conditions indicated.

Motor ratings and electrical characteristics plus motor and fan accessories.

Materials gages and finishes.

Filters with performance characteristics.

Dampers, including housings, linkages, and operators.

Shop drawings from manufacturer detailing dimensions, required clearances, components, and location and size of each field connection.

Coordination drawings for central-station air-handling units in accordance with Division 15 Section "Basic Mechanical Requirements."

Wiring diagrams detailing wiring for power and controls and differentiating between manufacturer-installed wiring and field- installed wiring.

Product certificates signed by manufacturers of central-station air-handling units certifying that their products comply with specified requirements.

Field quality control test reports specified in Part 3 of this Section.

Maintenance data for central-station air-handling units for inclusion in Operating and Maintenance Manual specified in Division 1.

QUALITY ASSURANCE

ARI Certification: Central-station air-handling units and their components shall be factory tested

in accordance with the applicable portions of ARI 430 - Standard for Central-Station Air-Handling Units and shall be listed and bear the label of the Air-Conditioning and Refrigeration Institute.

DELIVERY, STORAGE, AND HANDLING

Lift and support units with the manufacturer's designated lifting or supporting points.

Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

Deliver central-station air-handling units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

SEQUENCING AND SCHEDULING

Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.

Coordinate the size and location of structural steel support members.

EXTRA MATERIALS

Furnish one additional complete set of filters for each central- station air-handling unit.

Furnish one additional complete set of belts for each central- station air-handling unit.

Furnish one additional gasket for each sectional joint of each central-station air-handling unit.

PART 2 - PRODUCTS

MANUFACTURERS

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

Carrier Air Conditioning
McQuay
Temtrol
Trane Co. (The)
York International Corp.

MANUFACTURED UNITS

General Description: Factory assembled, consisting of fans, motor and drive assembly, coils, damper, plenums, filters, drip pans, and mixing dampers/section.

Types: Central-station air-handling units included in this project are of the following types:

Draw through.

ELECTRICAL WORK FOR MECHANICAL SYSTEMS

All electrical components shall be U.L. listed. All wiring components and devices shall conform to the National Electrical Code.

CABINET – GENERAL

Materials: Formed and reinforced galvanized steel panels (double wall) and accessories, with joints between sections sealed. All major internal components shall be removable for service.

Class 'A' Thermal Breaks are required such that condensation will not form on the exterior of AHU with SA temperature scheduled and 95 F dB and 77 F Wb ambient conditions.

Casing:

Unit shall be constructed of a complete frame (welded or bolted) with removable panels. Removal of side panels must not affect the structural integrity of each module. Closed cell foam gasketing shall be applied where modules are joined. All panels shall be sealed with closed cell foam gasketing.

Unit shall be double wall constructed in each module to allow cleaning of the unit interior. A minimum two-inch, 3 lb density insulation (min R-13) shall be sandwiched between a solid interior wall and the exterior wall. Interior wall shall be minimum 20 gauge galvanized steel and shall not allow the exposure of any insulation to the air stream. It shall be fabricated from solid sheet steel without any perforations (except provide perforated discharge plenum sections where scheduled).

The unit housing side and roof systems shall be constructed from a minimum 18 gauge galvanized steel.

The maximum allowable deflection of any panel shall not exceed 1/200th of the span in any direction at the designed working pressure. If panels cannot meet this deflection, internal reinforcing shall be added. These requirements are designed to assure structural integrity and prevent oil canning.

The side panels shall be attached to each other, to the roof, and to the unit floor using zinc plated bolts.

Each non-removable panel seam shall be sealed with an acrylic latex sealant which meets ASTM C834-76 (1981) Standards for Latex Sealing Compounds. This sealant shall be applied in a continuous bead along the entire seam prior to assembling the panels. After completion of the assembly and after all of the panels have been securely attached, an additional bead of sealant shall be run along the entire length of the exposed outside joints of all adjoining panels.

All duct connection flanges must extend beyond the standing seam, a minimum of 1".

ACCESS DOORS

Hinged, double wall, insulated, easy removal access doors shall be provided in all fan, access, and filter sections.

The exterior door skin shall be constructed from minimum 18 gauge steel matching the material used for the exterior panel system. 12 gauge reinforcement straps shall be provided when the unit operating pressure dictates additional support to prevent air leakage.

The doors interior liner shall be constructed from minimum 20 gauge steel matching the material used for the interior liner. The door liner shall be solid.

Access doors shall be fully gasketed with a closed cell, replaceable neoprene gasket. The gasketing material shall be installed to allow for easy removal and replacement.

The door and latch assembly system shall be manufactured such that a tight seal can be maintained without the assistance of operating pressure.

The latch shall provide a method of releasing cabinet operating pressure while maintaining a safety catch to the door.

INSULATION: Comply with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems," for insulation.

Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels.

Double-Wall Drain Pans: Formed sections of mastic coated 16 gauge stainless steel. Fabricate pans in sizes and shapes to collect condensate from cooling coils including coil piping connections and return bends when units are operating at the maximum cataloged face velocity across the cooling coil. Fill space between double- wall construction with minimum 1" thick foam insulation and seal moisture-tight. Drain pan shall be sloped to provide positive drainage of condensate. Provide drain connection.

Units with stacked coils shall have an intermediate drain pan or a drain trough to collect condensate from top coil.

FANS SECTION

Testing Requirements: The following factory tests are required:

General: Sound power level ratings shall comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings from Laboratory Test Data" and shall be the result of tests made in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

Unit's fans performance ratings for flow rate, pressure, power, air density, speed of rotation, and efficiency shall be factory tested and ratings established in accordance with AMCA Standard 210/ASHRAE Standard 51 – Laboratory Methods of Testing Fans for Rating.

Fan Section Construction: Fan section shall be equipped with a formed steel channel base for integral mounting of fan, motor, and casing panels. The fan scroll, wheel, shaft, bearings, and motor shall be mounted on a structural steel frame with frame mounted on base with spring vibration isolators with minimum 2" deflection.

Discharge Plenum Section: Plenums shall be provided to efficiently turn air and provide sound attenuation. Discharge plenum opening types and sizes shall be scaled to meet engineering requirements. The vertical discharge plenum height may be scaled to accommodate the appropriate discharge duct height.

Discharge plenum panels shall include an acoustical liner. The liner shall be fabricated from stainless steel perforated material to prevent corrosion and designed to completely encapsulate fiberglass insulation. The perforation spacing and hole size shall be such as to prevent insulation breakaway, flake off, or delamination when tested at 9,000 FPM, in accordance with UL Specification 181.

Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower. Fan wheel shall be double-width, double-inlet type with forward-curved blades or backward-curved airfoil section blades as indicated. Forward-curved blade wheels shall be galvanized steel or bonderized steel painted with baked-enamel finish. Airfoil wheels shall be steel painted with zinc chromate primer and an enamel finish coat. Fan shaft shall be solid steel, turned, ground, and polished. Fan wheels shall be keyed to the shaft.

Shaft Bearings: Grease-lubricated ball bearings selected for 200,000 hours' average life, with grease fittings extended to an accessible location inside the fan section.

Fan Drives: Designed for a 1.4 service factor and factory mounted with final alignment and belt adjustment made after installation.

Belt Drive: Motors and fan wheel pulleys shall be fixed pitch with installation of variable speed drive or adjustable pitch without drive.

Motors: Mounted on the outside of the fan cabinet shall have steel belt guards.

Access Door: See above requirements.

MOTORS

Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

Motor Sizes: Minimum size as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range. Motors over one horsepower shall be energy efficient (see section 15010 for additional motor requirements.

Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class B Insulation).

Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B, built in accordance with IEEE, ASA and NEMA standards. (Note: Provide inverter duty for motors driven by variable speed drives.)

Bases: Adjustable, slide bases with rails.

Bearings: The following features are required:

Ball or roller bearings with inner and outer shaft seals.

Grease lubricated.

Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

Enclosure Type: The following features are required:

Open drip-proof motors where satisfactorily housed or remotely located during operation.

Guarded drip-proof motors where exposed to contact by employees or building occupants.

Overload protection: Built-in, automatic reset, thermal overload protection.

Noise rating: Quiet.

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. Refer to Section 15010.

Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

COILS

Testing Requirements: The following factory tests are required:

Coil Performance Tests: Cooling and heating coils, except sprayed surface coils, shall be factory tested for rating in accordance with ARI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.

Coil Sections: Common or individual insulated, galvanized steel casings for heating and cooling coils. Coil section shall be designed and constructed to facilitate removal of coil for maintenance and replacement and to assure full air flow through coils.

Medium- and high-pressure units shall have double gaskets between sections and coil connection penetrations through casing sealed to minimize leakage.

Coils, General: Drainable, rigidly supported across the full face of the coil, and pitched to allow drainage.

Fins: Aluminum or copper (.008" thick), constructed from flat plate with belled collars for tubes. Fins shall be bonded to tubes by mechanically expanding copper tubes.

Tubes: Seamless copper 5/8" O.D. with .02" walls and .049 return bends.

Coil Casing: Galvanized steel.

Headers for Water Coils: Steel or cast iron, with connections for drain valve and air vent and threaded piping connections.

Air Bypass Arrestor: Provide foam sealing strip located between casing channels and fins along top and bottom.

FILTER SECTIONS:

General: Filter area, types, efficiencies, and locations shall be as scheduled. Filters shall comply with NFPA Standard 90A "Standard for the Installation of Air Conditioning and Ventilating Systems." Provide permanent blank-off plates in filter sections as required to prevent bypass air. Accordion style blank-off plates are not acceptable. Caulk all around filter racks so that no air can bypass filter sections

AHU Inlet Filters: Filter section shall house 2" thick pleated media type filters. 2" filter efficiency shall not be less than MERV 8 when tested in accordance with ASHRAE 52-76 test standard and shall have a minimum average arrestance of 90% when tested in accordance with ASHRAE 52-68 test standard.

Filter Section: Cabinet material and finish shall match the air handling unit cabinet, with filter media holding frames arranged for flat or angled orientation as indicated and gaskets to prevent air from bypassing the filter. Side access section shall have hinged easy removal access doors with quick-opening latches, gasketed to prevent air leaks on free side of the unit.

Filter Mixing Box Section: Cabinet material and finish shall match the air handling unit cabinet, with filter media holding frames arranged for flat or angled orientation as indicated and gaskets to prevent air from bypassing the filter. Side access section shall have hinged easy removal access doors with quick-opening latches, gasketed to prevent air leaks on free side of the unit. Dampers shall modulate the volume of outdoor and return. The dampers shall be ultra-low leakage type with edge and jaw seals. The blades shall rotate on stainless steel sleeve bearings. Dampers shall be arranged in opposed blade configuration. Coordinate with Controls Subcontractor prior to Bid for motorized actuator requirements.

Filter Gauges: Provide adjustable 0-2" magnahelic differential pressure gauges mounted on each filter bank for reading pressure drop across filters.

Differential pressure indicating transmitter shall be diaphragm operated with sensing element motion restrained by a calibrated spring affixed with a strain gauge transducer. Electrical signal shall be internally conditioned to a two wire standard 4-20 mA control loop output. Transmitter shall have local pointer dial indication of sensed pressure with white dial, black figures, and graduations and pointer zero adjustment. Transmitter shall be Dwyer Instruments, Inc., Catalog No. 605 or approved equal.

SILENCER SECTION

A rectangular silencer shall be provided (as scheduled) to reduce airborne sound transmitted through the air handler. The silencer ratings for dynamic insertion loss and pressure drop shall be in accordance with ASTM E-477 for forward flow (air and noise in the same direction) or reverse flow (air and noise in the opposite direction) per the project’s requirements. Acoustical performance within the air handler unit assembly shall be in accordance with AHRI 260.

ADDITIONAL CONSIDERATIONS

One year warranty shall be provided. Manufacturer shall guarantee in writing that the unit will perform in accordance with specified operating conditions shown on the contract documents.

Adjustment of isolators, belts, sheaves, bearings, and start-up are to be by local factory authorized technician of unit manufacturer. Report to be submitted to engineer showing proof of adjustments, fan rpm, voltage, amps, initial drop across filter bank, etc.

PART 3 - EXECUTION

EXAMINATION

Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of central-station air-handling units.

Examine rough-in for hydronic, condensate drainage piping and electrical to verify actual locations of connections prior to installation.

Do not proceed until unsatisfactory conditions have been corrected.

INSTALLATION, GENERAL

Install central-station air-handling units level and plumb, in accordance with manufacturer's written instructions.

Support floor-mounted units on base rails and housekeeping pads high enough to properly trap condensate and route to floor drain. Secure units to concrete base.

Arrange installation of units to provide access space around air-handling units for service and maintenance.

EQUIPMENT BASES

Construct concrete equipment pads as follows:

Coordinate size of equipment bases with actual unit sizes provided. Construct base 4” larger in both directions than the overall dimensions of the supported unit, construct height as required for full condensate trap without cutting floor, minimum 4” high.

Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.

Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.

Place concrete and allow to cure before installation of units. Use Portland Cement conforming to ASTM C 150, 4,000 PSI compressive strength, and normal weight aggregate.

Extend up floor drains through concrete pad as required.

CONNECTIONS

Piping installation requirements are specified in other Division 15 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:

Arrange piping installations adjacent to units to allow unit servicing and maintenance.

Connect condensate drain pans using full size Type L copper tubing. Extend to the nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

Duct installations and connections are specified in other Division 15 sections. Make final duct connections with flexible connections.

Electrical Connections: The following requirements apply:

Electrical power wiring is specified in Division 16.

Grounding: Connect unit components to ground in accordance with the National Electrical Code.

FIELD QUALITY CONTROL (NOTE: Start-Up shall be done in the presence of Owner's Representatives):

Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:

Inspect the field assembly of components and installation of central-station air-handling units including piping, ductwork, and electrical connections.

Prepare a written report on findings and recommended corrective actions.

ADJUSTING, CLEANING, AND PROTECTING

Adjust water coil flow, with control valves to full coil flow, to indicated GPM.

Adjust damper linkages for proper damper operation.

Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face.

COMMISSIONING

Final Checks Before Start-Up: Perform the following operations and checks before start-up:

Remove shipping, blocking, and bracing.

Verify unit is secure on mountings and supporting devices and that connection for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.

Perform cleaning and adjusting specified in this Section.

Disconnect fan drive from motor and 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.

Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.

Set outside-air and return-air mixing dampers to minimum outside-air setting.

Comb coil fins for parallel orientation.

Install clean filters.

Verify manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the full-open position.

Disable automatic temperature control operators.

Starting procedures for central-station air-handling units:

Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

Replace fan and motor pulleys as required to achieve design conditions.

Measure and record motor electrical values for voltage and amperage.

Shut unit down and reconnect automatic temperature control operators.

DEMONSTRATION

Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.

Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout."

Schedule training with at least 7 days' advance notice.

END OF SECTION 15854

SECTION 15891 – DUCTWORK

PART 1 - GENERAL

RELATED DOCUMENTS

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

Requirements of the following Division 15 Sections apply to this section:

Basic Mechanical Requirements
Basic Mechanical Materials and Methods

SUMMARY

This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gage.

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

Division 15 Section "Mechanical Insulation" for exterior duct and plenum insulation.

Division 15 Section "Duct Accessories" for flexible duct materials, dampers, duct-mounted access panels and doors, and turning vanes.

Division 15 Section "Air outlets and Inlets."

Division 15 Section "Air Terminals," for constant-volume control boxes, variable-air-volume control boxes, and reheat boxes.

Division 15 Section "Testing, Adjusting, and Balancing."

Division 15 Section "Controls" for automatic volume control dampers and operators.

DEFINITIONS

Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.

Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

SYSTEM PERFORMANCE REQUIREMENTS

The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany

requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

The duct system shall be tested for leakage in accordance with SMACNA HVAC Duct Leakage Test Manual – Latest Edition. Medium pressure duct (i.e. ductwork upstream of VAV boxes) shall meet Class 6 requirements (rectangular) or Class 3 (round).

SUBMITTALS

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

Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

Sealing Materials
Fire-Stopping Materials

Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in Section 15010.

Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

Maintenance data for volume control devices, fire dampers, and smoke dampers, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

QUALITY ASSURANCE

NFPA Compliance: Comply with the following NFPA Standards:

NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

PART 2 - PRODUCTS

FLEXIBLE DUCTS:

General: Comply with UL 181, Class 1.

Flexible Ducts - Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing glass fiber (minimum 1" thick in conditioned areas, 1-1/2" thick in non-conditioned spaces) insulation (min R = 6.2) around a continuous inner liner.

Reinforcement: Steel-wire helix encapsulated in the inner liner.

Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fiber glass tape, and nylon hanging cord.

Inner Liner: Polyethylene film.

Acoustical Medium Pressure Flexible Duct:

Provide where indicated on drawings Flexmaster (or approved equal) Type 8M UL181 Class 1 Air Duct.

The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel.

The internal working pressure rating shall be at least 10" w.g. positive and 4" w.g. negative with a bursting pressure of at least 2 ½ times the working pressure.

The duct shall be rated for a velocity of at least 4000 feet per minute.

The duct must be suitable for continuous operation at a temperature range of -20^{o}F to +250^{o}F.

Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties, shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" Diameter	7	31	40	38	40	27
8" Diameter	13	29	36	35	38	22
12" Diameter	21	28	29	33	26	12

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" Diameter	5	8	7	8	11	15
8" Diameter	10	7	7	8	10	13
12" Diameter	9	6	6	5	9	13

The self generated sound power levels (LW) dB re 10^{-12} watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed.

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6" Diameter	42	31	23	18	17	21
8" Diameter	41	34	27	19	18	21

12" Diameter	54	45	38	31	27	23

Factory insulate the flexible duct with fiberglass insulation. The R value shall be at least 6.2 at a mean temperature of 75^{o}F.

Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure A.

Manufacturers Flexible Duct Connectors:
- Clevaflex
- Genflex type
- Wiremold
- Flexmaster

SHEET METAL MATERIALS

Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.

Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.

Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

SEALING MATERIALS

Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FSTT-S-001657, Type I; formulated with a minimum of 75% solids, High Pressure Duct Sealant.

Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

FIRE-STOPPING

Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

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

"Dow Corning Fire Stop Sealant"; Dow Corning Corp.
"3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
"RTV 7403"; General Electric Co.
"Fyre Putty"; Standard Oil Engineered Materials Co.

HANGERS AND SUPPORTS

Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

Hangers: Galvanized sheet steel, or round, steel, threaded rod.

Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.

Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.

Duct Attachments: Sheet metal screws, blind rivets, or self- tapping metal screws; compatible with duct materials.

Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.

Where galvanized steel ducts are installed, provide hot-dipped- galvanized steel shapes and plates.

RECTANGULAR DUCT FABRICATION

General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

Supply Ducts Upstream of Boxes: 6 inches water gage, positive.

Supply Ducts Downstream of Boxes: 2 inches water gage, positive.

Return Ducts: 2 inches water gage, negative pressure.

Exhaust Ducts: 2 inches water gage, positive and negative.

Outside Air Ducts: 2 inches water gage, positive and negative.

Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard."

RECTANGULAR DUCT FITTINGS

Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.

ROUND & FLAT OVAL DUCT FABRICATION

General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given size of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.

Round Ducts: Provide round supply and return ducts and fittings as indicated with spiral lockseam construction, except for diameters greater than 72 inches. Use longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lock seams (without intermediate ribs) or with butt-welded longitudinal seams in gages listed in SMACNA “HVAC Duct Construction Standards,” Table 3-4.

Double-Wall (Insulated) Ducts: Fabricate all round and flat oval ducts to be double-wall with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.

Thermal Conductivity: 0.27 Btu/sq. ft./deg F/inch thickness at 75°F mean temperature.

Outer Shell: Base outer shell gage on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation, and in gages specified above for single-wall duct.

Insulation: Unless otherwise indicated, provide 2-inch-thick fiberglass insulation. Provide insulation ends where internally insulated duct connects to single wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the inner liner diameter.

Solid Inner Liner: Construct inner liners with solid sheet metal of the gages listed below. (Except, provide acoustical perforated liner for sound sensitive areas such as auditorium, control room, etc.)

3 to 8 inches: 28 gage with standard spiral construction.

9 to 42 inches: 28 gage with single-rib spiral construction.

44 to 60 inches: 26 gage with single-rib spiral construction.

62 to 88 inches: 22 gage with standard spiral construction.

Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

ROUND & FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.

Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.

Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:

Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.

Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.

Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:

3 to 14 inches: 24 gage.

15 to 26 inches: 22 gage.

27 to 50 inches: 20 gage.

Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.

90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.

Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or ½-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.

Round Elbows - 9 Through 14 and all Flat Oval Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or ½-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.

Round Elbows - Larger Than 14 Inches and all Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.

Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gage with 2-piece welded construction.

Round Gored Elbows Gages: Same as for non-elbow fittings specified above.

Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.

Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gage.

Double-Wall (Insulated) Fittings: Fabricate double-wall insulated fittings with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.

Thermal Conductivity: 0.27 Btu/sq. ft./deg F/inch thickness at 75 deg F mean temperature.

Outer Shell: Base outer shell gage on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation. Gages for outer shell shall be same as for uninsulated fittings specified above.

Insulation: Unless otherwise indicated, provide 2-inch-thick fiber-glass insulation. Provide insulation ends where internally insulated duct connects to single-wall duct or noninsulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the nominal single-wall size.

Solid Inner Liner: Construct round and flat oval inner liners with solid sheet metal of the gages listed below (except provide acoustical perforated liner where required for double-wall ductwork). For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."

3 to 34 inches: 24 gage.

35 to 58 inches: 22 gage.

60 to 88 inches: 20 gage.

Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

Static Pressure Classifications: Refer to rectangular duct fabrication section for minimum static pressure requirements.

PART 3 - EXECUTION

DUCT INSTALLATION, GENERAL

Flexible duct runs shall be a maximum of 6 feet and shall be supported every 3 feet with minimum 1 ½ inch strap. Maximum permissible sag is ½ inch per foot. Use Medium Pressure flexible ducts upstream of Air Terminals and Low Pressure flexible ducts downstream of Air Terminals.

Flexible duct connections shall include 3 wraps of approved tape and stainless steel draw band. Insulation jacket shall be sealed with 3 wraps of approved UL 181B tape.

Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

Seal ALL duct seams, joints, etc with generous coating of High Pressure Duct Sealant.

Install ducts with the fewest possible joints.

Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct usable space or block access for servicing building and its equipment.

Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

Install insulated ducts with 1-inch clearance outside of insulation.

Conceal ducts from view in finished and occupied spaces 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.

Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

Non-Fire-Rated Partition Penetrations: Where ducts pass 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 inches.

HANGING AND SUPPORTING

Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.

Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

Support vertical ducts at a maximum interval of 16 feet and at each floor.

Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

Install concrete insert prior to placing concrete.

Install powder actuated concrete fasteners after concrete is placed and completely cured.

CONNECTIONS

Equipment Connections: Connect equipment with flexible connectors in accordance with Division 15 Section "Duct Accessories."

Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.

Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.

Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.

FIELD QUALITY CONTROL

The Contractor will contract with an independent testing agency to perform, record, and report leakage tests in the presence of the Engineer.

Remake leaking seams and joints as required and apply sealants to achieve specified maximum allowable leakage.

ADJUSTING AND CLEANING

Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 15 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.

Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 15891

SECTION 15900 - CONTROLS

PART 1 - GENERAL

SCOPE

The extent of the Electronic Digital System work is as indicated on the drawings and schedules and by the requirements of this section. The control sequences are indicated by drawings and schedules and by the requirements of this section. The new controls will interface with the existing Leon County Courthouse control system and comply with all LEON COUNTY guidelines and requirements.

All control wiring, conduit, relays, transformers, transducers, current transformers, digital controllers, electronic interfaces, transmitters, sensors, enclosures, shutdown relays, electronic switches, control devices, software, firmware and hardware and power and control power necessary to complete the Control System shall be included under this section. (This section is intended to be a complete D.D.C. Based Control System.)

QUALITY ASSURANCE:

Manufacturer: Firm regularly engaged in the manufacture of Energy Management Control System components and temperature controls of types and sizes required; and with a minimum of five years experience in the manufacture of units of the specified type: Johnson Controls, Inc. or approved equal.

Installer: A firm with five years of successful installation experience on projects with work similar to that required for this project: Johnson Controls, Inc. or approved equal.

Under no circumstances shall the design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor.

Approved Subcontractors: Any subcontractors used on this project shall be subject to the approval of the Owner. This approval shall not be unreasonably withheld but shall prevent the use of unskilled workers, temporaries, and workers without experience in installing low voltage control systems.

Control components shall be the product of a single manufacturer as much as is practical.

CODES AND STANDARDS:

Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards and NEC.

NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

DRAWINGS AND SUBMITTALS:

Submit shop drawings and product data as follows:

Submit the following product data as part of the "Controls Package": Manufacturer's detailed information for each piece of equipment used, identifying each item used. Include catalog sheets for each item used in control diagrams. Identify specific model and accessories being used in the control diagram, when two or more devices or models are shown. Provide the

following information for items and devices: Proper system label, indication of coordination with submitted catalog information, proper settings and adjustments of instruments, physical dimensions for devices and accessories, and the normal condition of device, such as normally open or closed dampers, valves, and relays. Submit automatic control characteristics, and construction of all components.

Submit the following schematic drawings as part of the "Controls Package": Graphic flow diagram drawings for each system in each area indicating system piping, electrical connections, identification of controls conductors, and a complete written description and sequence of operation pertaining to the diagram and shown on the same drawing. Include in sequence the symbol elements from the diagram (such as space thermostats). Submit the number and type of conductors required for each device. All points of interconnection to equipment furnished by others shall be identified in detail on the control drawings.

Point-to-point diagrams shall be included to identify wiring runs as well as terminations and shall be provided in schematic format for each system. Drawings shall specifically identify the interface between all electric and DDC devices. Only where systems are identical shall typical diagrams be used, otherwise individual drawings of each system shall be provided. All control wires shall be labeled with field ID numbers/colors.

Detail on the control drawings the surge and transient suppression devices.

Software Manual: Prior to project acceptance, two software manuals shall be provided. The software manuals shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software feature. The manuals shall instruct the user on programming any portion of the DDC System. This shall include all control programs, algorithms, mathematical equations, variables, set points, time periods, messages, and other information necessary to load, alter, test and execute the system. The manuals shall include:

1. Complete description of programming language, including commands, editing and writing control programs, algorithms, printouts and logs, mathematical calculations and passwords.
2. Instructions on modifying any control algorithm or parameter, verifying errors, status, changing passwords and initiating or disabling control programs.
3. Software Documentation: All software programs shall be easily referenced from summary sheets which compare control programs with pertinent information about hardware and wiring information in the field. Documentation shall include:

    a. Complete point identification, including number, symbol, engineering units and control program reference number.
    b. Location identification of DDC hardware.

Software: Upon successful completion of the operational acceptance test, provide two electronic copies and two hard copies of all programs for uploading. Provide an updated disk and hard copy of all programs at the end of the contractor's warranty period. Hard copies of all application programs must be submitted. All control software must be readily accessed and printed by the Owner using control system hardware.

Maintenance Data: Submit maintenance instructions and spare parts lists for each type of control device. Include maintenance data, product data, and shop drawings in maintenance manual.

SERVICE AND GUARANTEE:

The control system shall be free from defects in workmanship and materials and shall be guaranteed to perform in accordance with the intent of the plans and specifications. During a minimum one year guarantee period, which shall begin upon the completion of a successful performance demonstration, provide service and adjustment of all systems at no additional cost to the Owner.

A copy of the control drawings shall be submitted for review by the HVAC equipment suppliers to insure that the manufacturer is in agreement with the control concepts being employed. A copy of verification letters shall be received from all compressorized and electronic equipment product venders to assure the proper application and interface of the controls with the equipment. Submit verification letters as part of the closeout package for record purposes.

The acceptance procedure shall commence only after the entire controls system has been adjusted and final calibration has been made. At this time, a demonstration shall be performed of the entire system operation in the witness of and to the satisfaction of the Engineer and Owner or their designated representatives. A written request for said demonstration shall be submitted at least 2 weeks prior to the demonstration. Upon completion of the satisfactory performance demonstration, an acceptance form shall be signed by all attending personnel and shall be submitted to the Engineer for record purposes. In addition, provide a minimum of two man-days of on-site instruction to the Owner's operating personnel in classroom type sessions. Address at this time all hardware, software, and operational features of the DDC. The instruction shall be scheduled in advance, may take place in as many as four 4-hour sessions on nonconsecutive days, and shall be documented by all in attendance and submitted to the Engineer for record purposes.

Make provisions for the Engineer's inspection and acceptance of complete and operating controls system(s) which shall include complete line by line review of the software, system demonstrations, verification of calibration or devices, etc., as required by the Engineer to perform substantial and final inspections of these systems. Make all corrections as required by the Engineer/Architect/Owner to provide system(s) that comply with the design documents as interpreted by the Engineer. See Architectural General Conditions for other requirements.

PART 2 - PRODUCTS

GENERAL:

The products described herein are intended to describe, in general, the minimum level of quality deemed acceptable; those devices identified herein but not required by the plans or to meet the intention of the sequence of operation need not be provided.

Where two units of the same type of equipment are required, these shall be products of a single manufacturer. Provide (as much as is practical) control components of a single manufacturer.

DIRECT DIGITAL CONTROLLERS:

Provide stand-alone distributed processing DDC units capable of being fully user-programmable and executing the sequence of operations and other software functions as specified herein and indicated on the plans. The use of a separate computer or special software shall not be required to generate user-defined programs. The DDC shall be capable of executing standard mathematical and Boolean functions and provide for PID control algorithms.

Provide software graphical Displays, Reports, Alarms and other Operator Interface Features for these systems as specified for the "Front-End" Color Graphics User Interface.

The DDC shall provide as minimum all digital inputs, analog inputs, digital outputs, and analog outputs as required to execute the sequence of operations. The system shall be capable of expansion to not less than 1,024 digital inputs, 1,024 analog inputs, 1,024 digital outputs and 1,024 analog outputs without changing (upgrading) software or "front-end" hardware. Expansion shall not require removal of any existing hardware.

Master Control Units (MCU) shall be defined as central controllers(s) from which information (schedules, reset temperatures (etc.) are automatically downloaded to field controllers via local area network and provide for program editing and modification of any controller on the system. Each MCU shall be provided with a Hayes Compatible auto-dial/auto-answer modem to communicate with remote modem. Where MCUs are completely accessible through the "Front-End" via a modem at the "Front-End," a modem at only the "Front-End" need be provided. Where multiple modems are provided, they all shall be attached to a common telephone line and accessed separately through software. All communications shall be limited to ASCII code characters and English Language based.

Each MCU shall have 7 day battery back-up, continuous self diagnostics, multi-level password access, programmable alarm actions, and history logging. Provide at least 0.6K bytes per output of user available memory in addition to memory required for system operation and diagnostics.

A Local Control Unit (LCU) shall be considered to be small stand-alone processors. Each LCU shall have the same capabilities as the MCU in software programming ability. Provide ample RAM and ROM to perform the sequence of operations specified, maintain setpoint changes, equipment schedules, communications capabilities and internal operating system. Each LCU shall continue to operate and schedule equipment attached in the event of a Bus failure. Each I/O furnished on the LCU shall meet the requirements for the Inputs and Outputs as specified for the MCU. Provide 24 hour battery back-up of software in the event of power failure, or provide programming required for operation in permanent memory. All software shall be uploaded, downloaded and accessible through the MCU.

Each MCU shall distribute data to multiple Local Control Units (LCUs). LCUs shall control AHUs, chillers, towers, pumps, package equipment, VAV boxes, etc. as required to comply with the sequence of operations and these specifications.

MCUs and LCUs shall have the following input/output capabilities: Analog inputs shall be in the range of 0-10 Vdc and shall withstand continuous direct shorting to 120 VAC power without failure. Digital Inputs shall accept dry contact closures and voltage level transitions and shall withstand continuous direct shorting to 120 Vac power without failure. Pulse accumulator inputs shall have the same characteristics as Digital Inputs, except that in addition, a buffer shall be included to totalize pulses between interrogations. Each pulse accumulator shall accept rates up to 10 pulses per second. Digital Outputs shall provide contact closure for momentary (pulse width modulation) and maintained operation of field devices. Output pulses shall have a minimum resolution of 0.1 seconds. Analog outputs shall measure 0-20 Vdc, 4-20 mA control input signals. Analog outputs shall have a resolution of 0.1 volt and 0.1 mA.

MCUs and LCUs shall have the ability to communicate with standard peripheral devices such as CRT's, Computers, Modems and Printers using standard RS-232 communications.

Each Master Control Unit (MCU) shall be capable of communicating digitally with each other and Local Control Units (LCU), micro-processor to micro-processor at a minimum communications speed of JCI Std. baud rates for Global exchange of data. The Control system shall be of modular design employing "smart" Controllers capable of providing stand alone control in the event that communication with the local monitor and control station is not possible.

Each MCU and LCU in the DDC system shall be able to download and upload its programming from the "Front-End," a remote terminal and a local terminal.

DDC Control System shall feature distributed processing type control where a single controller, either MCU or LCU controls a single piece of equipment. Substituting multiple LCUs to control a single piece of equipment (chiller, AHU, etc.) will not be acceptable.

Front End Computer(s) to DDC:

Modify and update existing Leon County and Leon County Courthouse "Front-End" user interface stand alone graphics based computer systems as required for new EMCS points, systems, designations, floor plans, etc. Refer to "Color Graphics User Interface" for the description of the software to operate on each "Front-End."

COLOR GRAPHICS/USER INTERFACE:

System hardware and software shall provide graphic user interface through which central communications and management of all stand-alone DDC controllers shall be accomplished. Viewing and commanding of the graphics interface shall include using a "mouse" pointing device. The requirement to use the keyboard shall be for only those functions specifically requiring text or numeric input.

Provide with windowing user interface, based on Microsoft "Windows," which supports concurrent viewing and commanding of system operations. The system shall be capable of simultaneously showing and performing a minimum of three of the functions listed below in any combination, using operator-sized windows.

- Time of day scheduling (viewing and changing)
- Dynamic color graphics (viewing and commanding)
- Alarm screen (viewing and acknowledging)
- Trend screen (viewing)
- Graphics construction (viewing and constructing)
- Graphics symbols (viewing and pasting into graphic)

Provide with on line directory, available for point selection when building graphics or as needed to avoid reference to notebooks or other written material.

Time of day scheduling, with a week-at-a-glance calendar format (or similar) and providing for overrides up to a week in advance minimum. The facility shall provide for establishing logical relationships between system components, (e.g., pumps, cooling towers, etc.) so an operator may simply override the start or stop time of a system by name, preserving the established component relationships. Multiple days shall be programmable from a single schedule.

Provide with provisions for holidays and special days, to support both types of unusual work schedules. These shall be programmable up to one year in advance. Selection of holidays and special days shall be done using a mouse to select appropriate days on a graphically-displayed calendar.

Provide with status indication within graphics through operator-selected colors or patterns. Points shall be commanded using only graphics and the mouse, where symbols are selected with the mouse, the combined from a drop down menu), or alternatively, from a function key). Provide for graphic linking such that graphics may be linked in hierarchical order for logical system penetration.

Provide with context sensitive help, which gives instructions appropriate to the current operation.

Provide with operator selected point groups, which may be recalled by name to view the current status of associated points.

Provide for flexible sort capability, such that the system operator may find and display all points with common text and/or numeric strings which he/she selects.

Provide for automatic collection of trend data from field panels, accomplished a minimum of 4 times per day. The operator shall be able to define the type of collection, as follows:

(1) Time based, where information is stored at sample intervals defined by the operator.
(2) Change of value based, where information is collected each time a point value changes beyond a threshold selected by the operator.

Provide for freehand, computer assisted graphic construction using the mouse. Standard full screen stencils, commonly used symbols and useful shapes shall all be provided to assist in graphic construction. A full complement of graphic symbols and systems shall be provided. Windowing shall allow selection of a symbol or shape in one window, and the subsequent transfer of the symbol to a second graphics construction window for use by means of the mouse or similar type software arrangement. To ensure rapid graphic construction, it shall not be necessary to exit either window to affect the transfer.

Graphic screens shall show campus site plan, building floor plans, HVAC equipment locations, zone & thermostat locations, real time graphics and dynamics of all HVAC equipment (to no less a degree and in the same or similar manner as shown on the drawings and approved control shop drawings. In addition, some means of associating, in communicating screens, all space temperatures and VAV Boxes with respective air handling systems shall be provided as well as some means of associating, in communicating screens, central plant equipment with associated building pumps and controls shall be provided. Provide means to display and adjust setpoints on the individual graphic screens.

Provide for automatic up and downloading. Database changes made at the central unit shall be automatically downloaded to the appropriate field panels. Similarly, database changes made at individual field panels shall be automatically uploaded to the central, to ensure database continuity.

Pre-program the software package linking screens to provide a mouse driven "tour" of the HVAC system for all systems. Provide Building Layout screens for each Building showing all rooms with room temperatures. Other screens shall show the real time dynamics of each air handling unit and the central plant to no less a degree and in the same or similar manner as shown on the control drawings. In addition, some means of associating, in communicating screens, all space temperatures with respective Air Handling Systems shall be provided.

Central plant screens shall separate the chilled water system from the Hot water system. Provide a separate screen for the variable speed pumping systems with Building Pressure differentials shown simultaneously. Provide menu driven Scheduling Routines for each Air Handling system and as specified elsewhere. These screens shall allow user to update setpoints such as Room temperatures and similar setpoints, where setpoints are not a function of mathematical equation. For the above, the status of all inputs and outputs attached to the DDC shall be displayed in engineering units readily understandable to the operator. The above requirements shall be viewed as an addition to the requirements set forth by the sequence of

operations and as required elsewhere in the specifications.
Graphics, menus, points, functions, parameters, and reports shall be fully user programmable and capable of being associated with any graphics display. Selection and Execution of operating strategies or movement between displays shall be accomplished through the use of pointing and clicking with a mouse via pop-up menus or the equivalent. The Front-End shall automatically alert the operator to important events (alarms, etc.) through displaying user defined message(s) on monitor without compromising work in progress.

Provide a multiple user - multiple command access level password system whereby specific users may be "passworded out" of particular operator commands limiting particular levels of monitoring and diagnostic functions, permitting others access to changing setpoints and alarm limits and allowing yet other levels to software code, etc.

SOFTWARE PROGRAMS:

Energy Management Control System (EMCS) software shall provide programs/functions/reports as shown on the drawings and as required by the sequence of operations for the following functions:

Time of Day Scheduling
Scheduled Start/Stop
VFD Control
CHW Temperature Reset
Temperature Monitoring and Control
Lead-Lag Selection of 2 or more Components
Flow Measuring (Converted to Engineering Units) and Control
Status
Run Time
Alarm Instructions
On-Site History Logging of Data
Static/Total Pressure Sensing and Control
Outside Air Temperature and Humidity Sensing & Control

Provide PID control algorithms for all modulating devices (chilled water valves, adjustable frequency controllers, etc.). PID control algorithms shall include anti-wind up routine to prevent PID loop of calculating a DDC output value exceeding 20% of the control range of the attached controlled device. Where PID constants used do not provide satisfactory operation, without hunting, across the entire control range, program shall be self "adaptive," evaluating system performance and recalculate/revise constants as required to provide satisfactory operation. Optimum start/stop routines shall be self adaptive evaluating previous performances and adapting its routine to just meet building condition upon occupancy.

Routine shall be furnished which shall provide an orderly shutdown of the system when power failure to the DDC is detected and which shall automatically restart the system in an ordered routine when power is restored. Provide for an orderly start-up of the system upon power failure, with incremental load staging to minimize peak demand level.

Software to operate the MODEM in the Auto-Answer/Auto-Dial mode shall be included in the standard software package. Software, etc., for interface to owner’s backbone system shall be included as required.

The DDC shall have the software capability to prevent access to the operation and display functions within the DDC by programmable user selected access codes. Different access levels and codes shall be available for display, operation and programming, and shall be separate at

the DDC, Local CRT and Remote Modem CRT.
All programmed or selected print-outs shall be annotated with the time of occurrence.

Each point shall be capable of being assigned multiple software addresses with a unique English language name for each software point, i.e., outdoor air assigned to a AHU group and a chilled water plant, each with a different unique English language name.

All points to be indicated in standard engineering units, i.e., ON, OFF, oF, GPM, CFM, %R.H., KW, AMP, %, BTU/HR, etc.

Calculations: The Program shall be capable of performing mathematical functions (+, -, /, etc.) as well as Boolean logic (<, >, +, and, or, etc.) and combination of both. The program shall be able to calculate a known slope as an input set point, based on another input variable. A pulse input shall be able to be converted into a rate of use. A pulse input shall be able to be totalized through a summing period of 1, 5, 15 or 60 minutes. The rate of change of an analog input shall be able to be calculated. Variable inputs shall be able to be converted by calculation with constants, other variables, square roots, powers, logs, etc., so as to provide an additional calculated point. Degree days shall be calculated from an O.A. temperature input. Wind chill factor shall be calculated from an O.A. temperature input and an O.A. wind speed input.

Program Start/Stop: Automatically start and stop each point at least six times per day, to the closest minute. Holiday scheduling would allow schedule change seven days in advance and/or up to 90 holidays on a specific date of a given year. Each day will be able to have a different and unique program. An "occupied" holiday would allow operation during other than normal hours, while "vacant" holiday would turn systems off during normal hours. Inputs would include: day of week, date and year, time(s) of day, equipment programmed, equipment status, equipment constraints (i.e., event-dependent start/stop).

SURGE PROTECTION:

Provide 100% Silicon Avalanche Diode surge protection on main electrical power at all MCU panels.

Provide Data Line protection at each point where communication buses enter or exit a building.

For protection of the Hayes Modem, provide a surge protector equal to Telephone Surge Protector Model DDS-11; Electronic Specialist, Natick, Massachusetts, 01760. Surge protection shall have a five nanosecond response time.

POWER SUPPLY REQUIREMENTS:

Auxiliary DC power supplies shall be 120 VAC to 24 VDC with a minimum of 2.4 amps rating on the DC outputs. The units shall be UL and CSA requirements (UL 1012 and CSA 22.2). The units shall also meet all of the following parameters:

Operating temperature 0 deg. to 50 deg. C.
Dielectric withstand voltage; input to ground = 3750 VAC.
Leakage current = 5 microamps line to ground.
Creepage distance = greater than 6 mm line connected metal parts to dead metal.
Load regulation = +/- 0.05% for a 10% line change.

Transformers shall be 120 VAC/24 VAC or 277/24 VAC as required and fused on the primary side. The transformers shall have their primary and secondary leads landed on terminal strips. The minimum transformer rating shall be 50 VA.

120 VAC/277 VAC power to all of the control panels shall be provided by this Division by a licensed Florida Electrical Contractor. Coordinate with owner for available Power.

CONTROL RELAYS:

Control relays shall have 24 VDC coils, be provided with varistors across the coil, be DIN rail mounted and shall be the spade type relay base.

Relays shall not be used to control motors greater than 1/6 HP and shall be IDEC brand. All starters shall have 120 VAC control power and shall be controlled by a relay external to the starter.

CONDUCTORS AND CONDUIT:

All control conductors shall be in conduit. (Except Teflon plenum rated insulated wiring not installed in conduit is acceptable above suspended ceilings. EXCEPTION: Any wire above suspended ceilings that are used to connect to the Fire Management System shall be in conduit.)

All low voltage conductors shall be stranded 18 gauge copper minimum twisted, 100 percent shielded pairs. ~~Higher gauge conductors or conductors without shielding may only be used under all of the following circumstances:~~

1. ~~The Contractor shall produce written engineering data from the manufacturer approving the use of such conductors.~~
2. ~~The use of such conductors shall not cause the end-to-end accuracy of the field devices to exceed limits~~.

Where wiring is required to be installed in conduit, EMT conduit shall be used. Conduit shall be minimum 1/2-inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

Flexible metallic conduit (maximum three-foot length) shall be used for electrical connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be used in exterior locations and interior location subject to moisture.

Junction boxes shall be provided at all cable splices, equipment terminations, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location J-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

Provide non-metallic bushings at all conduit terminations for wiring and tubing. Provide grommets at all enclosure openings.

TEMPERATURE SENSOR

Thermistor with range of ± 50^{o}F of operating range of sensed control variable, encased in stainless steel, protective cover for damage protection, as required. Thermistor shall be aged a minimum of 6 months with tolerance within 0.2% and heat dissipation constant greater than 2.5 milliwatts/^{o}C in still air. Accuracy +/- 0.5^{o}F.

Immersion Temperature Sensors: Provide precision electric/electronic resistance type sensor suitable for mounting in an immersion well. The sensor probe shall be 1/4" O.D. stainless steel in lengths to reach the center of the water pipe. Accuracy +/- 0.5^{o}F.

THERMOWELLS

Copper for non-potable water systems and monel for potable systems.

PRESSURE SENSORS

Rated at 150% (minimum) of operating line pressure , solid state of either strain gauge applied to flexible element, piexoresistive silicone chip, or membrane capacitive element type; sensor shall be accurate to within 1% of range; protect from damage with metallic cover. Sensors shall be "dead-end" devices (does not bleed air), BEC Controls P-5, Johnson Metasys Interface, Halpern Roberts, or approved equal.

PRESSURE SWITCHES

Rated at 150% of operating line; adjustable over operating range; snap action contact; platinum, silver or gold plated contacts.

PRESSURE GAUGE

Select gauge with stem mounting, 1 inch minimum diameter face, black figures in white background, and labeled 150% (minimum) of pressure range of measure device. Locate gauges for pneumatic actuators in auxiliary panels with transducers. Other pressure gauges shall be installed as shown on drawings.

Provide, at each sensing input on controller, 1-1/2" diameter dial indicator with scales to match input range (in deg. F, relative humidity, inches of water) for convenience in calibration and adjustment.

DIFFERENTIAL PRESSURE WATER SWITCH

Provide proof of flow across a pump, etc., by sensing differential pressure with a snap acting switch and brass bellows. Range shall be sized for the pressure drop sensed.

Flow Measurement: If not indicated specifically on the plans, it shall be the contractor's option to choose one of the following flow element types:

Venturi
Dual Turbine

In each case, the meters shall be accurate to ± 2% of reading and provide a pulse and 4-20 mA output for remote reporting to the EMS. Elements to be pressure rated for 250 psig.

Venturi-type flow meters shall be bronze or cadmium-plated steel with brass fittings and attached tag with flow conversion data. Ends shall be threaded for 2 inches and smaller elements and flanged or welded for 2 ½ inches and larger elements. Manufacturer shall be Armstrong, Barco, Gerand, or approved equal.

Dual Turbine-type flow elements with 316 stainless steel construction and local display (GPM) shall be an Onicon model F-1210 or approved equal. Must interface to existing Leon County EMCS.

AIR FLOW SENSORS:

Airflow/Temperature Measurement Devices

Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet sensors shall not be substituted for duct or plenum sensor probes indicated on the plans.

Duct and plenum mounted sensors shall be fabricated of anodized aluminum alloy tube with 303/304 stainless steel mounting brackets.

Fan inlet probes shall be field adjustable to fit the fan inlet and have 303/304 stainless steel mounting feet.

Each measuring device shall consist of one or more multi-point measuring probes and a single microprocessor-based transmitter. Each transmitter shall have an LCD display capable of displaying airflow and temperature. Airflow shall be field configurable to be displayed as a velocity or volumetric rate. Each transmitter shall operate on 24 VAC.

Each sensing point shall independently determine the airflow rate and temperature, which shall be equally weighted and averaged by the transmitter prior to output. Devices, which average multiple non-linear sensing point signals, are not acceptable. Pitot tube arrays are not acceptable.

A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location. Probes and transmitters shall not require field matching for proper operation.

The operating airflow range shall be 50-5,000 FPM unless otherwise indicated on the plans.

The operating temperature range for the measuring probes shall be -20° F to 140° F. The operating humidity range for the measuring probe shall be 0-99% RH (non-condensing).

The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.

Each independent airflow sensor shall have a laboratory accuracy of +/-2% of reading over the entire operating airflow range and be wind tunnel calibrated or verified against standards that are traceable to NIST.

Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.

Each independent temperature sensor shall have a laboratory accuracy of +/-0.15° F over the entire operating temperature range and be calibrated or verified against standards that are traceable to NIST.

The number of sensors for each location shall be as follows:

Ducts and plenums:

Area (sq.ft.)	Sensors
< = 1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
> = 16	16

Fan inlets: 2 per inlet

The airflow/temperature measuring device shall be capable of displaying the airflow and temperature readings of each sensor on the transmitter's LCD display.

The transmitter shall be capable of communicating with the host controls using the following interface options:

Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire)

RS-485: Field selectable ModBus-RTU and Johnson Controls N2 Bus

10 Base-T Ethernet: Field selectable ModBus TCP and TCP/IP

LonWorks Free Topology

Airflow/Temperature measuring devices shall be UL listed as an entire assembly.

The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.

UL 873 – Temperature and Airflow Indicating Equipment

Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system.

Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.

Submit a schedule of airflow measuring devices indicating compliance with specified accuracy at minimum and maximum airflow rates.

Submit installation, operation and maintenance documentation.

Additional Warranty – manufacturer's parts warranty for 36 months from date of shipment.

Manufacturer: Ebtron, Inc., Gold Series or approved equal. (Note 10 years experience producing products of this type is required.)

HUMIDITY SENSORS:

Provide sensors with minimum sensing span of 0 to 95% relative humidity. Accuracy shall be + or - 2%. Output shall be 4-20mA. Input shall be 24 VDC.

AIR PRESSURE SENSORS:

Provide static pressure sensors, of linear output type, with range of 0 to 5" w.g., adjustable in 2" spans.

Where indicated, provide static pressure controllers incorporated in same case as static pressure sensor, of direct or reverse-acting type, with adjustable throttling range from 0.00 to 5" w.g., and capable of controlling static pressures within tolerance of + or - 1%.

ELECTRIC CONTACTORS:

Provide contactors for operating or limit-control of electric heating loads which are UL listed for 100,000 cycles of resistive loads. Equip with replaceable molded coils and replaceable silver cadmium oxide contacts; coat core laminations with heat-resistant inorganic film to reduce core losses. Provide line and load terminals on contactors with higher-than-35 amp ratings, or provide one-piece formed-and-welded pressure type. Provide screw-type contactors for 35-amp-or-lower rating. Equip field-mounted contactors with suitable steel enclosures; and provide open-type mounting for those installed in factory-fabricated panels.

STEP CONTROLLERS:

Provide step controllers for control sequencing or for control of electric heat power loads, of 6-or 10-state type with heavy-duty switching rated to handle loads, UL-listed and operated by electric motors of quality specified for valve and damper actuation.

AIR FLOW SWITCHES:

Air flow switches shall be UL approved, of the differential pressure type. Pressure range shall be 0.05" to 12.0" w.g., and electrical rating shall be 277 volts AC, 10 ampere and 300 VA pilot duty at 115 VAC. Provide SPDT contact with screw-type terminals.

END SWITCHES:

Adjustable switches shall have adjustment indication and accessible adjustment. Minimum-positioning switches that control dampers shall be calibrated. Provide end switches integral to actuators.

CURRENT SENSOR:

Shall provide status by sensing current flow to equipment. An adjustable trip setpoint shall indicate loaded equipment by closing a N.O. solid state relay and open up relay on loss of load or equipment failure. Rated for sensing 0-135A continuous. Device shall be Hawkeye 700 series or approved equal. Provide with trip and power LEDs.

ACTUATORS:

Dampers/valves shall be equipped with operators of sufficient power to control dampers/valves without flutter or hunting through the entire operating range at air velocities at least 20 percent

greater than maximum design velocity. Actuators shall be designed with current limiting motor protection.

Spring return operators shall be provided for two position control, unless otherwise indicated. Furnish entire spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

Furnish non-spring return motors for dampers larger than 25 sq. ft. and for valves larger than 2 -1/2", sized for running torque rating of 150 inch-pounds, and breakaway torque rating of 300 inch-pounds. Size spring-return motors for running torque rating of 150 inch-pounds, and breakaway torque rating of 150 inch-pounds.

Electric motor operators for modulating control shall be the reversible type. Provide permanent split-capacitor or shaded pole type motors with gear trains completely oil-immersed and sealed. Equip spring-return motors, where indicated on drawings or in operational sequence, with integral spiral-spring mechanism.

Spring returns shall be provided on reversible operators where required for fail-safe operation.

Operators operating in sequence with other operators shall have adjustable operating ranges and set points.

Equip motors for outdoor locations and for outside air intakes with "O ring" gaskets designed to make motors completely weatherproof, and equip with internal heaters to permit normal operation at -40 deg. F.

Operators shall have sufficient power on close off to provide tight sealing against maximum pressures.

Provide operators for all dampers/valves, as required by sequence. All operators shall have ample power to overcome friction of damper linkage and pressure acting on the dampers/valves. The operators shall have external, adjustable stops to limit the stroke in both directions.

Provide motorized actuators for valves and dampers.

GLOBE VALVES

Two and Three Way Screwed Valves:

Valves 1/2 inch through 2 inches shall be bronze, screwed type, and shall be rated at 250 psi maximum working pressure for water. The maximum working temperature shall be 250 deg. F (121 deg. C) for hot water applications.

Valve stems shall be stainless steel or other approved, highly polished, corrosion-resistant alloy to decrease friction and increase response. Valve plugs shall be brass and guided to insure perfect seating.

Stem packing shall be spring loaded EP V-rings for water applications to eliminate leakage around the stem and to insure a minimum amount of stem friction. Stem lift shall be 1/2 inch to 3/4 inch.

Two-way flow type shall be equal percentage for water. Three-way flow type shall be linear.

Composition discs shall be replaceable and provide tight shutoff.

Two and Three Way Flanged Valves:

Valves 2-1/2 inches through 6 inches shall be cast iron flanged and shall be rated at 125 PSI maximum working pressure. The maximum working temperature shall be 300° F (149 ° F).

Valve plug stems shall be stainless steel or other approved, highly polished, corrosion-resistant alloy to decrease friction and increase response. Valve plugs shall be brass and guided to insure perfect seating. Stem packing shall be Teflon, spring loaded EP V-rings to eliminate water leakage around the stem and to insure a minimum amount of stem friction. Lift shall be 3/4 inch to 1-1/2 inch.

Two-way flow type shall be equal percentage for good modulating control. Three-way flow type shall be linear.

Composition discs shall be replaceable and provide tight shutoff.

All control valves shall be selected for a maximum full flow water pressure drop of 5 psig unless specifically stated otherwise.

CONTROL CABINETS:

Provide labeled control cabinets to house all transducers, switches, auxiliary devices, and MCUs and LCUs if not self contained.

Control cabinets shall consist of NEMA 1 wall-mounted modular cabinet enclosure. The front of each cabinet shall be hinged to provide access to the interior of each cabinet and shall be lockable and gasketed.

Cabinets shall be made of l6 gage furniture grade steel or 6063-T5 aluminum, suitably reinforced and braced to provide a flat-faced, rigid-front panel.

Surfaces shall be free of scale, welding slag and dirt, and shall be flat without waves. Handling during installation shall not distort or buckle cabinets.

Cutouts shall be square with panels to ensure that instruments will be installed level and square.

Finished cutouts and holes shall be free of burrs and sharp edges. Cutouts shall be made up of modular sections or fabricated sections, in sizes suitable for handling. Cabinet section joints shall be neat and straight. Cabinets shall be securely fastened together and aligned, and each cabinet shall be securely wall or floor anchored as required.

Exterior hardware (screws, hinges, etc.) shall be high-grade steel with polished nickel or chrome plated finish. Interior hardware (screws, nuts, etc.) shall be cadmium plated steel.

Access doors shall be provided with hinges, gaskets, latches and locks. Cabinet frames shall be sufficiently sturdy to prevent doors from sagging when open. Latches shall be provided to hold doors open at 90^{o} and roller latches shall be provided to hold doors closed. Keys shall be furnished and shall be common to all door locks.

Provide wiring and piping diagram of panel showing all components, located on the inside of the door protected by either laminated plastic or clear plastic protection sheet bonded to entire door.

DAMPERS AUTOMATIC CONTROL

Provide automatic control dampers as indicated, with damper frames not less than formed 16-ga galvanized steel. Provide damper blades not less than formed 16-ga galvanized steel, with maximum blade width of 8".

Secure blades to 1/2" diameter plated steel axles using zinc-plated hardware. Seal off against spring stainless steel blade bearings. Provide blade bearings of nylon and provide thrust bearings at each end of every blade.

Parallel blade operation shall be used for all two position applications and opposed blade configurations for all modulating applications.

Performance Data

Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.

1. Closed Position: Maximum pressure of 6 inches w.g. @ a 12" (305) blade length.
2. Open Position: Maximum air velocity of 2,500 feet per minute.

Leakage: Maximum 3.7 cubic feet per minute per square foot (1.1 $m^3/min/m^2$) at 1 inch w.g. (0.25 kPa) for all sizes 36 inches (914 mm) wide and above.

Pressure Drop: Maximum 0.07 inch w.g. (0.02 kPa) at 1,500 feet per minute (457 m/min) across 24 inch x 24 inch (610 x 610 mm) damper.

DAMPER AUTOMATIC CONTROL – OUTSIDE AIR APPLICATIONS:

Extruded aluminum (6063T5) damper frame shall not be less than .080" (2.03mm) in thickness. Damper frame shall be 4" deep. Aluminum frame shall be clear anodized to a minimum thickness of 0.7mil (18 microns) deep. Frame to be assembled using type 316 stainless steel screws.

Extruded aluminum blades shall be clear anodized to a minimum thickness of 0.7mil (18 microns) deep. Aluminum end caps are to be press fitted to blade ends and shall be clear anodized. Aluminum blade pivot rods shall be clear anodized.

Blade and frame seals shall be of extruded silicone. Seals are to be secured in an integral slot within the aluminum extrusions.

Bearings are to be composed of a Celcon inner bearing fixed to a 7/16" (11.11mm) aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

Linkage hardware to be installed in the frame side. All aluminum linkage hardware parts shall be clear anodized. All non-aluminum linkage hardware parts shall be type 316 stainless steel. To be complete with cup-point trunnion screws for slip-proof grip. Adjustable hexagon drive rod, U-bolt fastener and retaining nuts are to be type 316 stainless steel.

Dampers are to be designed for operation in temperatures ranging between -40°F (-40°C) and

212°F (100°C).

Dampers shall be provided with opposed blade action.

Dampers shall meet Leakage Class I rating. Standard air leakage data to be certified under the AMCA Ratings Program.

Pressure drop of a fully open 48" x 48" (1220mm x 1220mm) damper shall not exceed .02" (.004kPa) w.g. at 1000 fpm (5.08 m/s).

Dampers shall be made to size required without blanking off free area.

Dampers shall be available in two mounting types: i.e., "Installed in Duct" or "Flanged to Duct".

Installation of dampers must be in accordance with current manufacturer's installation guidelines provided with each shipment of dampers.

Acceptable product shall be TAMCO Series 1500 SW Salt Water Resistance Enhanced Air-Foil Control Damper, as manufactured by T. A. Morrison & Co., Inc. (Tel: 1-800-561-3449, USA & Canada) or pre-approved equal.

ELECTRICAL REQUIREMENTS:

Electrical Requirements: Provide electrical devices and relays that are UL listed and of type which meet current and voltage characteristics of project.

PART 3 - EXECUTION

Interface with Leon County Courthouse & Leon County Metasys System

Modify as necessary existing Leon County and Leon County Courthouse EMCS to provide a fully operational expanded EMCS system. The user must be able to adjust all setpoints, monitor status, obtain reports, etc. locally or at remote location. Contractor shall install and update graphics for each new and/or modified HVAC system installed and for modified floor plans.

QUALITY ASSURANCE

More than 1 field device shall not be multiplexed to a single I/O point. Each control or sensing point shall be terminated at a unique location on the DDC panel or dedicated controller.

The Contractor shall install equipment, conduit, and wiring parallel to building lines. All control conductors must be installed in a neat and workmanlike manner. Support all conductors in accordance with Code requirements and LEON COUNTY Standards. Control conductors may be installed in existing cable trays. Refer to "Wiring" below for additional requirements.

Low voltage wiring shall not be installed in the same conduit as high voltage wiring.

CONTROLS AND INSTRUMENTATION INSTALLATION:

All equipment and materials shall be installed in accordance with the manufacturer's instructions.

Provide communication accessories for an operable direct digital control system.

Provide power to modem and communication accessories; interconnecting conductors, analog or digital input sensors; analog or digital output sensors or relays; all software systems; and all labor for these systems including testing.

The software program shall follow the Owner's standards in regards to naming and utilizing 'labels', 'flags', 'variables', and assigning 'input' and 'output' names according to the devices they control.

Locate all controls devices (except those remote devices at valves, dampers and similar locations) within NEMA 1 enclosures adjacent to EMS microprocessor in mechanical rooms. Do not locate accessory devices (such as transducers) outside enclosures. Note that some devices, such as chilled water valves, fail open. However, the devices shall be closed upon the air handling unit in the "off" condition.

Locate remote control instruments or accessories on insulated/covered casings/pipes/ducts or the finished surfaces of the covering. Seal penetrations to assure no leaks are present around stems that penetrate into the air or water systems.

Secure controls conduit and air piping to building structure. Do not substitute attachments to work of other trades (such as pipes, ducts, other conduits). Provide accessory steel supports, as required. Provide flexible connections to isolated equipment.

The mechanical contractor shall install all automatic dampers; provide necessary blank-off plates (safing) required to install dampers that are smaller than duct size; assemble multiple section damper with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors; provide necessary sheet metal baffle plates to eliminate stratification; and provide access doors through ducts for service to control equipment.

Access doors or other approved means of access through ceilings and walls for service to control equipment are provided for in another section of the specification. It is the responsibility of the control subcontractor to furnish size and location requirements and to coordinate locations.

WIRING:

The term "wiring" is defined to include the providing of wire, conduit, and miscellaneous materials as required for mounting and connecting the EMS and control devices. Provide all wiring necessary for a complete automatic monitoring and control system. The 120 and 24 volt power wiring to the control panels and control devices will be provided by the controls contractor as part of this section. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed.

Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system. Provide drawings indicating the EMS system's wiring requirements.

Install circuits over 25-volt with color-code No. 12 wire in electric metallic tubing.

Install circuits under 25-volt with color-coded no. 18 wire, shielded, with 0.031" high temperature (105° F (41° F)] plastic insulation on each conductor.

Install low voltage and high voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electrical conduit. Where low voltage circuits are run in concealed but accessible locations, circuits need not be installed in conduit. Where circuits are installed in air supply or return plenums, low voltage wiring shall have "Plenum Rated" insulation or be run in conduit.

In unburied indoor locations, provide EMT conduit with compression type fittings in normally cooled/conditioned spaces, including air plenums; galvanized steel IMC with cast type galvanized screwed fittings for non-cooled/unconditioned spaces, including mechanical rooms. In unburied outdoor locations, provide weathertight galvanized steel IMC with cast type galvanized screwed fittings. Provide liquid-tight flexible metallic conduit (18 inches minimum, 6 feet maximum) for connections to all vibrating equipment. Provide insulated grounded bushings at conduit connections to all boxes and panels. Seal all conduit penetrations. Provide UL approved components and locate for accessibility, to NEC requirements. All control wiring whether in conduit or bare shall be home runs without any splices.

Spare Conductors: Provide a pair of spare conductors for each conduit routed to the mechanical rooms and central plant.

Fasten flexible conductors bridging cabinets and doors neatly along hinge side, and protect against abrasion. Tie and support the conductors neatly.

The EMS subcontractor shall supervise the installation of all EMS devices, components, panels, etc., furnished under this section.

Penetrations: Penetrations in rated partitions shall be sealed properly. When wiring passes through partitions it shall be surrounded by conduit which will be packed with fire safing. Penetrations may be drilled and packed with drywall compound.

All equipment and materials shall be installed in accordance with the manufacturer's instructions. Install electrical work and use electrical products complying with standard local electrical code.

Provide power to DDC and auxiliary panels; interconnecting conductors, conduit, and pneumatic controls piping between DDC and supporting/matching auxiliary panels; analog or digital input sensors; analog or digital output sensors or relays; all software systems; and all labor for these systems including testing. Provide dedicated circuits.

SENSORS:

Mount room temperature sensors and thermostats as shown on the drawings or 4' above floor as directed by the Architect.

Provide thermowells for all pipe mounted sensors.

Pressure sensors and gauges and control taps mounted in horizontal pipe shall be mounted in top of pipe to prevent entrance of sediment into these and similar devices.

VALVES:

Install valves for outdoor installation with weather-tight actuators.

Mount control valves in vertical position.

WATER FLOW MEASURING DEVICES

Locate flow device 10 pipe diameters downstream of any fittings or flow disturbances and 5 diameters upstream of fittings. Clearances less than these must be specifically submitted and approved by the engineer. Avoid locations downstream of tee fittings. Do not install within 10' downstream of balancing cock.

ENCLOSURES:

The tubing and wiring within all enclosures shall be run in plastic trays or shall be neatly routed and properly secured using adhesive-backed tie wraps.

Mount all enclosures, including those that house DDC panels and field device panels, so that the top of the enclosure does not exceed six feet, six inches (6' - 6"); and the center of the key pad/LCD combination does not exceed five foot, six inches (5'-6") from the floor or is less than four feet (4') from the floor.

IDENTIFICATION:

Provide engraved, laminated plates for identification of each controls component, controls damper, controls panel, remote contactor, flow sensor, display gauge (not internal panel gauges) etc. Label all nonpanel devices as well as instruments mounted in face of panels to indicate system function. Labels shall match As-Builts and O&M manual labels.

All panels installed under this specification shall be provided with a label indicating that they are part of the BAS and shall be marked with a panel number as defined on the drawings.

All terminal strips in junction boxes and control panels shall be labeled to indicate point number and designation. Terminal block identification shall also be provided that is consistent with the drawings.

Multi-conductor cables shall be marked with a Brady label to indicate cable designation as shown on the drawings. This identification shall be on both ends of the cable.

POWER WIRING

The power shall be obtained from dedicated circuits on the nearest available 120-volt panel and clearly labeled. Power for any EMCS equipment that is controlling equipment that operates under emergency power shall be obtained from emergency power panels.

TESTING AND START-UP

At the time of start-up, all electrical conductors shall be verified for continuity and secure connection. Where practical, analog points shall utilize a single conductor with no splices. If splices are required at any pint other than the connection to the device leads, it shall be done at a screw terminal block utilizing either captive washer or crimp-on terminal ends. All analog points shall also be calibrated at start-up for the specific wire resistance.

Start-up check list documentation shall be provided to the Owner as part of the as-built system documentation.

CALIBRATION:

After completion of the contractors' portion of the work, the automatic temperature controls Contractor shall regulate and adjust all thermostats, control valve motors and other equipment provided, place in complete operating condition, subject to approval of the Architect/Engineer, and supply any service incidental to the proper performance of the temperature controls system under the guarantee.

The manufacturer shall state in writing to the Architect/Engineer that the controls system is operating satisfactory as designed, and that all instruments, and damper linkages have been properly adjusted, and all software is in place and operating.

The controls subcontractor shall properly calibrate all control components to provide for proper controls sequencing, to avoid overlapping control actions and positively maintain dead bands where no control action is to occur. Adjust time constants and other software parameters to be compatible with equipment controlled to assure that no control devices, hunt, overshoot and undershoot excessively.

TRAINING:

Provide training to the Owner's staff. Schedule in advance (7 days minimum) and document training. Provide training in two 4-hour sessions.

CLEANING:

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

END OF SECTION 15900

SECTION 15910 - DUCT ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

This Section includes the following:

- Flexible connections
- Manual volume control dampers
- Fire dampers
- Turning vanes
- Duct-mounted access doors and panels
- Accessories hardware

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

Division 15 Section "Air Outlets and Inlets" for diffusers, registers, and grilles.

Division 15 Section "Air Terminals" for constant and variable air volume units.

SUBMITTALS

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

Product data including details for materials, dimensions of individual components, profiles, and finishes for the following items:

- Manual volume control dampers.
- Control dampers.
- Fire dampers.
- Duct-mounted access panels and doors.

Shop drawings from manufacturer detailing assemblies. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the following:

Special fittings and volume control damper installation (both manual and automatic) details.

Fire damper installations, including sleeves and duct-mounted access door and panel installations.

Product Certification: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static pressure loss, and dimensions and weights.

QUALITY ASSURANCE

NFPA Compliance: Comply with the following NFPA Standards:

NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

EXTRA MATERIALS

Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

FLEXIBLE CONNECTIONS:

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 and 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.

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:

American/Elgen Co.; Energy Div.
Duro Dyne Corp.
Flexaust (The) Co.
Ventfabrics, Inc.

MANUAL VOLUME CONTROL DAMPERS

General: Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking quadrant device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of 3 inches or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft, which must extend through insulation. Provide dampers with velocity and pressure rating for actual application.

Standard Volume Control Dampers: Multiple-blade, parallel- (2-position only) or opposed-blade design (modulating) (20 gauge) as indicated, standard leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications. Blades shall not exceed 6".

Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 18 gage, and with mitered and welded corners. Provide flangeless frames where indicated for installation in ducts.

Roll-Formed Steel Blades:20-gage galvanized steel.

Blade Axles: Galvanized steel.

Tie Bars and Brackets: Galvanized steel.

FIRE DAMPERS

General: Provide fire dampers for all fire rated partitions, walls, and floors as defined by the Architectural drawings and specifications. For renovation projects, contractors shall field verify existing conditions prior to submitting their bids. Fire dampers shall be UL labeled according to UL Standard 555 "Standard for Fire Dampers." Refer to Fire Damper Schedule at the end of this section.

Fire Rating: 1-1/2 hr for 1 hr and 2 hr rated walls and 3 hr for 3 hr and 4 hr rated walls as indicated by the fire rating of the wall to be penetrated. Refer to architectural drawings.

Frame: Type B; with frame and retracted blades outside of air stream fabricated with roll-formed, 21-gage, galvanized-steel; with mitered and interlocking corners.

Mounting Sleeve: Factory-installed or field-installed galvanized steel. Breakaway connections shall be utilized. Rigid connections require specific approval by the Engineer.

Minimum Thickness: 20 gauge for ducts 84" wide and smaller. Sleeve gauge shall in no case be less than the connecting ducts.

18 gauge for ducts 85" wide and larger.

Mounting Orientation: Vertical or horizontal as indicated.

Blades: Roll-formed, interlocking, 21-gage galvanized steel. In place of interlocking blades, provide full-length, 21-gage, galvanized-steel blade connectors.

Horizontal Dampers: Include a blade lock and stainless steel negator closure spring.

Fusible Link: Replaceable, 165 deg F.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include the following:

Air Balance, Inc.
American Warming and Ventilating, Inc.
Arrow Louver and Damper; Div. of Arrow United Industries Inc.
Louvers and Dampers, Inc.
Penn Ventilator Co.
Phillips-Aire.
Ruskin Mfg. Co.

TURNING VANES

Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.

Manufactured Turning Vanes: Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.

DUCT-MOUNTED ACCESS DOORS AND PANELS

General: Refer to the Access Door Materials Schedule at the end of this Section for frame and door thickness, number of hinges and locks, and location of locks. Provide construction and air tightness suitable for duct pressure class.

Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.

Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness, number of hinges and locks as indicated for duct pressure class. Provide vision panel where indicated. Provide 1-inch by 1-inch butt hinge or piano hinge and cam latches.

Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.

Insulation: 1-inch thick fiber glass or polystyrene foam board.

ACCESSORIES HARDWARE

Splitter Damper Accessories: Zinc-plated damper blade bracket, 1/4-inch, zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline and grease.

PART 3 - EXECUTION

EXAMINATION

Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

INSTALLATION

Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards.

Provide test holes at fan inlet and outlet and elsewhere as indicated.

Install fire dampers according to the manufacturer's UL-approved printed instructions.

Provide access doors in ductwork and in hard ceilings (when necessary) for maintenance of fire and fire/smoke dampers.

Install fusible links in fire dampers.

Label access doors according to Division 15 Section "Mechanical Identification."

ADJUSTING

Adjust duct accessories for proper settings.

Adjust fire and smoke dampers for proper action.

Final positioning of manual dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

ACCESS DOOR MATERIALS SCHEDULE

DUCT PRESSURE CLASS	DOOR SIZE INCHES	NUMBER OF HINGES	NUMBER OF LOCKS	METAL GAUGE FRAME	DOOR	BACK
2 INCHES	12X12	2	1-S	24	26	26
& LESS*	16x20	2	2-S	22	24	26
	24X24	3	2-S	22	22	26
3 INCHES*	12X12	2	1-S	22	22	26
	16X20	2	1-S,1-T,1-B	20	20	26
	24X24	3	2-S,1-T,1-B	20	20	24
4 TO 10**	12X12	2	1-S,1-T,1-B	20	20	26
INCHES	16X20	3	2-S,1-T,1-B	20	18	24
	24X24	3	2-S,2-T,2-B	18	18	24

S: SIDE
T: TOP
B: BOTTOM

*NOTE: Ruskin M#ADH-24 or pre-approved equal.
**NOTE: Ruskin M#ADH-24HP or pre-approved equal.

END OF SECTION 15910

SECTION 15933 - VAV AIR TERMINALS

PART 1 - GENERAL

RELATED DOCUMENTS:

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

Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

DESCRIPTION OF WORK:

Extent of air terminals work required by this section is indicated on drawings and schedules, and by requirements of this section.

Types of air terminals specified in this section include the following:

VAV Air Terminals
Fan Powered VAV Terminals

Refer to other Division-15 sections for testing, adjusting and balancing of air terminals; not work of this section.

Refer to other Division-15 sections for temperature controls which are to be furnished by others but installed as work of this section.

Refer to Division-16 sections for the following work; not work of this section.

Power supply wiring from power source to power connection on air terminals. Include disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

Provide the following electrical work as work of this section, complying with requirements of Division-16 sections:

Control wiring between field-installed controls and air terminals.

Control wiring specified as work of Division-15 for Automatic Temperature Controls is work of that section.

QUALITY ASSURANCE:

Manufacturer's Qualifications: Firms regularly engaged in manufacturer of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

Codes and Standards:

ADC Compliance: Provide air terminals which have been tested and rated in accordance with ADC standards, and bear ADC Seal.

ARI Compliance: Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.

NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems."

SUBMITTALS:

Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.

Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 1.

DELIVERY, STORAGE, AND HANDLING:

Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

Store air terminals 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

ACCEPTABLE MANUFACTURERS:

Manufacturer: Subject to compliance with requirements, provide air terminals of one of the following:

Trane (The) Co.
Enviro-Tech, Environmental Technologies, Inc.
Tempmaster (York International)

AIR TERMINALS:

General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

Casings: Construct of galvanized, double-wall sheet metal (with internal insulation) of the following minimum thicknesses:

Upstream Pressure Side: Steel 18 - ga.

Downstream Pressure Side: Steel 22 - ga.

Provide hanger brackets for attachment of supports.

Double-wall Insulated Construction: Air Terminal shall have double wall construction with internal insulation material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Provide minimum thickness of 1", and a minimum density of 1.55 pound fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A requirements and UL 181 Standards. The insulation shall be covered with 22 gage galvanized steel. There shall be no exposed edges of insulation (complete metal encapsulation).

Box (less heating coil) shall not impose a total pressure loss in excess of 0.3" w.g. at maximum design CFM. VAV boxes shall also be selected for a maximum velocity of 2000 fpm at the orifice and not exceeding discharge sound levels and radiated sound levels of NC 35 at 1" w.g. inlet static pressure with an allowance of 10 dB room absorption affect, 10' of lined duct and 13 dB ceiling attenuation. Provide sound data in accordance with ADC 1062 and ISO 3741.

Air Valve/Damper: Shall consist of minimum 22 gauge cylindrical body that includes embossment rings for rigidity. Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing. The shaft shall include a damper position indicator visible from the exterior of the unit. Provide maximum volume dampers, pressure independent, that are calibrated in CFM, factory-adjusted, and marked for specified air capacities. Provide mechanism to vary air volume thru valve for minimum to maximum, in response from signal from thermostat/temperature sensor. Air valve leakage shall not exceed 1% of maximum inlet rated airflow at 4” w.g. inlet pressure.

Velocity Sensor: Provide velocity pressure pick-up devices, hereafter referenced as sensors. Sensors with a single pick-up point are unacceptable. Air flow sensors shall be multiple-point-two-dimensional, or multiple point, averaging flow sensing ring. Provide calibration chart affixed to the side of each box for calibration of pressure differential to CFM.

Coordinate power requirements with Division 16 prior to bid.

Controls: Provide electric operators (24 volts) installed at the factory. Motors shall be bi-directional devices for 24 volts + ON (clockwise) direction, 24 volts - ON (Counter-clockwise) direction, and maintain position with power removed from operator. Provide 24 volt transformer.

Install electric powered controls, compatible with electric temperature control system specified in Division 15 sections. Coordinate with Division 15 controls contractor furnishing control modules. Factory installed controls. Include costs to ship controllers from Control Contractor; factory mount and test; and ship Air Terminal to job site.

Fan/Motor: Provide a fan and motor with the capacities scheduled on the drawings for the Fan Terminal Units. The centrifugal style fan shall have a wheel with forward curved blades. The permanently lubricated, split capacitor type motor with thermal overload protection shall be directly connected to the fan. Three speed or variable speed (SCR) control shall be provided with the control knob located externally. The motor shall be mounted to the fan housing using torsion isolation mounts properly isolated to minimize vibration transfer. The unit fan shall be installed with a back-draft damper at the fan discharge to prevent back-flow of primary air into the fan casing. A field adjustable mechanical damper stop shall be provided with the fan discharge damper for aid in balancing the fan capacity.

Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjustment, or maintenance. Bottom access panels are unacceptable.

Leakage: Construct casings such that when subjected to 0.5-in w.g. pressure for low pressure ducts and 3.0 in w.g. pressure for high pressure ducts, total leakage does not exceed 4% of specified air flow capacity with outlets sealed and inlets wide open. Construct air dampers such

that when subjected to 6.0-in w.g. inlet pressure with damper closed, total leakage does not exceed 10% of specified air flow capacity.

Identification: Provide label on each unit indicating Plan Number, CFM range, CFM factory-setting, and calibration curve (if required).

Hot Water Heating Coils: Provide heating coils constructed of copper tubes and aluminum fins in galvanized steel casing.

Hardware: Provide hardware as detailed and required to complete ceiling system including unit mounting brackets, trim pieces, alignment channels, etc.

Filter: Air terminals shall include a filter rack with a slide track for filter removal without the use of tools. Provide 1" disposable fiberglass filters.

PART 3 - EXECUTION

INSPECTION:

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

INSTALLATION OF AIR TERMINALS:

General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

Duct Connections: Connect ductwork to air terminals in accordance with Division-15 ductwork sections.

Install air terminal for ease of service. Provide mans to remove service panels. For Fan Powered Air Terminals, provide means to change filter.

FIELD QUALITY CONTROL:

Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.

Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

Replace dirty air filters with new at substantial completion for all Fan Powered Air Terminals.

CLEANING:

Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

END OF SECTION 15933

SECTION 15970 - VARIABLE FREQUENCY (SPEED) DRIVES

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and Specifications.

Division-16 sections apply to work of this section.

DESCRIPTION OF WORK:

Extent of variable frequency drive work is indicated by drawings and by requirements of this section.

Coordinate with requirements of Division 16 and include all associated costs in bid.

Coordinate with requirements of Section 15900 and include all associated costs in bid. Include N2 card for interface to existing Johnson Controls system.

QUALITY ASSURANCE:

Manufacturers: Firms regularly engaged in manufacture of variable frequency drives, of types, ratings, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installer's Qualifications: Firm with at least 5 years of successful installation experience with projects utilizing variable frequency drives similar to that required for this project.

NEC Compliance: Comply with applicable NEC requirements pertaining to wiring methods, materials, construction and installation of electrical equipment.

UL Compliance: Provide variable frequency drive components and accessories which are UL-listed, labeled and tested to ANSI/UL STD 508.

IEEE Compliance: Comply with applicable requirements of IEEE Std 59, pertaining to rectifier components and IEEE STD 519 criteria for induced system noise.

NEMA Compliance: Comply with applicable requirements of NEMA Pub 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)".

Comply with EC second environmental, conducted, and radiated limits.

Line Noise: Compliance to IEEE 519 - Harmonic analysis for particular job site including total voltage harmonic distortion and total current distortion.

Tests:

1. The unit shall be subject to a series of in plant quality controlled inspections before approval for shipment from manufacturers' facilities.

2. The integrated circuits shall undergo minimum 160 hour "burn-in" to test reliability. During the "burn-in", the temperature shall be cycled between 0 and 70^{o}C.

3. The completed unit shall undergo a fully loaded 24-hour "burn-in".

SERVICE AND REPLACEMENT PARTS:

1. The VSD supplier must maintain within service area of site, factory trained service representatives on a permanent basis.

2. The service support group will provide as a minimum, the following services:
   a. Factory coordinated start-up service.
   b. Perform 5 years parts and labor warranty.
   c. Operation instructions to Owner's maintenance department.

SUBMITTALS:

Product Data: Submit manufacturer's data on variable frequency drives including: types, ratings, capacities, warranties and performance data. Clearly indicate optional equipment provided.

Provide the following additional information in submittals:

1. Typical efficiency vs. speed graph for variable torque load.

2. Compliance to IEEE 519 - Harmonic analysis for particular job site including total voltage harmonic distortion and total current distortion.
   a. The VSD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VSD manufacturer to ensure compliance with IEEE standard 519-1992. Guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior to VSD installation.
   b. Prior to installation, the VSD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VSD's. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provided and the user.
   c. If the voltage THD exceeds 5%, the VSD manufacturer is to supply the additional equipment required to reduce the voltage THD to an acceptable level.
   d. VSD's shall have EMI/RFI filters on the line side of the input. The filter will be designed to limit conducted noise to EC second environmental, conducted, and radiated limits.

Shop Drawings: Submit dimensioned drawings of variable frequency drives indicating equipment layout and their spatial relationship to associated equipment.

Maintenance Data: Submit maintenance data indicating required steps of maintenance and repair.

Wiring Diagrams: Submit power and control wiring diagrams for variable frequency drives including connections to power and control panels, and feeders.

PRODUCT DELIVERY, STORAGE, AND HANDLING:

Deliver variable frequency drives and accessories individually packaged in factory-fabricated containers.
Handle variable frequency drives carefully to prevent internal component damage, impact, breakage, denting, and scoring enclosure finishes. Do not install damaged variable frequency drives; replace and return damaged units to equipment manufacturer. Store variable frequency drives in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS:

Available Manufacturers: Subject to compliance with requirements, manufacturers offering variable frequency drives which may be incorporated in the work include the following:

ABB
Danfoss
Yaskawa

VARIABLE SPEED DRIVES:

General:

Furnish complete variable frequency VSDs as specified herein for the fans and pumps designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VSD enclosure, unless otherwise specified. VSD shall be housed in a metal NEMA 1 enclosure, or other NEMA type according to the installation and operating conditions at the job site. The VSD's UL listing shall allow mounting in plenum or other air handling compartments. Provide a NEMA 12 enclosure for plenum and AHU compartments.

The VSD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.

With the motor's rated voltage applied to the VSD input, the VSD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VSDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation. The VSD shall include an input full wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

The VSD and options shall be tested to ANSI/UL Standard 508. The complete VSD, including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Assembly of the option panels by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VSD and option panel, in the case where these are not contained in one panel. Both VSD and option panel shall be manufactured in ISO 9001 certified facilities.

The VSD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VSDs without DC link reactors shall provide a minimum 5% impedance line reactor.

The VSD's full load amp rating shall meet or exceed NEC Table 430-150. The VSD shall be

able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

Each VSD shall include fast-acting current limiting input fuses, input power disconnect, motor overload relay wired to indicate "run" and "fault" conditions. The VSD shall include the following devices door mounted: "auto-manual-off" selection switch, output voltage meter, output current meter and output frequency meter. (Note: a single display window may be provided in lieu of meters.)

VSD shall be capable of full interface with facility energy management and control system.

The following basic and self-protective features shall be provided:

1. The current limiter shall be capable of the following: limiting output current to 110% of the inverter rating, and shall function automatically to prevent over current trip due to momentary overload conditions. Provide IEEE compliance noise filters.

2. Instantaneous overcurrent trip shall safely limit the output current to 120% of rated current in 50 microseconds or less.

3. Undervoltage trip shall activate automatically when the line voltage drops 10 - 15% below rated input voltage.

4. Overvoltage trip shall occur if voltage levels exceed 10 - 15% of nominal line voltage.

5. Over temperature trip shall be capable of the following: protect the inverter from elevated temperatures in excess of component rating; an indicator shall illuminate indicating the unit is tripped on over-temperature; when the internal temperature is reduced to an acceptable level, the unit will automatically restart.

6. Inverter logic shall automatically reset and restart from the above trip conditions upon correction of the trip condition. If restart does not occur after five (5) attempts the inverter shall require manual restart.

7. LED or LCD Status illuminated readout indication shall be provided for the trip conditions described herein, and as follows:

   A. Front Panel:
      (1) Power on.
      (2) Unit running.
      (3) Output speed.
      (4) Drive enable condition.
      (5) Internal safety trip.
      (6) External safety trip.
      (7) Input voltage.
      (8) KW draw or Amp draw per leg or phase.
      (9) Bypass status.

   B. Microprocessor Board:
      (1) Over current.
      (2) Low input line voltage.
      (3) Phase sequence.

A SPDT contact shall be provided for remote indication of trip condition and drive "run" condition.

8. Drive logic shall be microprocessor based and shall be isolated from power circuitry. Provide isolated 115 volt control circuit and dedicated control transformer.

9. In the event of power loss, the unit shall be designed to shutdown safely without component loss or failure. Upon return of power, the unit shall safely restart and return to normal operation.

10. Inverter shall safely shutdown without component failure if phase-to-phase short circuit or loss of an input phase occurs.

11. No damage shall occur to the inverter if input or output contactor, disconnect switch, or circuit breaker is opened or closed while control is activated. Prevention of damage on quick shut-off at any speed without lockout to restart from remote location.

12. To facilitate startup and service, the inverter shall be designed to operate without a motor connected to the inverter.

13. A "Hand/Off/Auto" switch and manual speed potentiometer with minimum/maximum adjustable speed control and speed override.

14. A NEMA 1 enclosure.

15. Linear timed acceleration and deceleration.

16. 15-65 HZ controller speed range.

17. Start/stop.

18. Line-to-line fault protection.

19. Line-to-ground short circuiting and accidental motor grounding protection.

20. Insensitive to incoming power phase.

21. Fast acting current limiting input fuses, rated with 200,000 interrupting amperes capability.

22. Protection against being adversely affected by radio frequency interference.

23. Output frequency terminal for remote metering.

24. Provisions for all EMCS interface points.

25. AC transient protection system consisting of MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

The VSD shall have the following adjustments via key pad:

1. Maximum Frequency: 0 - 65 HZ
2. Minimum Frequency: 0 - 65 HZ
3. Acceleration: Linear 1 to 50 seconds
4. Deceleration: Linear 1 to 50 seconds
5. Voltage Boost: 0 to 30 volts.

The VSD shall be designed and constructed to operate within the following service conditions:

1. Ambient temperature range: 0^{o}C to 40^{o}C
2. Atmosphere: Non-Condensing relative humidity to 95%
3. A-C Line voltage variation: -5% to +10%
4. A-C Line frequency variation: +1.8 HZ

Input Control Signal and Interface: Inverter shall be able to respond to input signals 3 analog programmable inputs to accept any of the following 0 - 5 volt DC speed signal, a 0 - 10 volt DC signal, a 4 – 20 ma DC speed signal or a 3 - 15 psig pneumatic speed signal. The unit shall be provided with an input signal offset adjustment to allow zero speed operation from input signals above zero, and an input signal gain adjustment to allow full speed operation from signals which do not reach full nominal control signal.

The bypass system (Mechanical Bypass – Electronic not acceptable) shall consist of an enclosure with:

1. "Drive-Off-Bypass" door mounted selector switch;

2. Factory UL Listed drive and bypass assembly. The drive and bypass shall be designed with a common back plate and UL labeled with a 100,000 AIC for the entire assembly.

3. The bypass consists of a main disconnect, drive and bypass contactors, thermal overload relay, 120V transformer with primary and secondary fuses, under voltage and phase loss protection for contactors and relays. The panel shall be constructed of steel.

4. Drive and Bypass status lights;

5. VSD and bypass contactors capable of interrupting the locked rotor rating of the motor. Bypass and load contactors must be interlocked to prevent simultaneous closure;

6. Motor overload relay (to protect motor when operating from the drive and bypass option);

7. Dedicated terminal strip to allow the unit to be inter-connected with external contacts from energy management controllers and input signals.

8. One (1) magnetic starter mechanically and electrically interlocked with contactors, bypass controller with separate power supply, and main circuit breaker. Provide reduced voltage starter for motors 15 hp and greater.

9. The drive/bypass shall provide single-phase motor protection in both the VSD and bypass modes.

Control and safety devices shall be interlaced through the bypass controller to provide automatic start-stop capabilities, fire stats and/or smoke detector safety interlocks, other specified interlocks and motor current overload protection when the drive is in either the "drive" mode or the "bypass" mode with power disconnected to the VSD. The VSD shall include all standard control features, including floating point control, provided by the manufacturer.

If the controller causes line notching of more than 16,800 volt micro-seconds or voltage distortion in excess of 5% as defined by IEEE 519-92, A Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

Where VSD is not in sight of motor being controlled, provide motor disconnect switch with early break contactors to shut down drive prior to motors electrical disconnection. Wire early break

contactors into VSD's function loss circuit.

New VSD installation shall not require the addition of different motors for proper VSD operation. The new VSD shall not cause damage to the driven motors.

PART 3 - EXECUTION

INSPECTION:

Installer must examine areas and conditions under which variable frequency drives are to be installed, and notify Engineer in writing of those conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION OF VARIABLE FREQUENCY DRIVES:

Install variable speed drives as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that variable frequency drives comply with requirements of NEMA standards and NEC, and applicable portions of NECAs "Standard of Installation", for installation of units.

Install electrical protective devices, for each variable frequency drive.

Provide all hardware necessary to mount drives on brick or block walls, columns or unistrut as required.

Install VSD mounted fan if ambient conditions are such that VSD is not functioning properly due to heat load.

GROUNDING:

Provide equipment grounding connections, sufficiently tight to assure permanent and effective ground, for variable frequency drives equipment as required.

CLEANING:

Touch-up scratched and marred surfaces of equipment to match original finishes; remove dirt and construction debris.

FIELD QUALITY CONTROL:

Upon completion of installation of variable frequency drives, and after circuitry has been energized with rated power source, test variable frequency drives to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance, otherwise remove and replace with new units and proceed with retesting. Submit report of test results.

TRAINING:

Train Owner's maintenance personnel on maintenance and operational procedures. Schedule training at site with Owner. Schedule training with minimum 7 days in advance notice. Notify Engineer in writing as to time and place of training.

END OF SECTION 15970

SECTION 15990 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

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. NEBB or AABC certification required.

The Contractor shall procure the services of an independent balancing and testing agency which specializes in the balancing and testing of heating, ventilating, and air conditioning systems. The agency will balance, adjust, and test all heating, ventilating, and air conditioning systems within the building. The contractor shall provide test and balance to place the system in operation. The contractor shall participate in the Test and Balance, make any changes necessary, and pay for any retesting that may be required to meet specification and drawing requirements. This initial test and balance shall be performed in accordance with this specification and a written report shall be provided. The project will not be accepted as substantially complete until this report has been made.

Test, adjust, and balance the following mechanical systems:

Supply, return, outside, and exhaust air systems, all pressure/flow ranges; including variable volume systems. Test and balance all air devices and traverse duct at each air handler and exhaust fan (record static and CFM).

Hydronic systems (record flow and pressure drop across major equipment including Air Handler Units, OA Preconditioning Units, Air Terminal Boxes, etc.); T&B to conditions scheduled or as indicated on drawings. T&B water flow at major pipe junction points as indicated on drawings.

- Cooling coils, energy recovery ventilators, and heat exchangers
  - measure and record entering and leaving dry bulb and wet bulb temperatures.
- Heating coils/Heat exchangers- measure and record entering and leaving temperatures
- Major Equipment (chillers, boilers, etc.)
  - measure and record entering and leaving temperatures

T&B air-side and water-side conditions before and after construction where indicated on drawings.

Verify temperature control system operation in both heating and cooling modes.

In retrofit projects, record preliminary flow and pressure data to confirm proper operation of existing equipment prior to any demolition work and to confirm new operating conditions can be achieved. Submit preliminary report to Engineer.

The installing mechanical contractor shall make any necessary sheave/pulley and belt changes to obtain final air flows.

The test and balance contractor shall provide preliminary testing as necessary to assist the mechanical contractor.

Test systems for proper sound and vibration levels. Record sound and vibration levels in final report.

SUBMITTALS:

Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

Engineer and Technicians Data:

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.

Forms shall be those standard forms prepared by the AABC or NEBB.

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:

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.

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.

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:

General Information and Summary
Air Systems
Hydronic Systems
Temperature Control Systems

Report Contents: Provide the following minimum information, forms and data:

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.

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.

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.

QUALITY ASSURANCE:

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.

Agency Qualifications:

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.

Codes and Standards:

NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

AABC: "National Standards For Total System Balance."

ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

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.

PROJECT CONDITIONS:

Systems Operation: Systems shall be fully operational prior to beginning procedures.

SEQUENCING AND SCHEDULING:

Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

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 5º 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

Not Used

PART 3 - EXECUTION

PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING:

Before operating the system, perform these steps:

Obtain design drawings and specifications and become thoroughly acquainted with the design intent.

Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.

Compare design to installed equipment and field installations.

Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

Check filters for cleanliness.

Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

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.

Determine best locations in main and branch ductwork for most accurate duct traverses.

Place outlet dampers in the full open position.

Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting of deficiencies.

Lubricate all motors and bearings.

Check fan belt tension.

Check fan rotation.

PRELIMINARY PROCEDURES FOR HYDRONIC SYSTEM BALANCING

Before operating the system perform these steps:

Open valves to full open position. Close coil bypass valves.

Remove and clean all strainers.

Examine hydronic systems and determine if water has been treated and cleaned. Check pump rotation.

Clean and set automatic fill valves for required system pressure.

Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).

Set temperature controls so all coils are calling for full flow.

Check operation of automatic bypass valves.

Check and set operating temperatures of chillers and boilers to design requirements.

Lubricate all motors and bearings.

MEASUREMENTS:

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.

Provide instruments meeting the specifications of the referenced standards.

Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

Apply instrument as recommended by the manufacturer.

Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

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.

Take all reading with the eye at the level of the indicated value to prevent parallax.

Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

Take measurements in the system where best suited to the task.

PERFORMING TESTING, ADJUSTING, AND BALANCING:

Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

Test and document a minimum of 8 measured points for the variable flow pumping systems to verify system pumping performance.

Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

Patch insulation, ductwork, and housings, using materials identical to those removed.

Seal ducts and piping, and test for and repair leaks.

Seal insulation to re-establish integrity of the vapor barrier.

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.

Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

TESTING FOR SOUND AND VIBRATION:

Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

RECORD AND REPORT DATA:

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.

Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

Record the total CFM measured at all of the outlets and compare to the total air flow measured at the unit.

DEMONSTRATION:

Training:

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.

Schedule training with Owner through the Architect/Engineer with at least 7 days prior notice.

END OF SECTION 15990