REPLACE
AHU #40
A/E PROJECT #201555

100% CONSTRUCTION DOCUMENTS

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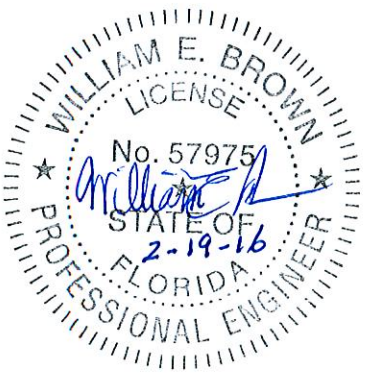

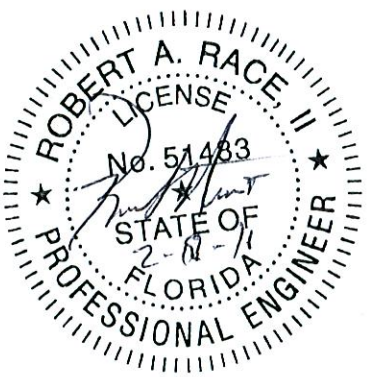

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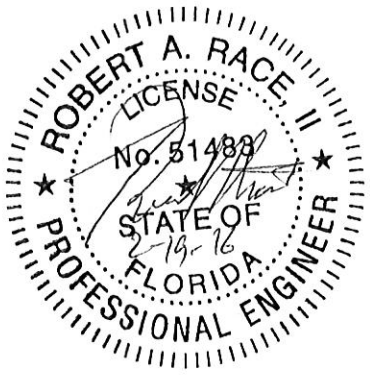

SECTION 01010 - SUMMARY OF WORK

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.

PROJECT DESCRIPTION

Pinellas County Government, through the Engineer, has prepared documents for the replacement of Air Handlers 40 and all associated piping, ductwork, controls and electrical devices and equipment at the Young-Rainey STAR Center, in Largo, Florida. All associated mechanical and electrical work shall be provided for the removal of designated equipment and the installation of new equipment as described herein and on the project drawings.

The use of cranes to place and remove roof mounted equipment shall be limited to prior notice and approval with the tenants of the occupied building. Lifts shall not be permitted over occupied areas.

CONTRACTOR'S USE OF PREMISES

General: The Contractor shall have limited use of the premises for construction operations throughout the course of the work until Substantial Completion. The Contractor's use of the premises is limited by the Owner's right to continue operations and to perform construction operations with its own forces or to employ separate contractors on portions of the project. Confine operations to areas within construction area. Portions of the site beyond the construction area are not to be disturbed. Facilities or portions of facilities shall not be occupied during construction, unless exits, fire detection and early warning systems, fire protection and safety barriers are continuously maintained and clearly marked at all times.

The Contractor shall submit to and comply with all access and security requirements of the Star Center and Raytheon Company. Contractors and sub-contractors who are to work inside the Raytheon areas will need to submit their identification information. Persons who fail to gain escort clearance will not be allowed inside the building and it is the contractor's responsibility to ensure they have personnel who are escort clearance capable to be allowed into the building BEFORE the project commencement. All personnel full names shall be provided to the STAR Center project manager for submission prior to the start of the project. There are no exceptions.

The Contractor shall maintain full care and control of the portion of the site where construction operations are occurring. However, the building will remain occupied and normal operations will continue therein.

All areas disturbed by construction operations shall be returned to their original condition prior to Substantial Completion.

QUALITY CONTROL

Workmanship and maintaining standards of quality shall be the responsibility of the Contractor. A higher standard of workmanship than is considered "industry standards" shall be required on all work, and is not necessarily described in detail in each Section of these Specifications. All work shall be carefully executed, using high standards of care. All concealed work shall be neat and orderly. All finish work

shall be in straight, clean lines. All imperfections shall be removed as work progresses.

Cleaning and adjusting of all work shall occur as it is installed. All items shall be cleaned promptly upon installation and shall be protected from damage throughout the course of the work.

PART 2 - PRODUCTS

(Not applicable).

PART 3 - EXECUTION

(Not applicable).

END OF SECTION 01010

SECTION 01020 - PROJECT COORDINATION

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 administrative and supervisory requirements necessary for project coordination including, but not necessarily limited to:

- Security information.
- Coordination.
- Construction schedule.
- Administrative and supervisory personnel.
- List of Subcontractors.
- As-built drawings.

COORDINATION

Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.

Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work.

The use of cranes to place and remove roof mounted equipment shall be limited to prior notice and approval with tenants of the occupied building. Lifts shall not be permitted over occupied areas.

SCHEDULE

The Contractor shall prepare and submit a Critical Path Method (CPM) graphic network diagram with computer analysis, in accordance with the Associated General Contractors of America publication "CPM In Construction", 1976. Approval of the schedule by the Architect shall not relieve the CM of responsibility for scheduling the work and maintaining progress as specified in the Contract Documents.

Schedule shall show critical submittal dates related to each activity or prepare separate coordinated listing of critical submittal dates. Show phases of work within each activity for major elements which involve purchase lead-time, fabrication, or other coordination issues, as well as installation. In additional to a critical path for each of the work segments, an overall critical path relating these segments to the overall project completion time shall be indicated.

PERSONNEL

Prior to Notice to Proceed, Contractor shall submit a list staff assignments, including the Superintendent

and Project Manager. List their addresses and business contact telephone numbers. Identify the Contractor's point of contact for all communication regarding the project. Provide home phone number of one person for emergency contact after business hours.

Comply with the Star Center and Raytheon Company requirements for security and access into the building and onto the roof prior to the start of the project..

LIST OF SUBCONTRACTORS

Prior to Notice to Proceed, Contractor shall submit to the Owner a list of all subcontractors for the project.

PART 2 - PRODUCTS

(Not Applicable).

PART 3 - EXECUTION

As-Built Drawings: One set of drawings will be maintained in jobsite office for Contractor to record field changes, and reviewed at meetings with the Owner.

END OF SECTION 01020

SECTION 01045 - CUTTING AND PATCHING

PART 1 - GENERAL

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 includes administrative and procedural requirements for cutting and patching.

QUALITY ASSURANCE

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

Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.

WARRANTY

Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties on the existing bonded roof.

PART 2 - PRODUCTS

MATERIALS, GENERAL

Use materials as indicated for patching and closing roof openings caused by removal of roof mounted equipment.

PART 3 - EXECUTION

INSPECTION

Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

PREPARATION

Fire alarm system bypass shall be coordinated in advance with the Owner through the STAR Center project manager before the start of cutting or burning on the site. Burn permits issued by the STAR CENTER.

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.

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.

Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Review proposed procedures with the Owner.

In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping.

END OF SECTION 01045

SECTION 01070 - ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

Listed below are abbreviations commonly used.

Abbreviation	**Meaning**
-A-	
a.	Acre
A	Area
A.B.	Anchor bolt
AC	Alternating current
A/C	Air Conditioning
A.C.I.	American Concrete Institute
A.H.U.	Air Handling Unit
A.I.A.	American Institute of Architects.
Alum.	Aluminum
approx.	approximate
Arch.	Architect
A.S.C.E.	American Society of Civic Engrgs
A.S.H.R.A.E.	American Society of Heating, Refrigerating & Air Conditioning Engineers
A.S.M.E.	American Society of Mechanical Engineers.
A.S.T.M.	American Society for Testing and Materials.
Attn	Attention
Aux.	Auxiliary
Ave.	Avenue
av.	Average
A.W.I.	Architectural Woodwork Institute
-B-	
BB	Ball Bearing
BF	Board feet
bm	Beam
B.M.	Bench Mark
bldg.	building
BLK	Concrete Block
B.T.U.	British thermal unit
B.T.U.H.	British thermal unit per hour

-C-	
C	100
C.C.	Center to Center
CCTV	Closed Circuit Television
C.E.	Civil Engineer
cer.	Ceramic
cu.ft.	cubic feet
cfm	cubic feet per minute
cfs	cubic feet per second
C.I.	Cast Iron
Cir.	Circuit
clg.	Ceiling
CM	Construction Manager
C.B.	Concrete Block
C.O.	Cleanout; change order
C.T.	Ceramic Tile
Clr.	Clear
Ceof.	Coefficient
Col.	Column
comp.	Composition
conc.	Concrete
const.	Construction
cont.	continuous
CMU	Concrete Masonry Unit
contr.	Contractor
corr.	Corrugated
cu.	cubic
CWT	100 pounds
cu.yd.	cubic yard
CPT	Carpet
-D-	
d	penny
dia.	Diameter
Db.	Decibel
dbl.	double
DC	Direct current
Deg.	Degree
Dept.	Department
D.F.	Drinking Fountain
diag.	Diagonal
dim.	Dimension
D.L.	Dead load
dn.	Down
Do.	Ditto
dr.	Drive; Door
D.	Depth
D.S.	Downspout
dwg.	Drawing
D.W.	Drywall
D.W.X.	Type "X" Drywall

D.W.M.	Drywall Moisture Resistant
D.W.R.	Dishwasher
-E-	
E	Modules of Elasticity
ea.	each
El.	Elevation
Elec	Electric
Elev.	Elevation; Elevator
Engr.	Engineer
Eq.	Equal
E.W.C.	Electric Water Cooler
EXST.	Existing
Exp.	Exposed; Expansion
EIFS	Exterior Insulation and Finishing System
EP	Epoxy Paint
EXP	Exposed
-F-	
Fdn.	Foundation
F.E.	Fire Extinguisher
F.E.C.	Fire Extinguisher Cabinet
Fin.	Finish
Flr.	Floor
F.S.	Full size
F.S.	Face of stud
ft.	feet
ftg.	Footing
ft.lb.	foot-pound
F.O.	Field Order
-G-	
ga.	gauge
gal.	gallon
galv.	Galvanized
G.I.	Galvanized iron
gpm	gallons per minute
gr.	Grade
gyp.	Gypsum
GWB	Gypsum Wallboard
-H-	
H.	Height
H.B.	Hose Bibb
HCP	Handicapped
H.M.	Hollow metal
H.C.F.W.	Hollow core flush wood
horiz.	horizontal
h.p.	horsepower
Hwy.	Highway
HZ	Hertz

HDW	Hardware
-I-	
I	Moment of Inertia
I.C.B.O.	Internations Conference of Building Officials
Id.	Identification
ID	Inside Diameter
in.	inches
in. lb.	inch-pound
incl.	Include
int.	Interior
I.P.	Iron pipe
-J-	
Jan.	Janitor
-K-	
K	Kip (1,000 ft. lbs.)
KG	Kilogram
kwh	kilowatt-hour
-L-	
lav	Lavatory
lb.	pound
L.O.A.	Length overall
lin.	Linear
L.L.	Live load
L.S.	Lump sum; Licensed Surveyor
-M-	
M	Bending moment
max.	maximum
MBF	1,000 Board feet
MC	medicine cabinet
Mech.	Mechanical
Mezz.	Mezzanine
mfg.	manufacturing
M.H.	Manhole
min.	minimum
misc.	miscellaneous
M.O.	Masonry opening
MIRR	Mirror
MW	Micro Wave
MRGWB	Moisture Resistant Gypsum Wallboard
-N-	
NOA	Net Operable Area (sq.ft)
N.E.C.	National Electrical Code
N.E.M.A.	National Electrical Manufacturers Association
neg.	negative
N.I.C.	Not in contract

No.	Number
N.P.C.	National Plumbing Code
N.T.S.	Not to scale
NAT	Natural Finish
-O-	
O.C.	On Center
OD	Outside diameter
opp.	opposite
oz.	Ounce
O	Round
-P-	
P	Paint (color as selected)
PBX	Private branch exchange
pcs.	pieces
pcf	pounds per cubic foot
Perm.	Permanent
Perp.	Perpendicular
Pl.	Plate; P
pos.	positive
P.P	Power pole
pr	pair
psf	pounds per square foot
psi	pounds per square inch
P.T.D.	Paper towel dispenser
ptn.	Partition
-Q-	
qt.	quart
-R-	
r	Radius of gyration
ref	refer; reference; refrigerator
req'd	required
RGE	Range
R.R.	Railroad
R/W	Right of Way
-S-	
S	Section Modules
S.C.F.W.	Solid core flush wood
Sect.	Section
SCWD	Solid Core Wood Door
SC	Sealed Concrete Finish
S.F.	Sealed floors; Square foot
S.G.B.	Soap Grab and Bar
Sh	Sheet
SH	Shower head
SHC	Shower curtain
sim.	Similar

S.N.D.	Sanitary Napkin Dispenser
Spec.	Specification
sprklr.	Sprinkler
sq.	square
sq. ft.	square foot
sq. in.	square inch
sq. yd.	square yard
SR	Shower rod
St.	Street
std.	Standard
sto.	Storage
Struct.	Structural
sym.	symmetrical
SPC	Suspension Cement Plaster Ceiling

-T-

T.B.	Towel bar
T & G	Tongue and Groove
Tol.	Tolerance
T.P.H.	Toilet paper holer
TPS	toilet partition screen
Trans.	Transformer
TV	Television
typ.	typical

-U-

U.B.C.	Uniform Building Code
U.L.	Underwriters Laboratories
U.	Urinal

-V-

V	Vinyl
V.T.	Vinyl tile
VCT	Vinyl Composition Tile

-W-

W	Width
W.C.	Water closet
WD	Wood
WF	Wide Flange

-Y-

yd.	yard

PART 2 - PRODUCTS (not applicable)

PART 3 – EXECUTION (not applicable)

END OF SECTION 01070

SECTION 01090 - DEFINITIONS AND STANDARDS

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.

DEFINITIONS

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

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

Directed: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted", mean "directed by the Architect/Engineer", "requested by the Architect/Engineer ", and similar phrases. However, no implied meaning shall be interpreted to extend the Architect's/Engineer's responsibility into the Contractor's area of construction supervision.

Approve: The term "approved", where used in conjunction with the Architect's/Engineer's action on the Contractor's submittals, applications, and requests is limited to the duties and responsibilities of the Architect as stated in General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill Contract requirements unless otherwise provided in the Contract Documents.

Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.

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

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

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

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

The term "experienced", when used with the term "Installer" means having a minimum of 5 previous Projects similar in size and scope to this Project, being familiar with the precautions required and having complied with requirements of the authority having jurisdiction.

Project Site is the space available to the Contractor for performance of construction activities, either exclusively or in conjunction with others performing other construction activities as part of the Project.

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

DRAWING SYMBOLS

Graphic Symbols: Symbols used are described on the Drawings.

INDUSTRY STANDARDS

Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference. Individual sections indicate which codes and standards the Contractor must keep available at the Project Site for reference.

Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.

Updated Standards: At the request of the Architect/Engineer, Contractor or authority having jurisdiction, submit a Change Order proposal where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected. The Architect will decide whether to issue a Change Order to proceed with the updated standard.

Conflicting Requirements: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced unless the Contract Documents indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect for a decision before proceeding.

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

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

Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

GOVERNING REGULATIONS/AUTHORITIES

The Architect/Engineer has contacted authorities having jurisdiction where necessary to obtain information necessary for the preparation of Contract Documents; that information may or may not be of significance to the Contractor. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.

SUBMITTALS

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

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01090

SECTION 01200 - PROJECT MEETINGS

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

Work included: To enable orderly review during progress of the Work, and to provide for systematic discussion of problems, the Architect/Engineer or the Owner will conduct project meetings throughout the construction period.

SUBMITTALS

Minutes: The Architect/Engineer will compile minutes of each project meeting, and will furnish, within five (5) working days, one copy to the Contractor and required copies to the Owner.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

MEETING SCHEDULE

Project meetings will be held at the end of the month to include Pay Request review.

Coordinate as necessary to establish mutually acceptable schedule for meetings.

MEETING LOCATION

All meetings shall be held at the job site

PRECONSTRUCTION MEETING

A Preconstruction Meeting will be scheduled to be held within 5 working days after the Owner has issued the Notice to Proceed.

Representatives of the Owner, the Contractor and all Subcontractors are to attend.

Minimum agenda: Data will be distributed and discussed on at least the following items:

Procedures for communication.

Construction schedule, including sequence of critical work.

Contract Documents, including distribution of required copies of original Documents and revision.

Processing of Shop Drawings and other dates submitted to the Architect/Engineer for review.

Rules and regulations governing performance of the Work.

Procedures for safety and first aid, security, quality control, housekeeping, and related matters.

Security requirements for work inside Raytheon tenant areas.

PROJECT MEETINGS

Attendance:

The Contractor is to assign the project supervisor to attend all meetings throughout progress of the Work.

Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspect of the Work is involved.

Minimum agenda:

Review, revise as necessary, and approve minutes of previous meetings.

Review progress of the Work, since last meeting, including status of submittals for approval.

Identify problems which impede planned progress.

Develop corrective measures and procedures to regain planned schedule.

Complete other current business.

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

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 administrative and procedural requirements for submittals required for performance of the Work, including:

- Schedule of Values.
- Shop Drawings.
- Catalogue and Product Data.
- Samples.

Requirements of “Submittals” Section are only applicable to those items that are in compliance with the Specifications. If the Contractor wishes to submit an item for consideration that is not in compliance with the Specifications, refer to the procedures for "Substitutions" in another Division 1 section.

DEFINITIONS

Submittals: Written and graphic information and physical samples that require Architect’s and Contractor responsive action.

File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP Site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

All Shop Drawings shall be submitted within the first 10 days of “Notice to Proceed”, **No exceptions.**

Contractor to provide a Shop Drawing Submittal Schedule which itemizes by CSI Division, all shop drawings required and their date of submission. Likewise a Submittal Log shall be kept identifying the submission, dates and results.

SUBMITTAL PROCEDURES

Prepare coordinated Submittals and provide all required elements as indicated in individual Specification Sections.

- Submit one paper copy of each Submittal along with product samples and other required physical elements.

Post electronic submittals as PDF electronic files directly to Project Web Site or Architect's/Engineer's FTP site specifically established for Project.

Submit electronic Submittals as PDF electronic files directly to Architect's/Engineer's Project Manager and the STAR Center project manager..

Architect/Engineer will return annotated PDF file to Contractor.

All Submittals shall be provided to the Architect/Engineer and the STAR Center project manager electronically in PDF format, with 1 matching hard copy. All Submittals will be returned to the Contractor electronically in PDF format. A record hard copy of each Submittal shall be provided by the Contractor and kept at the jobsite.

Submittal Preparation: Place a permanent label or title block on each submittal for identification.

Indicate name of firm or entity that prepared each submittal on label or title block.

Provide a space approximately 4 by 5 inches (100 by 125 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect/Engineer and Contractor.

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

Project name
Date
Name and address of Architect/Engineer and Contractor
Name and address of Contractor
Name and address of subcontractor
Name and address of supplier
Name of manufacturer
Unique identifier, including revision number
Number and title of appropriate Specification section.
Drawing number and detail references, as appropriate
Other necessary identification
Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

Review: The Contractor shall review all submittals for compliance with the Construction Documents prior to submitting to the Architect/Engineer. No submittals will be reviewed by the Architect that have not been reviewed and stamped by the Contractor.

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.

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 Architect's/Engineer's review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Architect/Engineer will promptly

advise the Contractor when a submittal being processed must be delayed for coordination. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.

SCHEDULE OF VALUES

Coordinate the Schedule of Values and Applications for Payment with the Contractor's Construction Schedule and project phases.

Break the Schedule completely into phases so the work of each phase can be evaluated independently.

Submit the Schedule of Values to the Architect/Engineer and the STAR Center project manager at the earliest feasible date, but in no case later than 10 days after the Notice to Proceed. No exceptions. No request for payment will be made without submission of an approved schedule of values.

Arrange the Schedule of Values in a tabular form with separate column for each item listed.

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

Round off amounts to the nearest whole dollar; the total shall equal the Contract Sum.

For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work. No payment shall be made for stored materials unless stored on-site or in a bonded warehouse.

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:

Identification of products.
Schedules.
Compliance with specified standards.
Notation of coordination requirements.
Notation of dimensions established by field measurement.
Relationship and attachment to adjoining construction clearly indicated.
Seal and signature of professional engineer if required.

SAMPLES

Submit fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or

containers of materials, color range sets, and swatches showing color, texture and pattern. Samples for color selection must be samples of the actual product. Printed material for color selection will not be accepted.

FLORIDA BUILDING CODE COMPLIANCE DOCUMENTATION

Provide documentation with Submittals for exterior components and cladding in accordance with the Florida Product Approval System for Exterior Apertures, or Miami-Dade Notice of Acceptance process, including windows, exterior doors and frames, roofing, precast lintels, metal soffits, louvers and vents, and all structural components that effect the structural integrity of building during windstorms, to indicate:

Evidence that the product has been evaluated for compliance with standards established by the Florida Building Code by a Florida Building Commission approved entity or Florida licensed P.E. or R.A.

Evidence that the manufacturer has contracted with a Florida Building Commission approved quality assurance entity to monitor manufacturing production and has actively complied or have the product listed and labeled by a commission approved certification program.

Installation instructions consistent with the evaluation of compliance.

ARCHITECT'S/ENGINEER'S ACTION

For each Submittal where action and return is required, the Architect/Engineer will review each submittal, mark to indicate action taken, and return to the Contractor within 14 days of receipt of hard copy.

Incomplete Submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

Submittals not required by the Contract Documents may be returned by the Architect/Engineer without action.

Compliance with the Contract Documents is exclusively the Contractor's responsibility. The Contractor shall not submit any item that is not in full compliance with the Documents, without explicitly so noting in a cover letter with the submittal that the particular substitution had prior approval. Architect's/Engineer's acceptance of any item shall not constitute acceptance of any variance from the Documents, unless explicitly accepted as a Substitution.

In order to provide a coordinated color scheme, color selection will not be made for any item until all items requiring color selection have been submitted.

Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

Note date and content of previous submittal.
Note date and content of revision in label or title block and clearly indicate extent of revision.
Resubmit submittals until they are marked "NO EXCEPTION TAKEN" on Architect's action stamp.

Distribution: Furnish copies of final Submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

Use for Construction: Retain complete copies of Submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's/Engineer's and Contractor's action stamp.

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, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves.

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.

Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

PART 2 - PRODUCTS

(Not Applicable).

PART 3 - EXECUTION

Do not use Submittals or Shop Drawings without an appropriate final stamp from the Architect indicating action taken in connection with construction.

END OF SECTION 01300

SECTION 01420 - REFERENCES

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

The intent of this Section is to establish for the record, the Contractor=s responsibility to provide the latest, updated requirements of organizations, standards, regulations and agencies specified as industry standards within these specifications as these items are subject to change.

INDUSTRY STANDARDS

Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. The Contractor is to comply with such published standards as they are a part of the Contract Documents be reference.

Publication Dates: If updated regulations and standards are available, Contractor to notify Architect/Engineer and comply with latest standards in effect as of date of the Contract Documents.

Copies of Standards: Each entity engaged in construction Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents. These standards and regulations are indicated in the specification Section as abbreviations or acronyms, i.e., ADAAG, ASTM, CODES, U.L., etc.

SPECIFICATION COORDINATION

Specification Coordination instructions are not included in this Section. This Section affects all regulations and standards bound within these specifications.

DRAWING COORDINATION

Contractor to review Product Approval Requirements as indicated and comply, i.e. (NOA) Notice of Approval, (FPA) Florida Product Approval, etc.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

Comply with current industry standards specified including any up-dated publications.

END OF SECTION 01420

SECTION 01600 - MATERIALS AND EQUIPMENT

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

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

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

DEFINITIONS

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

> "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
>
> "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, which is current as of the date of the Contract Documents.
>
> "Foreign Products", as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.

"Materials" are products that are substantially shaped, but, worked, mixed, finished, refined or otherwise fabricated, processed or installed to form a part of the Work.

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

QUALITY ASSURANCE

Source Limitations: Provide products of the same kind, from a single source.

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

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

No available domestic product complies with the Contract Documents.

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

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

Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.

PRODUCT DELIVERY, STORAGE AND HANDLING

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

Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.

Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

PRODUCT SELECTION

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

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

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

Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated when the statement "No Substitutions" or "No Substitutions will be permitted" appears after the product named.

Non-Proprietary Specifications: The Specifications list products or manufacturers that are available and may be incorporated in the Work. The Contractor may propose a substitute product that complies with Contract requirements. Such substitution must equal to or better than original product specified. The proof of the product or system is the responsibility of the proposer and must be completely noted prior to submittal to Architect/Engineer or the submittal will not be considered. Any proposed “substitutions” must be approved by the Architect, (5) days before time to open bids.

Descriptive Specification Requirements: Where Specifications describe a product or assembly listing exact characteristics required with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.

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

Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.

PART 3 - EXECUTION

INSTALLATION OF PRODUCTS

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

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

END OF SECTION 01600

SECTION 01630 - PRODUCT SUBSTITUTIONS

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 administrative and procedural requirements for handling requests for substitutions made before and after bid.

DEFINITIONS

Substitutions: Requests for changes in products and methods of construction required by Contract Documents, proposed by a Bidder before the bids are received by the Contractor are considered requests for "substitutions."

The following are not considered substitutions:

Revisions to Contract Documents by the Engineer.

Specified options of products and construction methods included in Contract Documents.

The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

REQUESTS FOR SUBSTITUTIONS

All requests for substitutions shall include the following:

A statement by the Contractor certifying that the proposed Work complies with the requirements of the Specifications. It is the Contractor's responsibility to ensure that all substitutions used in the Work comply with the requirements of the Specifications.

Identify the product and fabrication and installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, product Data, including drawings and descriptions of products, and fabrication and installation procedures.

Samples, where applicable or requested.

A detailed comparison of qualities of the proposed substitution with those of the Work specified, including elements such as size, weight, durability, performance and visual effect.

Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.

A statement indicating the substitution's effect on the Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

Cost information, including a proposal of the net change, if any, in the Contract Sum (for substitutions after bid).

Substitution Request Submittal (before bid): Requests for substitution will be considered if received in writing no later than 10 days prior to bid date. Information must be complete.

Engineer's Action: Approvals will be issued in the form of an addendum issued to all bidders. Denials will be sent only to bidder requesting substitution.

Substitution Request Submittal (after Contract award): Requests for substitution after Contract Award will not be considered at the discretion of the Engineer and Owner for just cause. Examples of just cause are lack of availability of the specified product, availability of new products, inability to receive timely delivery, and the like.

Engineer's Action: Within one week of receipt of the request for substitution, the Architect will request additional information or documentation necessary for evaluation of the request. Within 2 weeks of receipt of the request, or one week of receipt of the additional information or documentation, whichever is later, the Architect will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name.

SUBSTITUTIONS

Conditions: The substitution request will be received and considered by the Architect and Owner entirely at their discretion.

The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval. It is exclusively the Contractor's responsibility to ensure that all work complies with the Documents.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

Contractor (Not Applicable)

END OF SECTION 01630

SECTION 01700 - PROJECT CLOSEOUT

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

Inspection procedures
Project record document submittal
Submittal of warranties
Final cleaning

Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 15 and 16.

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.

Submit record drawings, and similar final record information.

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

Submit documentation, satisfactory to Owner, that any unsettled claims will be settled and that work not actually completed and accepted will be completed without undue delay.

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

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 Architect.

Submit consent to surety to final payment.

Submit a final liquidated damages settlement statement.

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

Upon completion of re-inspection, 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, re-inspection will be repeated.

RE-INSPECTION CHARGES

The Engineer, when requested by the Contractor, will make additional re-inspections which may be required to ascertain full and final compliance of the Work with the Contract Documents. However, all reinspections required beyond the initial inspections to certify substantial and final completion as part of the Engineer's prescribed services shall be at the expense of the Contractor and shall be assessed at the

Engineer's rate of one hundred fifty dollars ($150.00) per hour. All such charges will be adjusted through a Change Order crediting the contract sum for the additional cost of the Engineer's services.

Re-inspection charges shall be based on hourly rates for actual job time plus travel time, support and clerical time as invoiced by the Architect for such re-inspections.

These charges shall be in addition to any liquidated damages that may be imposed for late completion pursuant to other provisions of these documents.

RECORD DOCUMENT SUBMITTALS

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

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

Each trade shall be responsible for maintaining the record drawing for their part of the work. The master set of drawings shall not be used for construction purposes and shall be stored in a fire resistive location.

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

Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.

Note related Change Order numbers where applicable.

The Engineer and his consultants shall have access to the Record Drawings at the project site on a daily basis during normal working hours.

Upon completion of construction, submit the set of reproducible drawings along with 1 set of black line white-prints for review and approval by the Architect.

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

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

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION

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.

END OF SECTION 01700

SECTION 07600 - SHEET METAL WORK

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 includes the following sheet metal flashing and trim:

Formed equipment support flashing.

SUBMITTALS

Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

Shop Drawings: Show layouts of new metal flashings, including plans and details. Distinguish between shop and field-assembled work. Include the following:

Identify material, thickness, weight, and finish for each item and location in Project.

Details for forming sheet metal work, including profiles, shapes, seams, and dimensions.

Details for fastening, joining, supporting, and anchoring metal work, including fasteners, clips, cleats, and attachments to adjoining work.

QUALITY ASSURANCE

Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual". Conform to dimensions and profiles shown unless more stringent requirements are indicated.

Build mockup of typical new wall scuppers meeting SMACNA details, including supporting construction cleats, seams, joints, attachments and accessories.

Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

Approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

DELIVERY, STORAGE AND HANDLING

Deliver new metal work materials and fabrications undamaged. Protect metal fworkduring transportation and handling.

Unload, store, metal work in a manner to prevent bending, warping, twisting, and surface damage.

COORDINATION

Coordinate installation of sheet metal work with interfacing and adjoining construction to provide a leak-proof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

SHEET METALS

Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

Minimum Thickness: 24 ga (.0250 inch), unless indicated otherwise.
Finish: No. 2D (dull, color rolled).

MISCELLANEOUS MATERIALS

General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal installation.

Fasteners: Stainless steel screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

Fasteners: Stainless-steel.

Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work matching or compatible with material being installed, non-corrosive, size and gauge for performance.

Flashing Joint Cover: W.R. Grace, "PERM-A-BARRIER".

Mastic Sealant: Elastomeric, non-hardening, non-skinning, non-drying, non-migrating sealant to maintain joints weathertight, ASTM C920, Fed. Spec. No. TT-S-0023C, Type II-C.

Solder for Stainless Steel: ASTM B 32, grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in new wall copings and trim and remain watertight.

FABRICATION, GENERAL

General: Custom fabricate flashings to comply with recommendations in SMACNA's "Architectural Sheet Metal manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

Fabricate sheet metal work in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

Fabricate sheet metal work without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

Seams: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

Expansion Provisions: Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

FINISHES

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Product" for recommendations for applying and designing finishes.

Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

EXAMINATION

Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
Proceed with installation only after unsatisfactory conditions have been corrected.

ROOF FLASHING INSTALLATION

General: Install sheet metal work to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

Flashing: Coordinate installation of storm collar draw band flashing with installation of roof waterproof system base flashing at pipe supports as indicated in the drawings. Attach flashing to fit tightly in place.

Secure all counter flashings in a waterproof manner as indicated.

Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.

Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

In general, flashings to extend minimum of (8) inches above roofing for roof mounted equipment, expansion joints, etc. for warranty.

FABRICATED UNITS

General Metal Fabrication: Shop fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA's "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer's instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

CLEANING AND PROTECTION

Clean and neutralize flux materials. Clean off excess solder and sealants.

Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

Replace sheet metal work that have been damaged or that have deteriorated beyond successful repair by finish touch-up or similar minor repair procedures.

END OF SECTION 07600

SECTION 07900 - JOINT SEALERS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SYSTEM PERFORMANCES

Provide joint sealers that have been produced and installed to establish and maintain watertight and airtight continuous seals.

QUALITY ASSURANCE

Installer Qualifications: An Installer who has experience in the application of the types of materials required, and who agrees to employ only skilled tradesmen in the work.

Single Source Responsibility for Joint Sealer Materials: Obtain joint sealer materials from a single manufacturer for each different product required.

General Performance: Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, with recognized limitations of wear and aging as indicated for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

SUBMITTALS

Manufacturers Data: Submit one copy of manufacturer's technical data for each sealer product required, including instructions for joint preparation and joint sealer application.

Test Reports: Submit the following test reports:

Certificates: Submit certificates from manufacturers of joint sealers attesting that their products comply with specification requirements and are suitable for the use indicated.

GUARANTEE

Submit one copy of written guarantee agreeing to repair or replace sealants which fail to perform as air-tight and water-tight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified by submitted by manufacturer's data, as an inherent quality of the material for the exposure indicated. Provide two (2) year guarantee signed by the Installer and Contractor.

DELIVERY, STORAGE, AND HANDLING

Deliver materials to project site 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 materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

PROJECT CONDITIONS

Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:

When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturers

When joint substrates are wet due to rain, frost, condensation or other causes.

PART 2 - PRODUCTS

MATERIALS, GENERAL

Colors: Provide color of exposed joint sealers to match adjacent finishes from manufacturer's standard colors that will generally match or blend with adjacent finished surfaces.

Colors: Provide standard colors of joint sealers where sealer is not exposed to view.

ELASTOMERIC JOINT SEALANTS

Modulus of Elasticity: For joints subject to movement, either thermal expansion or dynamic movement, provide elastomeric sealants which have the lowest modulus of elasticity which is consistent with the exposure to abrasion or vandalism. For horizontal joints subject to traffic provide sealants with high modulus of elasticity, as required to withstand indentation by stiletto heels. Comply with manufacturer's recommendations wherever no other requirements are indicated.

Compatibility: Before purchase of each specified sealant, investigate its compatibility with the joint surfaces, joint fillers and other materials in the joint system. Provide only materials (manufacturer's recommended variation of the specified materials) which are known to be fully compatible with the actual installation condition, as shown by manufacturer's published data or certification.

SEALANTS

EXTERIOR USE T: Exterior joints in horizontal traffic surfaces. Control expansion and isolation in cast-in-place concrete slabs for concrete sidewalks.

One part polyurethane sealant:

"Vulken 45" Tremco Sealants
"Sonolastic SL-1" BASF Chemical Co.

EXTERIOR USE NT: Exterior joints in vertical surfaces and non-traffic horizontal surfaces.

Joints between different materials
Perimeter joints between different materials and frames of doors and windows.
Other joints as indicated.

One part non-sag polyurethane sealant for NT:

Basis of Design: Vulken 921 Bostik or Chem Calk 915

INTERIOR USE T: Interior joints in horizontal traffic surfaces, at all interior spaces and for the control of permeable gasses through joints to be sealed tight.

Control and expansion joints in tile flooring
Other joints as indicated

Multi-Part NonSag Urethane Sealant for Use T:

"Dymeric 240/240 FC" - Tremco Sealant
"Chem Calk 500" - Bostik, Inc.
"NP-2" - BASF chemicals Co.

INTERIOR USE NT: Interior joints in vertical surfaces and horizontal non-traffic surfaces.

Door and window frames
Control and expansion joints on exposed interior walls
Joints where drywall partition abuts partition of different material
Other joints as indicated

Acrylic Latex Sealant: Manufacturer's standard one part, acrylic latex gun-grade, for use NT, formulated to be paintable and recommended for exposed applications on interior.

"Sonolac" BASF Chemicals Co.
"Chem Calk 600" - Bostik, Inc.
"Admark Acrylic Latex"; ADCO Products

MISCELLANEOUS MATERIALS

Joint Cleaner: Provide the type of joint cleaning compound recommended by the sealant or caulking compound manufacturer, for the joint surfaces to be cleaned.

Joint Primer/Sealant: Provide the type of joint primer/sealer recommended by the sealant manufacturer, for the joint surfaces to be primed or sealed.

Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and joint filler or other materials at back (3rd) surface of joint. Provide self-adhesive tape where applicable.

Sealant Backer Rod: Compressed closed cell rod stock polyethylene foam. Provide size and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on backside and provide a highly compressible backer to minimize the

possibility of sealant extrusion when joint is compressed.

Basis of Design: SOF ROD as manufactured by NMC of North America, Inc.

PART 3 - EXECUTION

Joint Surface Preparation: Completely clean all joint surfaces immediately before installing joint sealers.

Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer or caulking compound.

For elastomeric sealants, do not proceed with installation of sealant over joint surfaces which have been painted, lacquered, waterproofed or treated with water repellent or other treatment or coating.

Roughen joint surfaces on vitreous coated and similar non-porous materials, wherever sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or wool to produce a dull sheen.

Prime all joint substrates as recommended by joint sealer manufacturer. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.

INSTALLATION

General: Comply with joint sealer manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply. Prime or seal the joint surfaces as recommended by the sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.

Installation of Sealant Backings: Install sealant backer-rods for liquid elastomeric sealants, except where recommended to be omitted by the sealant manufacturer for application shown.

Install joint-fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.

Do not leave gaps between ends of joint-fillers.

Do not stretch, twist, puncture or tear joint-fillers.

Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.

Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.

Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

Install sealants to depths as recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 25% of joint width, but neither more than 3/8" deep nor less than 1/8" deep.

For joints sealed with non-elastomeric sealants, fill joints to a depth in the range of 75% to 125% of joint width.

Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces including rough textures such as exposed aggregate panels. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or the sealant/caulking compound.

CURE AND PROTECTION

Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

The Installer shall advise the sub-contractor of procedures required for the curing and protection of sealants and caulking compounds during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at the time of acceptance by the Contractor.

Exposed joints to be caulked are, but not limited to, the following:

Between all metals and other materials.
Between hollow metal door frames and gypsum board, masonry or exterior finish.
Between walls and hard ceilings.
All other joints as indicated on the drawings.
Between casework and building.
Between plumbing fixtures and floor or wall.

END OF SECTION 07900

SECTION 15010 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

RELATED DOCUMENTS

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

DEFINITIONS AND REQUISITES

The terms Architect/Engineer shall be defined as Long & Associates, Architects/Engineers, Inc., Tampa, Florida.

The term "provide" shall mean furnish and install.

The phrases "where shown", "where indicated" and "as indicated" shall mean shown and where or as indicated on the drawings.

The phrase "or equal" shall mean equivalent as determined by the Engineer.

Division 15 Specification sections are inter-related and what is required by one section shall be deemed as what is required by the other sections. An individual section that lists other specific sections as "RELATED DOCUMENTS" is done so for the convenience of the reader and is not to be construed as the only related sections.

SUMMARY

This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Division 15. It expands and supplements the requirements specified in section of Division 1. It is applicable to all Division 15 sections.

EXTENT OF WORK

The extent of mechanical work is as called for and indicated in the contract document drawings and specifications. The performance of all mechanical work is the responsibility of the Construction Manager and shall be a complete installation in accordance with the contract documents.

QUALIFICATIONS

Mechanical Contractor shall be a State licensed Mechanical Contractor. Submit documentation of certification

CODES

The following codes shall govern all Division 15 work:

NFPA 101
Florida Building Code, current edition
Florida Building Code, Mechanical, current edition

National Electric Code, current edition
State Regulations as promulgated by the State Fire Marshal
OSHA

PART 2 - PRODUCTS

Mechanical equipment used as the basis of design is generally indicated in equipment schedules. Throughout the specifications, materials and equipment may be specified by multiple manufacturers. In some cases, manufacturers are limited to comply with Young-Rainey Star Center standards. The bidder may assume that the manufacturers specified will be an acceptable manufacturer that can provide materials and equipment equivalent to that provided by the manufacturer used in the basis of design, however, materials and equipment submitted by manufacturers other than the basis of design will not be accepted on the basis of the manufacturer's name only. Materials and equipment submitted by manufacturers other than the basis of design must furnish materials and equipment substantially equivalent in size, function and performance as described in the equipment schedules. The burden of proof of equivalence will be the responsibility of the bidder.

Electrical characteristics for mechanical equipment shall correspond to the equipment utilized in the basis of design. Equipment having different electrical characteristics or equipment that requires different electrical protection to maintain a tested rating other than that indicated may be proposed. The Contractor shall identify such differences as deviations on the equipment submittals. All electrical modifications required to accommodate acceptance of the proposed deviation including, but not limited to, circuit breakers, disconnects, fuses, motor controllers, raceways, conductors and terminations shall be performed at the Contractor's expense and at no additional cost to the Owner. Failure to indicate such deviations on the equipment submittal shall not relieve the Contractor from providing the electrical modifications if the proposed equipment is accepted. All equipment shall comply with energy ratings specified and fit within the space allotted.

The Contractor shall be responsible for dimensional variations between the equipment used in the basis of design and the equipment actually furnished so as to ensure a successful installation. No claim for additional compensation shall be considered for field modifications that may be necessary to accommodate dimensional variations between manufacturers.

PART 3 - EXECUTION

GENERAL

The work to be done under division 15 shall include the furnishing of all material, labor, equipment, tools and transportation required to provide a complete, working mechanical system with all devices and accessories indicated and specified herein.

The Drawings and Specifications are complimentary and what is required by one shall be binding as if required by both. If a discrepancy exists between the requirements of the drawings and specifications, the more stringent requirement shall apply.

WORK IN EXISTING FACILITIES

Existing Facilities: Work includes dismantling and removal of certain existing equipment, and revisions to existing piping. The facility's tenants will continue to occupy the existing facility during performance

of work. Temporary utility shutdowns may be required to accomplish portions of the work. All shutdowns must be scheduled with the Young-Rainey Star Center Maintenance Department and coordinated with the Building Staff.

AFTER HOURS WORK

Certain portions of the work may require after hours work to accommodate construction requirements. The contractor shall include in his bid all costs for after hours work associated with construction requirements. Removal and installation of rooftop equipment by crane shall be performed after hours and when the facility is unoccupied.

DEMOLITION

Remove existing mechanical equipment, ductwork, piping, controls, etc. not indicated as remaining, or not required for the operation of any mechanical systems. Equipment shall be disposed of by the contractor in accordance with applicable federal, state and local laws, rules and ordinances.

ACCESSIBILITY

Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of equipment and devices requiring access so that service and maintenance can be performed without disassembly of equipment or other building elements.

Extend all grease fittings to an accessible location.

ROUGH-IN

Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

Refer to equipment specifications in Division 2 through 16 for rough-in requirements.

MECHANICAL INSTALLATIONS

Coordinate mechanical equipment and materials installation with other building components.

Verify all dimensions by field measurements. Do not scale the drawings. Locate and arrange ductwork, piping and equipment to present a neat and orderly appearance with due consideration given to coordination with work of other trades.

Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

Coordinate the installation of required supporting devices with other structural components, as they are constructed.

Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to completing other work.

Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

Coordinate the installation of mechanical materials and equipment above ceilings with suspension system, light fixtures, and other installations.

Coordinate connection of mechanical systems with exterior underground and overhead utilities and services.

Comply with requirements of governing regulations, franchised services companies, and controlling agencies.
Provide required connection for service.

Isolate all equipment to minimize objectionable noise and vibration.

MECHANICAL COORDINATION DRAWINGS

Prepare and submit a set of coordination drawings showing major elements, components, and systems of mechanical equipment and materials in relationship with other building components. Prepare drawings to an accurate scale of 1/4"-1'0" or larger, using dimensions from accepted shop drawings. Indicate the locations of all equipment and materials, including clearances for installing and maintaining insulation, servicing and maintaining equipment, valve stem movement, and similar requirements. Indicate movement and positioning of large equipment into the building during construction. Coordinate drawings with shop drawings of other trades.

Prepare floor plans, elevations, sections, and details to conclusively coordinate and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

Mechanical equipment layouts:
Specific equipment installations, including: air handling units;
Work in pipe and duct chases;
Exterior wall penetrations;
Numbered valve location diagrams;

CUTTING AND PATCHING

This Article specifies the cutting and patching of mechanical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment.

Do not endanger or damage installed Work through procedures and processes of cutting and patching.

Arrange for repairs required to restore other work, because of damage caused as result of mechanical installations.

No additional compensation will be authorized for cutting and patching work that is routine, or is necessitated by ill-timed, defective, or non-conforming installations.

Perform cutting, fitting, and patching of mechanical equipment and materials required to:

- Uncover work to provide for installation of ill-timed Work;
- Remove and replace defective Work;
- Remove and replace Work not conforming to requirements of the Contract Documents;
- Remove samples of installed Work as specified for testing;
- Install equipment and materials in existing structures;
- Upon written instruction from the Architect/Engineer, uncover and restore work to provide for Architect/Engineer observation of concealed work.

Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, ductwork and other mechanical items made obsolete by the new Work.

Protect the roof surface, structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas. Provide suspended catch tarps below new work and AHU while removing or installing units. Coordinate all roof work with the Owner and Tenants.

Locate, identify, and protect mechanical and electrical services to remain that serves other equipment required to remain in operation. When transit services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

MECHANICAL SUBMITTALS

Refer to Conditions of the Contract (General and Supplementary) and Division 1 Section 01300 "SUBMITTALS" for submittal definitions, requirements, and procedures.

Submittal of shop drawings, product data, and samples will be accepted only when submitted by this Contractor through the General Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

In addition to other requirements of Section "Submittals", mechanical shop drawings shall be submitted in accordance with the following:

- In individual separate electronic PDF files for each type of equipment. Provide separate files for HVAC submittals and for plumbing submittals.

- With cover sheet indicating project, Contractor, Subcontractor, related suppliers, all with addresses and phone numbers.

- With table of contents listing each item.

Submit all HVAC submittals in one group. Piece-by-piece submittals will not be accepted.

PRODUCT OPTIONS AND SUBSTITUTIONS

Refer to the Instructions to Bidders and the Division 1 Section SUBSTITUTIONS for requirements in selecting products and requesting substitutions. "Basis of Design" manufacturers for mechanical equipment are indicated in equipment schedules.

PRODUCT LISTING

Within 30 days of Notice to Proceed, prepare listing of major mechanical equipment and materials for the project.

When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods and similar items used in work, except as otherwise indicated.

Provide products which are compatible within systems and other connected items.

NAMEPLATE DATA

Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

DELIVERY, STORAGE, AND HANDLING

Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Do not store equipment and materials that are not designed for exposure to weather outdoors.

Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

RECORD DOCUMENTS

Refer to the Division-1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

OPERATION AND MAINTENANCE DATA

Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty, 3-ring vinyl covered binders, with pocket folders for

folded sheet information. Mark appropriate identification on front and spine of each binder. Include Index of Information contained in each binder. Include the following types of information:

Emergency instructions
Spare parts list
Copies of warranties
Wiring diagrams
Recommended maintenance intervals
Inspection procedures
Shop drawings and product data

List of all Material and Equipment Supplies Contractors and Subcontractors who installed mechanical system components. Include Business Address and Telephone Number.

In addition to the information required elsewhere for Maintenance data, include the following information:

Copy of all approved shop drawings and submittals.

Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.

Manufacturer's printed maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

Servicing instructions and lubrication charts and schedules.

OWNER OPERATING INSTRUCTIONS

General Operating Instructions: In addition to specific training of Owner's operating personnel specified in individual Division 15 sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified in Division 15 sections and elsewhere in these specifications, provide general operating instructions for total mechanical systems. Conduct a 4 hour, walk-through with explanations and demonstrations for orientation and education of Owner's personnel to be involved in continued operation of equipment and controls.

Describe each basic mechanical system and how its control system functions, including flow adjustments, temperature control and similar operations.

Explain and point out identification system, valve numbering system, displayed diagrams, signals, alarms, and similar audio-visual provisions of work.

Describe basic sequencing requirements and interlock provisions for system start-up, phasing, coast-down, shut-down and seasonal operations.

Emphasize emergency procedures and safety provisions for protection of mechanical systems and safety of occupants during equipment malfunction, disasters, power failures and similar unusual circumstances, and describe system limitations and precautions including weather adjustments.

Outline basic maintenance procedures and major equipment turn-around requirements.

Demonstrate what adjustments have been made and can continue to be made to reduce noise and vibration, improve system output, decrease energy consumption, and similar performance improvements.

Point out operational security provisions, safety, unavoidable hazards and similar operator limitations.

Display and conduct "thumb-through" explanation of maintenance manuals, record drawings, spare parts inventory, storage of extra materials, meter readings, and similar service items.

Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instructions in proper orientation and maintenance. If installers are not experienced in procedures, 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
- Shut-down
- Emergency operations
- Safety procedures
- Economy and efficiency adjustments
- Effective energy utilization

SYSTEM START-UP DEMONSTRATION

System Demonstration: Demonstrate operation of HVAC System. See individual sections for detailed requirements. Schedule coordination meeting 10 days prior to demonstration. System will not be accepted as "Substantially Complete" until demonstration has been performed.

System Performance Test Run: Refer to Division 15 sections for initial start-up of equipment and systems for purposes of testing, adjusting and balancing. At time of mechanical work closeout, check each item in each system to determine that it is set for proper operation. With Owner's Representative

and Architect/Engineer present, operate each system in test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of systems to refine and improve performances wherever possible, including noise and vibration controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be requested for Architect/Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible. Such systems operation shall be certified that they have been run and can in fact be demonstrated.

END OF SECTION 15010

SECTION 15050 - BASIC MECHANICAL 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 includes the following:

- Piping materials and installation instructions common to most piping systems.
- Transition Fittings
- Dielectric fittings
- Mechanical demolition
- Equipment installation requirements common to equipment sections
- Painting and finishing
- Supports and anchorages

DEFINITIONS

Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and mechanical equipment yards.

Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

The following are industry abbreviations for plastic materials:

- CPVC: Chlorinated polyvinyl chloride plastic.
- PVC: Polyvinyl chloride plastic.

The following are industry abbreviations for rubber materials:

- EPDM: Ethylene propylene diene terpolymer rubber.
- NBR: Acrylonitrile-butadiene rubber.

SUBMITTALS

Product Data: For the following:

Dielectric fittings

Welding certificates

QUALITY ASSURANCE

Steel Support Welding: Qualify processes and operators according to AWS D1.1, Structural Welding Code – Steel.

Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, Welding and Brazing Qualifications

Comply with provisions in ASME B31 Series, Code for Pressure Piping.

Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

DELIVERY, STORAGE, AND HANDLING

Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

COORDINATION

Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section _Access Doors and Frames

PART 2 - PRODUCTS

MANUFACTURERS

In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

PIPE, TUBE, AND FITTINGS

Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

JOINING MATERIALS

Refer to individual Division 15 piping Sections for special joining materials not listed below.

Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

AWWA C110, rubber, flat face, 1/8 inch 3.2 mm thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

Solvent Cements for Joining Plastic Piping:

CPVC Piping: ASTM F 493.

PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

TRANSITION FITTINGS

AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

Manufacturers:

Cascade Waterworks Mfg. Co.
Dresser Industries, Inc.; DMD Div.

Ford Meter Box Company, Incorporated (The); Pipe Products Div.
JCM Industries.
Smith-Blair, Inc.
Viking Johnson.

Aboveground Pressure Piping: Pipe fitting.

Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

Manufacturers: Eslon Thermoplastics

Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

Manufacturers: Thompson Plastics, Inc.

Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

Manufacturers:

NIBCO INC.
NIBCO, Inc.; Chemtrol Div.

DIELECTRIC FITTINGS

Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

Insulating Material: Suitable for system fluid, pressure, and temperature.

Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

Manufacturers:

Capitol Manufacturing Co.
Central Plastics Company.
Eclipse, Inc.
Epco Sales, Inc.
Hart Industries, International, Inc.
Watts Industries, Inc.; Water Products Div.
Zurn Industries, Inc.; Wilkins Div.

Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- psig 1035- or minimum working pressure as required to suit system pressures.

Manufacturers:

Capitol Manufacturing Co.

Central Plastics Company.
Epco Sales, Inc.
Watts Industries, Inc.; Water Products Div.

Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

Manufacturers:

Advance Products & Systems, Inc.
Calpico, Inc.
Central Plastics Company.
Pipeline Seal and Insulator, Inc.

Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig1035- or 2070-kPa minimum working pressure where required to suit system pressures.

Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig2070-kPa minimum working pressure at 225 deg F107 deg C.

Manufacturers:

Calpico, Inc.
Lochinvar Corp.

Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F107 deg C.

Manufacturers:

Perfection Corp.
Precision Plumbing Products, Inc.
Sioux Chief Manufacturing Co., Inc.
Victaulic Co. of America.

PART 3 - EXECUTION

MECHANICAL DEMOLITION

Refer to Division 1 Sections 01405 Cutting and Patching for general demolition requirements and procedures.

Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

Equipment to Be Removed: Disconnect and cap services and remove equipment.

If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

PIPING SYSTEMS - COMMON REQUIREMENTS

Install piping according to the following requirements and Division 15 Sections specifying piping systems.

Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Install piping to permit valve servicing.

Install piping at indicated slopes.

Install piping free of sags and bends.

Install fittings for changes in direction and branch connections.

Install piping to allow application of insulation.

Install isolation valve upstream of all dielectric unions.

Select system components with pressure rating equal to or greater than system operating pressure.

Verify final equipment locations for roughing-in.

Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

PIPING JOINT CONSTRUCTION

Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

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

Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's _Copper Tube Handbook,_ using lead-free solder alloy complying with ASTM B 32.

Brazed Joints: Construct joints according to AWS's _Brazing Handbook,_ _Pipe and Tube_ Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 Quality Assurance.

Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

PVC Nonpressure Piping: Join according to ASTM D 2855.

Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

PIPING CONNECTIONS

Make connections according to the following, unless otherwise indicated:

Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

Install equipment to allow right of way for piping installed at required slope.

PAINTING

Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

ERECTION OF METAL SUPPORTS AND ANCHORAGES

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

Field Welding: Comply with AWS D1.1.

END OF SECTION 15050

SECTION 15060 - HANGERS AND SUPPORTS

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 includes hangers and supports for mechanical system piping and equipment.

Related Sections include the following:

Division 5 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.

DEFINITIONS

MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

PERFORMANCE REQUIREMENTS

Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

SUBMITTALS

Product Data: For each type of pipe hanger, steel support system component, and thermal-hanger shield insert indicated.

Shop Drawings: For multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

Welding Certificates: Copies of certificates for welding procedures and operators.

QUALITY ASSURANCE

Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

MANUFACTURERS

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

Pipe Hangers:

B-Line Systems, Inc.
Carpenter & Patterson, Inc.
Grinnell Corp.
Mason Industries, Inc.
PHD Manufacturing, Inc.
Piping Technology & Products, Inc.

Channel Support Systems:

B-Line Systems, Inc.
Grinnell Corp.; Power-Strut Unit.
GS Metals Corp.
Michigan Hanger Co., Inc.; O-Strut Div.
National Pipe Hanger Corp.
Thomas & Betts Corp.
Unistrut Corp.
Wesanco, Inc.

Thermal-Hanger Shield Inserts:

Carpenter & Patterson, Inc.
Michigan Hanger Co., Inc.
PHS Industries, Inc.
Pipe Shields, Inc.
Rilco Manufacturing Co., Inc.
Value Engineered Products, Inc.

MANUFACTURED UNITS

Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.

Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

Thermal-Hanger Shield Inserts: 100-psi (690-kPa) minimum compressive-strength insulation, encased in sheet metal shield.

Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.

Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.

For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.

For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.

Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

MISCELLANEOUS MATERIALS

Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

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

Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.

Properties: Nonstaining, noncorrosive, and nongaseous.

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

PART 3 - EXECUTION

HANGER AND SUPPORT APPLICATIONS

Specific hanger requirements are specified in Sections specifying equipment and systems. Use of powder actuated drive pin fasteners is prohibited.

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

Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).

Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).

Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).

Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.

Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to concrete beams in new concrete construction.

Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist or beam construction to attach to top flange of structural shape.

C-Clamps (MSS Type 23): For structural shapes.

Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

Light (MSS Type 31): 750 lb (340 kg).
Medium (MSS Type 32): 1500 lb (675 kg).
Heavy (MSS Type 33): 3000 lb (1350 kg).

Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

Steel Pipe-Covering Protection Saddles (MSS Type 39): For hot piping, NPS 2 1/2 to 8. Fill interior voids with insulation that matches adjoining insulation.

Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi (690-kPa) minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

HANGER AND SUPPORT INSTALLATION

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

Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

Field assemble and install according to manufacturer's written instructions.

Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.

Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

Install building attachments within concrete slabs or attach 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, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Refer to drawings for restrictions on use of mechanical-anchor fasteners.

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

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

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

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

Insulated Piping: Comply with the following:

Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.

Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

Shield Dimensions for Pipe: Not less than the following:

NPS 4 (DN100) and below: 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

Pipes NPS 8 (DN200) and Larger: Include wood inserts.

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

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

EQUIPMENT SUPPORTS

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

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

METAL FABRICATION

Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes 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 shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with 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 no roughness shows after finishing and 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. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

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

Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."

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

END OF SECTION 15060

SECTION 15075 - MECHANICAL IDENTIFICATION

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 includes the following mechanical identification materials and their installation:

- Equipment nameplates
- Equipment markers
- Pipe markers

SUBMITTALS

Product Data: For each type of product indicated.

Samples: For color, letter style, and graphic representation required for each identification material and device.

QUALITY ASSURANCE

ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

COORDINATION

Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

Coordinate installation of identifying devices with location of access panels and doors.

Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

EQUIPMENT IDENTIFICATION DEVICES

Equipment Nameplates: Metal, with data engraved or stamped, furnished by equipment manufacturer.

Data:

- Manufacturer, product name, model number, and serial number
- Capacity, operating and power characteristics, and essential data
- Labels of tested compliances

Location: Accessible and visible.

Fasteners: As required to mount securely on equipment.

Equipment Markers: Engraved, color-coded laminated plastic, white lettering on black background, secured to equipment by Contractor.

Terminology: Match schedules as closely as possible.

Data: Name and number.

Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.

PIPING IDENTIFICATION DEVICES

Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

Colors: Comply with ASME A13.1, unless otherwise indicated.

Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.

Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

PART 3 - EXECUTION

APPLICATIONS, GENERAL

Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

EQUIPMENT MARKERS

Install and permanently fasten equipment markers on each major item of mechanical equipment. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

HVAC rooftop air handling units
Indoor Air Handler Units

Install equipment markers with stainless steel screws on each major item of mechanical equipment.

PIPING IDENTIFICATION

Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pretensioned pipe markers. Use size to ensure a tight fit.

Locate pipe markers and color bands where piping is exposed in finished spaces; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

Near each valve and control device.

Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

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

Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m in) areas of congested piping and equipment.

ADJUSTING

Relocate mechanical identification materials and devices that have become visually blocked by other work.

CLEANING

Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 15075

SECTION 15081 - DUCT INSULATION

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 includes semirigid and flexible duct and plenum insulation, insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

Related Sections include the following:

Division 15 Section "Pipe Insulation" for insulation for piping systems.

SUBMITTALS

Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

Shop Drawings: Show fabrication and installation details for the following:

Removable insulation sections at access panels.

Application of field-applied jackets.

Applications at linkages for control devices.

Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

QUALITY ASSURANCE

Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

DELIVERY, STORAGE, AND HANDLING

Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

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

COORDINATION

Coordinate clearance requirements with duct Installer for insulation application.

SCHEDULING

Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

MANUFACTURERS

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

Mineral-Fiber Insulation:

CertainTeed.
Knauf FiberGlass GmbH.
Owens-Corning Fiberglas Corp.

INSULATION MATERIALS

Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film (3.0 lbs/cu.ft.density).

Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film (1.5 lbs/cu.ft. density).

ACCESSORIES AND ATTACHMENTS

Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

Welded Pin Holding Capacity: 100 lb (45 kg) for direct pull perpendicular to the attached surface.

VAPOR RETARDERS

Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

Tapes: FSK Tape foil face, vapor retarder, matching duct insulation facing; with acrylic adhesive with ASTM C1136 and UL listed.

Width: 3 in. (77 mm)
Thickness: 6.5 mils (0.16 mm)
Adhesion: 90 oz. force/inch in width
Elongation: 2 percent
Tensil Strength: 40 lbf/in.

PART 3 - EXECUTION

EXAMINATION

Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

Proceed with installation only after unsatisfactory conditions have been corrected.

PREPARATION

Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

GENERAL APPLICATION REQUIREMENTS

Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

Refer to schedules at the end of this Section for materials, forms, and thicknesses required for each duct system.

Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

Keep insulation materials dry during application and finishing.

Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

Apply insulation with the least number of joints practical.

Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

Apply insulation with integral jackets as follows:

Pull jacket tight and smooth.

Joints and Seams: Cover with tape to maintain vapor seal.

Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

Install anchor pins (welded) and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.

Impale insulation over anchors and attach speed washers.

Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with pressure sensitive tape matching insulation facing.

Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation with overlapping layers for a minimum width of 5 inches..

Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.

DUCT SYSTEM APPLICATIONS

Insulation materials and thicknesses are specified in schedules at the end of this Section.

Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

Insulate the following plenums and duct systems:

Outdoor supply and return air ductwork.

Outdoor exposed supply, return air ductwork.

OUTDOOR DUCT AND PLENUM APPLICATION SCHEDULE (For New Portions of Duct)

Service: Rectangular, supply-air ducts, exposed to outdoors.

Material: Mineral-fiber blanket.

Thickness: 2 inches.

Number of Layers: One.

Encase insulation with galvanized sheet metal duct and sealed for exposure to the weather.

Service: Rectangular, return-air ducts, exposed to outdoors.

Material: Mineral-fiber blanket.

Thickness: 2 inches (50 mm).

Number of Layers: One.

Encase insulation with galvanized sheet metal duct and sealed for exposure to the weather.

END OF SECTION 15081

SECTION 15083 - PIPE INSULATION

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 includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

Related Sections include the following:

Division 15 Section “Duct Insulation” for insulation of ducts and plenums.
Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

SUBMITTALS

Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated. Include insulation schedule and identify where each type of product is proposed for use.

Shop Drawings: Show fabrication and installation details for the following:

Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.

Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

Removable insulation at piping specialties and equipment connections.

Application of field-applied jackets.

Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

QUALITY ASSURANCE

Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

DELIVERY, STORAGE, AND HANDLING

Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature. Store only indoors in dry location. Protect against dirt, water, chemical and mechanical damage. Do not install damage or wet insulation. Remove insulation that has become wet or damaged from project site.

COORDINATION

Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

Coordinate clearance requirements with piping Installer for insulation application.

Coordinate installation and testing of steam or electric heat tracing.

SCHEDULING

Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

MANUFACTURERS

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

Mineral-Fiber Insulation:

CertainTeed
Knauf FiberGlass GmbH
Owens-Corning Fiberglas Corp.
Schuller International, Inc.

Cellular-Glass Insulation:

Pittsburgh-Corning Corp.

INSULATION MATERIALS

Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.

Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.

FIELD-APPLIED JACKETS

Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy. Complying with ASTM B 209 (ASTM B 209M), and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this section. Minimize the number of elbows, no plastic or PVC permitted.

Finish: Corrugated Finish.

Moisture Barrier: 1-mil-(0.025 mm) thick, heat bonded polyethylene and kraft paper.

ACCESSORIES AND ATTACHMENTS

Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.

VAPOR RETARDERS

Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

EXAMINATION

Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

Proceed with installation only after unsatisfactory conditions have been corrected.

PREPARATION

Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

GENERAL APPLICATION REQUIREMENTS

Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

Apply multiple layers of insulation with longitudinal and end seams staggered.

Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

Keep insulation materials dry during application and finishing.

Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

Apply insulation with the least number of joints practical.

Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

Apply insulation continuously through hangers and around anchor attachments.

Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

Apply adhesives and mastics at the manufacturer's recommended coverage rate.

Apply insulation with integral jackets as follows:

Pull jacket tight and smooth.

Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.

Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

Roof Penetrations: Install insulation continuously through roof assembly.

Seal penetrations with flashing sealant.

Install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing. Seal jacket of roof flashing with flashing sealant.

CELLULAR-GLASS INSULATION APPLICATION

Apply insulation to straight pipes and tubes as follows:

Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.

For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

Apply insulation to flanges as follows:

Apply preformed pipe insulation to outer diameter of pipe flange.

Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of the same thickness as pipe insulation.

Apply insulation to fittings and elbows as follows:

Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

When premolded sections of insulation are not available, apply mitered sections of cellular-glass insulation. Secure insulation materials with wire, tape, or bands.

Cover fittings with heavy aluminum fitting covers. Overlap covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with stainless steel bands.

Apply insulation to valves and specialties as follows:

Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.

Apply insulation to flanges as specified for flange insulation application.

Use preformed standard aluminum fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with stainless steel bands.

FIELD-APPLIED JACKET APPLICATION

Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

Provide metal fitting covers same material and thickness as jacket at elbows, tees and other fittings. Overlap ends 1 inch minimum and secure with stainless steel bands.

PIPING SYSTEM APPLICATIONS

Insulation materials and thicknesses are specified in schedules at the end of this Section.

Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

Condensate drain piping located outdoors.

FIELD QUALITY CONTROL

Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

Inspect fittings and valves randomly selected by Architect.

Remove fitting covers from 5 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.

Remove fitting covers from 5 valves or 1 percent of valves, whichever is less, for various pipe sizes.

Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

INSULATION APPLICATION SCHEDULE, GENERAL

Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

INTERIOR INSULATION APPLICATION SCHEDULE

Service: Chilled-water supply and return.

Operating Temperature: 35 to 75 deg F (2 to 24 deg C).

Insulation Material: Cellular glass, with jacket.

Insulation Thickness: Apply the following insulation thicknesses:

Piping, Up to 4" size: 2" thick

Field-Applied Jacket: Aluminum.

Thickness: 0.024 inch (0.6 mm).

Vapor Retarder Required: No.

Finish: None.

EXTERIOR ABOVE GROUND INSULATION

Service: Chilled-water supply and return.

Operating Temperature: 35 to 75 deg F (2 to 24 deg C).

Insulation Material: Cellular glass, with jacket.

Insulation Thickness:

Piping, Up to 4" size: 3" thick

Field-Applied Jacket: Aluminum in exposed locations.

Thickness: 0.024 inch (0.6 mm).

Vapor Retarder Required: No.

Finish: None.

END OF SECTION 15083

SECTION 15110 - VALVES

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 includes the following general-duty valves:

- Ferrous-alloy butterfly valves
- Copper-Alloy ball valves

Related Sections include the following:

- Division 15 Section "DDC Building Automation System" for control valves and actuators.
- Division 15 piping Sections for specialty valves applicable to those Sections only.

DEFINITIONS

The following are standard abbreviations for valves:

- CWP: Cold working pressure.
- EPDM: Ethylene-propylene-diene terpolymer rubber.
- NBR: Acrylonitrile-butadiene rubber.
- PTFE: Polytetrafluoroethylene plastic.
- SWP: Steam working pressure.
- TFE: Tetrafluoroethylene plastic.

SUBMITTALS

Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

QUALITY ASSURANCE

ASME Compliance: ASME B31.9 for building services piping valves.

ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

DELIVERY, STORAGE, AND HANDLING

Prepare valves for shipping as follows:

Protect internal parts against rust and corrosion.

Protect threads, flange faces, grooves, and weld ends.

Set butterfly valves closed or slightly open.

Use the following precautions during storage:

Maintain valve end protection.

Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

MANUFACTURERS

In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

VALVES, GENERAL

Refer to Part 3 "Valve Applications" Article for applications of valves.

Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.

Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

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

Valve Actuators:

Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.

Extended Valve Stems: On insulated valves.

Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

Valve Bypass and Drain Connections: MSS SP-45.

FERROUS-ALLOY BUTTERFLY VALVES

Available Manufacturers:

Manufacturers:

Single-Flange, Ferrous-Alloy Butterfly Valves:

Crane Co.; Crane Valve Group; Stockham Div.
Grinnell Corporation.
Kitz Corporation of America.
NIBCO INC.

Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

Single-Flange, 200-psig (1380-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem.

COPPER-ALLOY BALL VALVES

Manufacturers:

Two-Piece, Copper-Alloy Ball Valves:

Conbraco Industires, Inc.; Apollo Div.
Crane Co.; Crane Valve Group; Crane Valves.
Grinnell Corporation.
NIBCO INC.
Kitz

Copper-Alloy Ball Valves, General: MSS SP-110

Two-Piece, Copper-Alloy Ball Valves: Bronze body with regular-port, chrome-plated bronze ball; TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

All exterior valves shall have hard clear plastic weathershields similar to Belimo ZS-CCV. No “baggies” permitted.

PART 3 - EXECUTION

EXAMINATION

Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

Proceed with installation only after unsatisfactory conditions have been corrected.

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

Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

Examine threads on valve and mating pipe for form and cleanliness.

Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

Do not attempt to repair defective valves; replace with new valves.

VALVE APPLICATIONS

Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

Shutoff Service: Butterfly.

Throttling Service: Ball or butterfly.

If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

Chilled-Water Piping: Use the following types of valves:

Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 600-psig (4140-kPa) CWP rating, copper alloy.

Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Single-flange 200-psig (1380-kPa) CWP rating, ferrous alloy, with EPDM liner.

Heating Water Piping: Use the following types of valves:

Ball Valves, NPS 2 (DN 50) and Smaller: Two-piece, 400-psig (2760-kPa) CWP rating, copper alloy.

Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Single-flange, CWP rating, ferrous alloy, with EPDM liner.

Select valves, except wafer and flangeless types, with the following end connections:

For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.

For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.

VALVE INSTALLATION

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

Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

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

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

Install valves in position to allow full stem movement.

JOINT CONSTRUCTION

Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

ADJUSTING

Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 15110

SECTION 15122 - METERS AND GAGES

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 includes test wells, test thermometers and gages installed in piping systems.

Related Sections include the following:

Mechanical equipment Sections that specify meters and gages as part of factory-fabricated equipment

SUBMITTALS

Product Data: Include scale range and ratings for each meter, gage, fitting, specialty, and accessory specified.

Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location 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.

PART 2 - PRODUCTS

MANUFACTURERS

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

Liquid-in-Glass Test Thermometers:

Palmer Wahl Instrument Group
Trerice: H.O. Co.
Weiss Instruments, Inc.
Winters Instruments, US

Pressure Gages:

Marsh Bellofram.
Trerice: H. O. Trerice Co.
Weiss Instruments, Inc.

Test Wells:

Peterson Equipment Co., Inc.
Sisco Manufacturing Co.
Trerice: H. O. Trerice Co.
Watts Industries, Inc.; Water Products Div.

THERMOMETERS, GENERAL

Scale Range: Temperature ranges for services listed are as follows:

Heating Hot Water: 0 to 220 deg F, with 2-degree scale divisions.

Chilled Water: -30 to 120 deg F, with 1-degree scale divisions.

Accuracy: Laboratory grade test thermometers with plus or minus 1 percent of range span.

Quantity: Furnish 3 (three) test thermometers of each range and place in carrying case for turnover to Owner at completion of project.

LIQUID-IN-GLASS THERMOMETERS AND CARRYING CASE

Description: Laboratory calibration type with graduated scale.

Tube: Red or blue reading, non-mercury with magnifying lens.

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

Protective Carrying Case: Furnish felt lined, hinged carrying case with capacity to hold up to ten thermometers. Case shall have positive lock hasp or push button opening mechanism.

THERMOMETER TEST WELLS

Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.

Material: Brass, for use in copper piping.

Material: Stainless steel, for use in steel piping.

Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.

Insertion Length: To extend to one-third of diameter of pipe.

Cap: Threaded, with chain permanently fastened to socket.

Heat-Transfer Fluid: Oil or graphite.

PRESSURE GAGES

Description: ASME B40.1, precision phosphor-bronze bourdon-tube type with bottom connection; liquid-filled-case type.

Case: Stainless steel, with 4-1/2-inch- (115-mm-) diameter, glass lens.

Connector: Stainless steel, NPS 1/4 (DN8).

Scale: White-coated aluminum with permanently etched markings.

Accuracy: Plus or minus 1 percent of full range.

Range: Comply with the following:

Fluids under Pressure: Water - 0-100 psi

Carrying Case: Provide pre-molded plastic hinged carrying case with capacity for two gages.

Quantities: Furnish 2 (Two) precision pressure gages and place in carrying case. Turn over to Owner at completion of project.

PRESSURE-GAGE FITTINGS

Valves: NPS 1/4 (DN8) stainless-steel needle type.

Snubbers: ASME B40.5, NPS 1/4 9DN8) stainless steel with corrosion-resistant porous metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

METER AND GAGE INSTALLATION, GENERAL

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

THERMOMETER TEST WELL INSTALLATION

Install thermometers and test well where indicated.

Install in the following locations:

Inlet and outlet piping of each cooling and heating coil.

Install thermometer wells in vertical position in piping where test thermometers are wells indicated.

Fill wells with oil or graphite and secure caps.

PRESSURE-GAGE TEST PORT INSTALLATION

Install pressure gages test ports in piping with needle valve and snubber located on pipe at most readable position.

Install pressure gages test ports in the following locations:

Inlet and outlet piping of each cooling and heating coil.

CONNECTIONS

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

ADJUSTING AND CLEANING

Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint. Turn over thermometer and pressure gages to Owner and obtain receipt.

END OF SECTION 15122

SECTION 15181 - HYDRONIC PIPING

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 includes piping, special-duty valves, and hydronic specialties for chilled-water cooling, and condensate drain piping.

Related Sections include the following:

Division 15 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.

Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.

Division 15 Section "Valves" for general-duty gate, globe, ball, butterfly, and check valves.

Division 15 Section "Meters and Gages" for thermometers, flow meters, and pressure gages.

Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.

Division 15 Section "DDC Building Automated System" for temperature-control valves and sensors.

SUBMITTALS

Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.

Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

Welding Certificates: Copies of certificates for welding procedures and personnel.

Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

Test procedures used.
Test results that comply with requirements.
Failed test results and corrective action taken to achieve requirements.

Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.

Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

QUALITY ASSURANCE

Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

COORDINATION

Coordinate piping installation with roof curbs, equipment supports.

Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

MANUFACTURERS

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

Automatic Flow-Control Valves:

Flow Design, Inc.
Griswold Controls.
Hayes

PIPING MATERIALS

General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

STEEL PIPE AND FITTINGS

Steel Pipe, NPS 2 (DN 50) and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40, black steel, plain ends.

Steel Pipe, NPS 22 through NPS 12 (DN through DN 300): ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.

Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.

Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

Material Group: 1.1.
End Connections: Butt welding.
Facings: Raised face.

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

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

COPPER TUBE AND FITTINGS

Drawn-Temper Copper Tubing: ASTM B88, Type L.

DWV Copper Tubing: ASTM B 306, Type DWV.

Wrought-Copper Fittings: ASME B16.22.

Wrought-Copper Unions: ASME B16.22.

Solder Filler Metals: ASTM B 32, 95-5 in antimony.

VALVES

Ball and butterfly valves are specified in Division 15 Section "Valves."

Refer to Part 3 "Valve Applications" Article for applications of each valve.

Automatic Flow-Control Valves: Gray-iron body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:

Gray-iron or brass body, designed for 175 psig (1206 kPa) at 200 deg F (93 deg C) with stainless-steel piston and spring.

Brass or ferrous-metal body, designed for 300 psig (2068 kPa) at 250 deg F (121 deg C) with corrosion-resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.

Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig (2067 kPa) at 250 deg F (121 deg C).

HYDRONIC SPECIALTIES

Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.

Y-Pattern Strainers: 125-psig (860-kPa) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.

PART 3 - EXECUTION

PIPING APPLICATIONS

Chilled Water, NPS 2-1/2 (DN 65) and Larger: Schedule 40 steel pipe with welded or flanged joints.

Condensate Drain Lines: Type DWV copper tubing with soldered joints for outdoors, Schedule 40 PVC with glued joints for indoors.

VALVE APPLICATIONS

General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:

Shutoff Duty: Ball, or butterfly valves.
Throttling Duty: Ball or butterfly valves.

Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

PIPING INSTALLATIONS

Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation requirements.

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

Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

Install piping at a uniform grade of 0.2 percent upward in direction of flow.

Reduce pipe sizes using eccentric reducer fitting installed with level side up.

Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

Anchor piping for proper direction of expansion and contraction.

PIPE JOINT CONSTRUCTION

Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for threaded, welded, and flanged joints in steel piping.

HYDRONIC SPECIALTIES INSTALLATION

Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

Install automatic air vents at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.

TERMINAL EQUIPMENT CONNECTIONS

Size for supply and return piping connections shall be same as for equipment connections.

Install control valves in accessible locations close to connected equipment.

Install ports for pressure and temperature gages at coil inlet connections.

PIPING INSTALLATIONS

Refer to Division 15 Section ABasic Mechanical materials and Methods@ for basic installation requirements.

Install groups of pipes parallel to each other, spaced to permit applying insulation and serving of valves.
Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

Install piping at a uniform grade of 0.2 percent upward in direction of flow.

Reduce pipe sizes using eccentric reducer fitting installed with level side up.

Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the top or side of the main pipe. For up-feed risers, install the takeoff coming out of the top of the main pipe.

Install strainers on supply side of each control valve, pressure-reducing valve, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 501).

Anchor piping for proper direction of expansion and contraction.

HANGERS AND SUPPORTS

Hanger, support, and anchor devices are specified in Division 15 Section AHangers and Supports.@ Comply with requirements below for maximum spacing of supports.

Install the following pipe attachments:

Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.

Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.

Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.

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

NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).

NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).

NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).

NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).

NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).

Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).

NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).

NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

PIPE JOINT CONSTRUCTION

Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

HYDRONIC SPECIALTIES INSTALLATION

Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

Install flexible pipe connectors in inlet and outlet piping at each air handling unit..

FIELD QUALITY CONTROL

Prepare hydronic piping according to ASME B31.9 and as follows:

Leave joints, including welds, uninsulated and exposed for examination during test.

Provide temporary restraints for joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

Flush system with clean water. Clean strainers.

Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

Perform the following tests on hydronic piping:

Use ambient temperature water as a testing.

While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.

Check compression tanks to determine that they are not air bound and that system is full of water. Isolate compression tank gauge glasses if test pressure may damage glass.

Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure.

Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

Prepare written report of testing.

ADJUSTING

Perform these adjustments before operating the system:

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

Set automatic fill valves for required system pressure.

Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or 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 boiler, chiller, and cooling tower to design requirements.

Lubricate motors and bearings.

CLEANING

Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION 15181

SECTION 15725 - OUTDOOR AIR-HANDLING UNITS

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 includes constant-volume, modular air-handling units with coils for outdoor installations.

Related Sections include the following:

Division 16 Section “Motor Controllers” for factory mounted Motor Starter requirements..

Division 15 Section “Mechanical Identification” for equipment nameplate and identification requirements.

Division 15 Section “Hydronic Piping” for piping requirements at coils.

Division 15 Section “Metal Ducts” for ductwork connections to units.

SUBMITTALS

Product Data: For each type of modular outdoor air-handling unit indicated. Include 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, electrical characteristics, and motor and fan accessories.

Material gages and finishes.

Filters with performance characteristics.

Curb Adapters including dimensioned drawings.

Florida Product Approval Number or Florida Notice of Acceptance (NOA) number for missile impact rating, large and small missile impact.

Anchoring details, drawings and calculations described in the paragraphs “Manufacturer’s Additional Services.”

Field Quality-Control Test Reports: From manufacturer.

QUALITY ASSURANCE

Source Limitations: Obtain modular outdoor air-handling units through one source from a single manufacturer.

Product Options: Drawings indicate size, profiles, and dimensional requirements of modular outdoor air-handling units and are based on the specific system indicated.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

NFPA Compliance: Modular outdoor air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

AMCA Compliance: Air Handling Units shall be tested in accordance with the latest revision of AMCA - 300, “Test Code for Sound Rating” in a test laboratory certified by AMCA.

ARI Certification: Modular outdoor air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

Comply with NFPA 70.

REFERENCES

AMCA 99 – Standard Handbook

AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes

AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices

AMCA 500 – Test Methods for Louvers, Dampers, and Shutters

ANSI/AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings

ANSI/UL 900 – Test Performance of Air Filter Units

ARI 410 – Forced-Circulation Air Cooling and Air Heating Coils

ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment

NFPA 90A – Installation of Air Conditioning and Ventilation Systems

SMACNA – Low Pressure Duct Construction Standards

AMCA 611-95 – Methods of Testing Airflow Measurement Stations for Rating

ASHRAE 52.1/52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

ASHRAE 62 – Ventilation for Acceptable Indoor Air Quality

ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

OPERATION AND MAINTENANCE DATA

Submit operation and maintenance data. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

RATINGS AND CERTIFICATIONS

Conform to AMCA 210 for fan performance ratings.

Unit sound ratings will be reported in accordance with AHRI 260 for inlet, discharge and casing radiated sound power levels.

Conform to E.T.L. or U.L. standards.

Conform to AHRI 410 for capacities, pressure drops, and selection procedures of air coils.

Conform to AHRI 430 for all fabrication procedures of air handling units.

Utilize only ANSI/UL 900 listed Class I or Class II filter media, approved by local authorities.

Utilize only ISO9001 certified facilities in the manufacturing of the air- handling unit.

Electric control wiring shall be in accordance NEC codes & ETL requirements

Damper performance will comply with AMCA 500.

Motors shall satisfy the Federally mandated Energy Policy Act (EPACT).

Airflow monitoring stations shall be rated in accordance with AMCA 611-95 and bear a Certified Ratings Seal for airflow measurement performance.

Florida Notice of Acceptance (NOA) for missile impact rating, large and small missile impact.

COORDINATION

Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

DELIVERY, STORAGE AND HANDLING

All handling and storage procedures shall be per manufacturer's recommendations.

Units shall be shrink-wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit for avoidance of general rusting must be handled as best suits the circumstances. Store in a place protected from construction traffic and handle carefully to avoid damage to components, enclosures, and finish.

All openings shall be protected against damage from shipping.

Safety warning labels shall be clearly marked in 3-language format

All loose-shipped items need to be packed, protected and secured with the air units.

WARRANTY

The manufacturer's standard warranty shall be for a period of twelve months from the date of substantial completion. Warranty shall cover defects in manufacturing, including components purchased from third party vendors, such as motors. A factory trained and factory employed technician shall be available within 50 miles of the job site to respond to a service call.

ENVIRONMENTAL REQUIREMENTS

Do not operate units for any purpose, temporary or permanent, until ductwork has been installed and cleaned, filters are in place, bearings lubricated, belts adjusted, and fan has been test run under observation.

Manufacturers "start-up" requirements must be complied-with to ensure safe and correct operation.

EXTRA MATERIALS

Manufacturer shall furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Filters: One set of filters for use during construction. One set of filters for each modular outdoor air-handling unit.

Fan Belts: One set for each modular indoor air-handling unit fan.

PART 2 - PRODUCTS

MANUFACTURERS

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

ClimateCraft (Basis of Design)
Trane Company
York, A Johnson Control Company

MANUFACTURER'S ADDITIONAL SERVICES

Manufacturer shall be responsible for design of anchoring system for roof mounted air handling units and their supports. Equipment shall be anchored to resist wind loads indicated on the structural drawings. Equipment and supports shall be anchored to structure (not roof deck).

Equipment manufacturer shall engage the services of a currently registered specialty engineer licensed in the State of Florida to design the anchoring system. Equipment submittal shall include signed and sealed

drawings indicating anchoring details, material types and thicknesses, fastener types and design calculations. Materials shall be G-90 Hot Dipped Galvanized Steel or Type 304 stainless steel.

MANUFACTURED UNITS

Modular outdoor air-handling units shall be factory assembled and consist of fans, motor and drive assembly, coils, damper, plenums, filters, access doors, condensate pans, mixing dampers, manufacturer's standard base rail and accessories.

Outdoor air handling unit modules shall be assembled to form a complete, unitized housing and function as an integrated unit. Outdoor unit cabinets shall be manufactured to equal or exceed the minimum thickness indicated in the Florida Building Code. Cabinets shall be designed to withstand the wind loads indicated on the structural drawings and to withstand small and large missile impact when tested in accordance with the test protocols described in the Florida Building Code. Outdoor units shall carry a Florida Product Approval Number or a Florida Notice of Acceptance Number.

CABINET CONSTRUCTION

Cabinets shall be constructed in a watertight and airtight manner. The manufacturer's standard cabinet construction shall result in an ASHRAE/ANSI Standard 111 Leakage Class 5 rating, or better, as measured in accordance with AMCA Standard 210. A leakage rate as a percent of airflow shall only be submitted following calculation at specific project conditions. Maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65. Published leakage rates at generic conditions shall not be submitted.

Casing deflection shall not exceed L/200 at +12.0 w.g. in all positive pressure sections and -12.0 w.g. in all negative pressure sections where L is defined as the panel span. Panels shall be designed to deflect no more than 1/200 (.0005" per inch) of span under operating design conditions when measured at the panel span. Casing shall be rated for 1% leakage at 1.5 times the operating pressure with a maximum overall pressure of 12" wc.

The unit shall be constructed on a 5" welded structural tubular steel base. Base tubing shall be cold-formed carbon steel, electric resistance welded. Equipment using a die-formed sheet metal base is not acceptable. Formed intermediate cross members shall be constructed of hot rolled 12 gauge galvanized steel. After fabrication, the base frame shall be thoroughly cleaned and coated with high solids, polyamide epoxy paint system for superior corrosion resistance.

Units shipped in multiple sections shall be engineered for ease of field assembly. Gasket supplied with the unit shall be a high quality weather resistant closed-cell EPDM sponge rubber. Each section shall include a permanent label to aid in proper field assembly. All gasket and necessary assembly hardware shall ship loose with unit. Floors shall be designed to deflect no more than 1/200 of span under operating conditions.

Floors

Shall be fabricated of 10 gauge aluminum tread plate. All floor sheets shall be isolated from the base assembly with an EPDM thermal break gasket.

Floors shall be insulated with a two-part polyurethane water impervious foam insulation. If glass fiber insulation is used, a 20 gauge type 304 stainless steel under liner shall be provided.

Under liner shall be fabricated of 16 gauge G-90 galvanized steel

Wall and roof panels

Panels shall be 2"thick double wall construction. Panel joints shall be sealed with an industrial EPDM gasket to form a water and airtight seal. Air handling manufacturers using caulk to seal panels must include an owner witnessed field leakage test. The test shall require the unit to be field design air flow tested and cabinet leak tested for 1% at 1.5 times the operating pressure.

Panels shall be individually removable for service without removing the roof or compromising the integrity of the cabinet wall. Panels shall be joined with 5/16" bolts that can be removed and refastened. Panel attachment with screws is not acceptable. All panels shall utilize thermal break construction between the exterior panel and the interior liner and between the panels and the base and roof frames.

For long term durability, exterior panels shall be a minimum 16 gauge smooth aluminum

Interior liners shall be a {16 gauge aluminum. Panel liners shall be of a single piece construction and attached to the exterior panels with a full thermal break. To allow for cleaning, no fasteners shall be used on the exposed liner surface. Single wall units are not acceptable.

Insulation

All wall and roof panels shall be insulated with an injected foam insulation with an R value of 6.6/inch. Panels shall be designed to deflect no more than 1/200 of span under operating design conditions when measured at the panel seam. Insulation shall fill the panel without voids. Panels shall have a minimum 16 gauge aluminum solid interior liner.

Access doors shall be provided into all sections of the air-handling unit as indicated in the plan documents. Doors shall be sized as shown on plan drawings, shall be a minimum 2" thick with R13 polyurethane foam insulation and shall be double wall construction using the same material type as the corresponding section. Doors shall comply with the requirements of UL 1995 and NFPA 90. The door frame shall be 0.125" extruded 6063-T5 aluminum. Each door shall be mounted with adjustable die cast aluminum hinges. All doors and mounting frames shall incorporate a thermal break design and the doors shall seal to a replaceable extruded EPDM sponge rubber gasket. Doors shall open against static pressure or shall include a pressure relief feature on the door latch.

The door latch assembly shall consist of a roller cam compression arm with a chrome plated steel inner handle and glass fiber/nylon composite outer handle. One {tool operated} {key operated} lock shall be provided on each fan section access door. All doors shall have a minimum of two latches. Doors over 72" tall shall have 3 or more latches.

The entire unit, including walls, roof, doors, joints, and seams shall include thermal break construction. This construction shall be supported by tested performance producing no condensation on the exterior surface when the air tunnel temperature is 50°F DB under the following exterior conditions:

$(Th - 50) / (Th - Tdp) < 3.4$

Th = Ambient dry bulb temperature (°F) external to housing

Tdp = Ambient dew point temperature (°F) external to housing

FAN ASSEMBLIES – DIRECT DRIVE FAN ARRAY

Approved manufacturers: ClimateCraft and Hunt Air

Fan Arrays shall be direct-drive, non-overloading SWSI plenum fans designed for industrial duty and suitable for continuous operation.

Fans shall be arranged in an array using one or more welded structural steel assemblies and shall be of the size and quantity specified in the unit schedule. Screwed or riveted frames are unacceptable. Fan assemblies shall be attached directly to base structural members.

Fan wheels shall have a minimum of 12 airfoil blades for superior sound characteristics and shall be constructed of aluminum to reduce rotational weight and vibration. Fan blades shall be extruded aluminum for uniformity and improved vibration characteristics.

Each fan and motor assembly shall be independently isolated within the structural assembly using 1 inch deflection spring isolators . Isolators shall be mounted in a three point arrangement that provides both vertical and horizontal (thrust) isolation and shall not require field adjustment . If hard mounted or rubber in shear is used in place of internal spring isolations, external isolation of the entire unit is required. Isolation system shall be seismic rated.

A fan inertia base shall be provided or the fan structure shall exceed an equivalence of 2x mass of the total rotating parts of the fan array. Fan and motor assemblies shall be designed such that no natural frequencies exist within the operating RPM range of the fan, eliminating the need for "lockout" frequency settings in the variable speed drive. The purchasing contractor will be responsible for all costs associated with externally isolating any unit that does not include individual fan isolation.

All fan arrays shall meet the minimum motor efficiency, maximum brake horsepower and total motor horsepower values scheduled. All fans shall be selected to operate at a point no higher than 90% of the peak static pressure rating as defined by the fan performance curve at the selected operating speed. Manufacturer must ensure maximum fan RPM is below the first critical speed.

All fan and motor assemblies shall be dynamically balanced by the manufacturer to a maximum allowable vibration of 0.040 inches per second at design RPM and a maximum 0.080 inches per second overall vibration limit to bring the fan balance in conformance to a BV-5 Grade G1 per ANSI/AMCA 204. In addition, the manufacturer shall insure that no critical frequencies exist in the fan operating range by varying motor speed in 1Hz increments from design RPM to 50% of design RPM.

Motors

Electrical characteristics and horsepower shall be as specified on the project schedule.

Motors shall be Premium Efficiency per NEMA MG1 Table 12-12 ODP type, shall have NEMA Class F insulation, shall meet NEMA Standard MD-1 Inverter Duty rating and shall be designed to withstand 1600V peak voltage spikes and rise times $\geq$0.1 microseconds.

Motors shall have grease lubricated ball bearings designed to deliver a minimum L10 life of 250,000 hours at full load and the maximum operating RPM of the associated fan. Grease zerks and spring loaded grease relief valves shall be provided in each motor to allow easy bearing lubrication without damaging the seals due to over lubrication. {Permanently lubricated bearings are allowed if a spare motor per array is provided.}

For efficient operation in a direct drive application, motors shall be capable of operating greater than 60HZ to at least the design operating speed of the fan.

Motors shall be factory wired to a motor control center for connection to a VFD. The motor control center shall include for each motor circuit a control device providing overload protection, short circuit protection and a manual disconnect means, and all circuits shall be wired to a common main panel terminal block. Each motor shall be factory wired directly to an individual VFD. All motors shall operate at all times and be controlled in unison, maintaining a consistent and uniform airflow pattern over coils, filters and other devices.

Each motor shall be provided with a shaft grounding device to harmlessly bleed potential induced shaft voltages to ground.}

Warranty

All rotating parts shall be warranted by the unit manufacturer for a full five (5) years from date of unit start-up.

Fan Array Controls

Fan arrays shall be controlled using a common control signal, such as the duct static control signal, to modulate the fan speed.

Each fan array in the air handling unit shall be provided with a factory installed airflow measuring instrument. Every fan in the array will have an airflow measuring device that is guaranteed by the unit manufacturer to have no impact on the fan airflow performance and will not increase the fan sound power. The output of the airflow measurement device on each fan shall be wired by the unit manufacturer back to a central processor mounted on the cabinet exterior that will add the flow from each fan to provide a total airflow for the fan array. Using one air flow measuring device and multiplying by the number of fans provided is not acceptable due to lack of accuracy.

COILS

Provide complete coil section(s) with service access door(s) as shown on the plan drawings. Coil connections shall extend through the section casing for ease of installation. Coil connections must be sealed from both the inside and exterior surfaces of the panel with the sleeve of the inner seal covering the pipe within the depth of the panel, all to minimize leakage and condensation. An integral stainless steel air seal which completely seals around the coil casing and extends to the unit pressure bearing surface shall be provided. Air seals/safing materials that are mechanically fastened to the inner liner of the cabinet only shall be constructed of 16 gage materials to match the material type in the appropriate section and shall be gasketed and have fasteners every 3 inches.

Multiple, “stacked” coil arrangements must be constructed so as to allow independent removal of any coil without the removal of another within the coil bank.

All coils shall meet or exceed the capacities specified on the mechanical schedule and all water coil performances shall be certified in accordance with the AHRI Forced Circulation Air Heating and Air Cooling Coil certification program which is based on AHRI Standard 410. Face velocities shall not exceed those specified on the mechanical schedule.

All cooling coil sections shall include a double sloped drain pan constructed from 304L stainless steel. All corners shall be welded watertight. Coils shall rest on stainless steel supports. The pan shall have a minimum pitch of 2" from high point to the bottom of the drain outlet connection, providing at least a 1/8" per foot slope. The drain pan shall be insulated with a 2-part sprayed on polyurethane, water impervious foam. Insulation shall be applied to the entire under side of the drain pan and coil section base assembly. If multiple stacked coils are used, intermediate drain pans are required. Intermediate pans shall be insulated and drained with 3/4" copper down-comers to the main pan.

Water coils shall be of a staggered tube design with high efficiency die formed corrugated plate-type fins for maximum performance. All coils shall be tested with 400 psig compressed air under clear water. Coils shall be designed to operate at 300 psig internal pressure and up to 250ºF. Tubes shall be 5/8" diameter, seamless 0.020" wall copper, mechanically expanded into full drawn fin collars for a continuous compression bond over the full finned length for high efficiency performance. Coil casings shall be a minimum 16 gauge stainless steel. Coil casing reinforcements shall be required for fin lengths over 42". Coils shall be serviceable using 0.25" M.P.T. drain and vent taps on the supply and return headers. Threaded seamless red brass coil connections shall be brazed to copper supply and return headers.

FILTERS

Provide complete filter section(s) with filter racks and service access door(s) as shown on the plan drawings. Holding frames provided for medium efficiency applications will be either upstream or downstream accessible. Holding frames provided for high efficiency applications will be upstream accessible, only. Holding frames shall be constructed from heavy gauge galvanized steel and shall be equipped with polyurethane foam gaskets. Frames shall be installed with vertical stiffeners and appropriate frame-to-frame sealant to provide a rigid leak tight assembly. An integral air seal which completely seals around the filter frame assembly and extends to the unit pressure bearing surface shall be provided. Air seals/safing materials that are mechanically fastened to the inner liner of the cabinet only shall be constructed of 16 gage materials to match the material type in the appropriate section and shall be gasketed and have fasteners every 3 inches

Filter fasteners shall be capable of being installed without the requirement of tools, nuts or bolts. The holding frame shall be designed to accommodate standard size filters with the application of the appropriate type fastener. The filter rack shall be designed to use standard 24"x24" and 12"x24" filters only. Odd sized filters are not allowed. Holding frame assemblies shall be sized to meet or exceed the face area specified by the mechanical schedule.

DAMPERS

Mixing box outdoor air and return air openings shall be airfoil low-leak dampers, Damper shall be opposed blade type. The frame shall be fabricated from 16 gauge galvanized steel. Damper shall meet the leakage requirements of ASHRAE Std. 90.1 and of the International Energy Conservation Code by leaking less than 3 CFM/sq. ft. at 1" of static pressure, and shall be AMCA licensed as a Class 1A damper.

ELECTRICAL POWER AND CONTROLS

Unit operating voltage shall be 460V/3 phase, 60Hz. All wiring and electrical equipment supplied by the manufacturer shall conform to and be installed in accordance with the requirements of UL1995.

Provide copper wires, bus bars, and fittings throughout, except internal wire of the control transformer may be aluminum if copper termination is provided. Identify power supply terminals with permanent markers. The maximum temperature of terminals shall not exceed 167°F (75°C) when the equipment is tested in accordance with its rating. Mount a permanent nameplate on the unit to display the manufacturer, serial number and model number, date of manufacture, horsepower, current rating and voltage.

PART 3 - EXECUTION

INSTALLATION

Install in strict accordance with manufacturer's requirements, shop drawings, and Contract Documents.

Adjust in alignment on concrete foundations, sole plates or other supporting structure. Level, grout, and bolt in place.

Coordinate electrical installation with electrical contractor.

Coordinate controls with control contractor.

Provide all appurtenances required ensuring a fully operational and functional system.

START-UP

Equipment start-up is to be supervised by the unit manufacturer or a manufacturer-certified service organization. Physical connections and start-up are provided by the installing contractor. . The start-up engineer shall conduct such operating tests as required to ensure that the unit is operating in accordance with design. Complete testing of all safety and emergency control devices shall be made. The start-up engineer shall submit a written report to the owner and manufacturer containing all test data recorded as required above and a letter certifying that the unit is operating properly.

Provide complete Operation & Maintenance Manuals with descriptive literature, model, and serial number of all equipment, performance data, manufacturer's instructions for operating and maintenance, lubrication recommendation and schedule, and winter shutdown procedure.

EXAMINATION

Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

Examine roughing-in of hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

Proceed with installation only after unsatisfactory conditions have been corrected.

INSTALLATION

Install on roof curb in accordance with manufacturer's recommendations.

Arrange installation of units to provide access space around modular outdoor air-handling units for service and maintenance.

CONNECTIONS

Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
Install piping adjacent to machine to allow service and maintenance.

Connect piping to modular outdoor air-handling units with flexible connectors.

Install condensate drain piping, trap at unit and extend to nearest floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

Chilled-Water Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Connect to supply and return coil tappings with unions or flanges. Pipe with accessories as indicated.

Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

Electrical: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.

Ground equipment according to Division 16 Section "Grounding and Bonding."

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

FIELD QUALITY CONTROL

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

> Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
>
> Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
>
> Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

VERIFICATION AND STARTUP

Engage a factory-authorized service representative to perform startup service.

Final Checks before Startup: Perform the following:

Verify that shipping, blocking, and bracing are removed.

Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

Perform cleaning and adjusting specified in this Section.

Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.

Lubricate bearings and other moving parts with factory-recommended lubricants.

Set zone dampers to fully open position for each zone.

Set outside-air dampers to outside-air setting.

Comb coil fins for parallel orientation.

Install clean filters.

Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

Starting procedures for modular outdoor air-handling units include the following:

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.

Manually operate dampers from fully closed to fully open position and record fan performance.

ADJUSTING

Adjust damper linkages for proper damper operation.

CLEANING

Clean air-handling units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.

After completing system installation and testing, and adjusting modular outdoor air-handling and air-distribution systems, clean filter housings and install new filters.

DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain modular indoor air-handling units.

END OF SECTION 15725

SECTION 15750 - VARIABLE FREQUENCY DRIVES

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 specification covers complete a variable frequency drives (VFDs) designated on the drawing schedules to be variable speed. All standard and optional features shall be included within the VFD panel.

The VFD shall be UL Type 1 or UL Type 12 as required on the schedule. The VFD shall have been evaluated by UL and found acceptable for mounting in a plenum or other air handling compartment. Manufacturer shall supply a copy of the UL plenum evaluation upon request.

The VFD shall be tested to UL 508C. The appropriate UL label shall be applied. When the VFDs are to be located in Canada, C-UL certifications shall apply. VFD shall be manufactured in ISO 9001, 2000 certified facilities.

The VFD shall be CE marked and conform to the European Union Electro Magnetic Compatibility directive.

The VFD shall be UL listed for a minimum short circuit current rating of 42 kA and 480 volts and labeled with this rating.

The VFD manufacturer shall supply the VFD and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten years.

DEFINITIONS

BAS: Building automation system.

CPT: Control power transformer.

EMI: Electromagnetic interference.

IGBT: Insulated-gate bipolar transistor.

LAN: Local area network.

LED: Light-emitting diode.

MCP: Motor-circuit protector.

NC: Normally closed.

NO: Normally open.

OCPD: Overcurrent protective device.

PCC: Point of common coupling.

PID: Control action, proportional plus integral plus derivative.

PWM: Pulse-width modulated.

RFI: Radio-frequency interference.

TDD: Total demand (harmonic current) distortion.

THD(V): Total harmonic voltage demand.

VFD: Variable-frequency motor drive.

SUBMITTALS

Product Data: For each type and rating of VFD indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

Shop Drawings: For each VFD indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

Show tabulations of installed devices, equipment features, and ratings. Include the following:

Each installed unit's type and details.
Factory-installed devices.
Enclosure types and details.
Nameplate legends.
Short-circuit current (withstand) rating of enclosed unit.
Features, characteristics, ratings, and factory settings of each VFC and installed devices.
Specified modifications.

Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

Product Certificates: For each VFD, from manufacturer.

Source quality-control reports.

Field quality-control reports.

Operation and Maintenance Data: For VFDs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.

Manufacturer's written instructions for setting field-adjustable overload relays.

Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.

Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

QUALITY ASSURANCE

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Comply with NFPA 70.

PROJECT CONDITIONS

Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:

Ambient Temperature: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).

Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)

Humidity: Less than 95 percent (noncondensing).

Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

Notify Owner no fewer than two days in advance of proposed interruption of electrical systems. Indicate method of providing temporary electrical service.

Do not proceed with interruption of electrical systems without Owner's written permission.

Comply with NFPA 70E.

Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces and other items.

COORDINATION

Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:

Torque, speed, and horsepower requirements of the load.

Ratings and characteristics of supply circuit and required control sequence.

Ambient and environmental conditions of installation location.

WARRANTY

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.

Warranty Period: Five years from date of Substantial Completion.

EXTRA MATERIALS

Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Power Fuses: Equal to three of each size and type.

Control Power Fuses: Equal to two of each size and type.

Indicating Lights: Two each type and color installed.

Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 - PRODUCTS

The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable 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 the driven load and to eliminate the need for motor de-rating.

When properly sized, the VFD shall allow the motor to produce full rated power at rated motor voltage, current, and speed without using the motor's service factor. VFDs 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 VFD shall include an input full-wave bridge rectifier and maintain a fundamental (displacement) power factor near unity regardless of speed or load.

The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable.

VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load, where harmonic performance is most critical.

The VFD's full load output current rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 second while starting.

The VFD shall provide full motor torque at any selected frequency from 20 Hz to base speed while providing a variable torque V/Hz output at reduced speed. This is to allow driving direct drive fans without high speed de-rating or low speed excessive magnetization, as would occur if a constant torque V/Hz curve was used at reduced speeds. Breakaway current of 160% shall be available.

A programmable automatic energy optimization selection feature shall be provided standard in the VFD. This feature shall automatically and continuously monitor the motor=s speed and load to adjust the applied voltage to maximize energy savings.

The VFD must be able to produce full torque at low speed to operate direct drive fans.

Output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD.

An automatic motor adaptation algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to perform the test.

VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

All VFDs shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.

PROTECTIVE FEATURES

A minimum of Class 20 I^2t electronic motor overload protection for single motor applications shall be provided. Overload protection shall automatically compensate for changes in motor speed.

Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature. The VFD shall display all faults in plain language. Codes are not acceptable.

Protect VFD from input phase loss. The VFD should be able to protect itself from damage and indicate the phase loss condition. During an input phase loss condition, the VFD shall be able to be programmed to either trip off while displaying an alarm, issue a warning while running at reduced output capacity, or

issue a warning while running at full commanded speed. This function is independent of which input power phase is lost.

Protect from under voltage. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal. The VFD will continue to operate with reduced output, without faulting, with an input voltage as low as 70% of the nominal voltage.

Protect from over voltage. The VFD shall continue to operate without faulting with a momentary input voltage as high as 130% of the nominal voltage.

The VFD shall incorporate a programmable motor preheat feature to keep the motor warm and prevent condensation build up in the motor when it is stopped in a damp environment by providing the motor stator with a controlled level of current.

VFD shall include a signal loss detection algorithm with adjustable time delay to sense the loss of an analog input signal. It shall also include a programmable time delay to eliminate nuisance signal loss indications. The functions after detection shall be programmable.

VFD shall function normally when the keypad is removed while the VFD is running. No warnings or alarms shall be issued as a result of removing the keypad.

VFD shall catch a rotating motor operating forward or reverse up to full speed without VFD fault or component damage.

Selectable over-voltage control shall be provided to protect the drive from power regenerated by the motor while maintaining control of the driven load.

VFD shall include current sensors on all three output phases to accurately measure motor current, protect the VFD from output short circuits, output ground faults, and act as a motor overload. If an output phase loss is detected, the VFD will trip off and identify which of the output phases is low or lost.

If the temperature of the VFD's heat sink rises to 80 deg C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. It shall also be possible to program the VFD so that it reduces its output current limit value if the VFD=s temperature becomes too high.

In order to ensure operation during periods of overload, it must be possible to program the VFD to automatically reduce its output current to a programmed value during periods of excessive load. This allows the VFD to continue to run the load without tripping.

The VFD shall have temperature controlled cooling fan(s) for quiet operation, minimized losses, and increased fan life. At low loads or low ambient temperatures, the fan(s) may be off even when the VFD is running.

The VFD shall store in memory the last 10 alarms. A description of the alarm, and the date and time of the alarm shall be recorded.

INTERFACE FEATURES

Hand, Off, and Auto keys shall be provided to start and stop the VFD and determine the source of the speed reference. It shall be possible to either disable these keys or password protect them from undesired operation.

There shall be an AInfo@ key on the keypad. The Info key shall include Aon-line@ context sensitive assistance for programming and troubleshooting.

The VFD shall be programmable to provide a digital output signal to indicate whether the VFD is in Hand or Auto mode. This is to alert the Building Automation System whether the VFD is being controlled locally or by the Building Automation System.

Password protected keypad with alphanumeric, graphical, backlit display can be remotely mounted. Two levels of password protection shall be provided to guard against unauthorized parameter changes.

All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.

To set up multiple VFDs, it shall be possible to upload all setup parameters to the VFD=s keypad, place that keypad on all other VFDs in turn and download the setup parameters to each VFD. To facilitate setting up VFDs of various sizes, it shall be possible to download from the keypad only size independent parameters. Keypad shall provide visual indication of copy status.

Display shall be programmable to communicate in multiple languages including English, Spanish and French.

A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

A quick setup menu with factory preset typical HVAC parameters shall be provided on the VFD. The VFD shall also have individual Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.

A three-feedback PID controller to control the speed of the VFD shall be standard.

> This controller shall accept up to three feedback signals. It shall be programmable to compare the feedback signals to a common setpoint or to individual setpoints and to automatically select either the maximum or the feedback signal as the controlling signal. It shall also be possible to calculate the controlling feedback signal as the average of all feedback signals or the difference between a pair of feedback signals.
>
> The VFD shall be able to apply individual scaling to each feedback signal.
>
> For fan flow tracking applications, the VFD shall be able to calculate the square root of any or all individual feedback signals so that a pressure sensor can be used to measure air flow.
>
> The VFD’s PID controller shall be able to actively adjust its setpoint based on flow. This allows the VFD to compensate for a pressure feedback sensor which is located near the output of the pump rather than out in the controlled system.

The VFD shall have three additional PID controllers which can be used to control damper and valve positioners in the system and to provide setpoint reset.

Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

Five simultaneous meter displays shall be available. They shall include at a minimum, frequency, motor current, motor voltage, VFD output power, VFD output energy, VFD temperature in degrees, among others.

Programmable Sleep Mode shall be able to stop the VFD. When its output frequency drops below set Asleep@ level for a specified time, when an external contact commands that the VFD go into Sleep Mode, or when the VFD detects a no-flow situation, the VFD may be programmed to stop. When the VFDs speed is being controlled by its PID controller, it shall be possible to program a Awake-up@ feedback value that will cause the VFD to start. To avoid excessive starting and stopping of the driven equipment, it shall be possible to program a minimum run time before sleep mode can be initiated and a minimum sleep time for the VFD.

A run permissive circuit shall be provided to accept a Asystem ready@ signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of initiating an output Arun request@ signal to indicate to the external equipment that the VFD has received a request to run.

VFD shall be programmable to display feedback signals in appropriate units, such as inches of water column (in-wg), pressure per square inch (psi) or temperature (°F).

VFD shall be programmable to sense the loss of load. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. To ensure against nuisance indications, this feature must be based on motor torque, not current, and must include a proof timer to keep brief periods of no load from falsely triggering this indication.

Standard Control and Monitoring Inputs and Outputs:

Four dedicated, programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.

Two programmable relay outputs, Form C 240 V AC, 2 A, shall be provided for remote indication of VFD status.

Each relay shall have an adjustable on delay / off delay time.

Two programmable analog inputs shall be provided that can be either direct-or-reverse acting.

Each shall be independently selectable to be used with either an analog voltage or current signal.

The maximum and minimum range of each shall be able to be independently scalable from 0 to 10 V dc and 0 to 20 mA.

A programmable low-pass filter for either or both of the analog inputs must be included to compensate for noise.

The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting,

One programmable analog current output (0/4 to 20 mA) shall be provided for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.

It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.

It shall be possible to command all digital and analog output through the serial communication bus.

Optional Control and Monitoring Inputs and Outputs:

It shall be possible to add optional modules to the VFD in the field to expand its analog and digital inputs and outputs.

These modules shall use rigid connectors to plug into the VFD's control card.

The VFD shall automatically recognize the option module after it is powered up. There shall be no need to manually configure the module.

Modules may include such items as:

Additional digital outputs, including relay outputs
Additional digital inputs
Additional analog outputs
Additional analog inputs, including Ni or Pt temperature sensor inputs

It shall be possible through serial bus communications to control the status of all optional analog and digital outputs of the VFD.

Standard programmable firefighters override mode allows a digital input to control the VFD and override all other local or remote commands. It shall be possible to program the VFD so that it will ignore most normal VFD safety circuits including motor overload. The VFD shall display FIREMODE whenever in firefighter's override mode. Fire mode shall allow selection of forward or reverse operation and the selection of a speed source or preset speed, as required to accommodate local fire codes, standards and conditions.

A real-time clock shall be an integral part of the VFD.

It shall be possible to use this to display the current date and time on the VFD's display.

Ten programmable time periods, with individually selectable ON and OFF functions shall be available. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter setpoints and output relays. Is shall be possible to program unique events that occur only during normal work days, others that occur only on non-work days, and others that occur on specific days or dates. The manufacturer shall provide free PC-based software to set up the calendar for this schedule.

All VFD faults shall be time stamped to aid troubleshooting.

It shall be possible to program maintenance reminders based on date and time, VFD running hours, or VFD operating hours.

The real-time clock shall be able to time and date stamp all faults recorded in the VFD fault log.

The VFD shall be able to store load profile data to assist in analyzing the system demand and energy consumption over time.

The VFD shall include a sequential logic controller to provide advanced control interface capabilities. This shall include:

Comparators for comparing VFD analog values to programmed trigger values

Logic operators to combine up to three logic expressions using Boolean algebra

Delay timers

A 20-step programmable structure

SERIAL COMMUNICATIONS

The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

Johnson Controls Metasys N2
Modbus RTU
Siemens FLN P1

Optional communication shall include:

LonWorks Free Topology (FTP)

BACnet MS/TP

Communications shall be fully compatible with the existing TRANE Summit EMCS system currently installed in the building and in use on the site.

VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.

The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD's control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

ADJUSTMENTS

The VFD shall have a manually adjustable carrier frequency that can be adjusted in 0.5 kHz increments to allow the user to select the desired operating characteristics. The VFD shall also be programmable to automatically reduce its carrier frequency to avoid tripping due to thermal loading.

Four independent setups shall be provided.

Four preset speeds per setup shall be provided for a total of 16.

Each setup shall have two programmable ramp up and ramp down times. Acceleration and deceleration ramp times shall be adjustable over the range from 1 to 3,600 seconds.

Each setup shall be programmable for a unique current limit value. If the output current from the VFD reaches this value, any further attempt to increase the current produced by the VFD will cause the VFD to reduce its output frequency to reduce the load on the VFD. If desired, it shall be possible to program a timer which will cause the VFD to trip off after a programmed time period.

If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: external interlock, under-voltage, over-voltage, current limit, over temperature, and VFD overload.

The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

An automatic start delay may be selected from 0 to 120 seconds. During this delay time, the VFD shall be programmable to either apply no voltage to the motor or apply a DC braking current if desired.

Four programmable critical frequency lockout ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment shall be provided. Semi-automatic setting of lockout ranges shall simplify the set-up.

BYPASS SYSTEMS

Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

Bypass Mode: Manual operation only; requires local operator selection at VFD. Transfer between power converter and bypass contactor and retransfer shall only be allowed with the motor at zero speed.

Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

Bypass Contactor: Load-break, NEMA-rated contactor.

Output Isolating Contactor: Non-load-break, NEMA-rated contactor.

Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.

Bypass Contactor: Load-break, NEMA-rated contactor.

Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.

Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

Bypass Contactor Configuration: Full-voltage (across-the-line) type.

NORMAL/BYPASS selector switch.

HAND/OFF/AUTO selector switch.

NORMAL/TEST Selector Switch: Allows testing and adjusting of VFD while the motor is running in the bypass mode.

Contactor Coils: Pressure-encapsulated type.

Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

Overload Relays: NEMA ICS 2.

Solid-State Overload Relays:

Switch or dial selectable for motor-running overload protection.
Sensors in each phase.
Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

Analog communication module.

NC NO isolated overload alarm contact.
External overload reset push button.

PART 2 - EXECUTION

EXAMINATION

Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.

Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

Proceed with installation only after unsatisfactory conditions have been corrected.

INSTALLATION

If possible and available, it is preferred that VFD shall be factory mounted within the rooftop unit and/or receive cooling air from the RTU.

Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

Wall-Mounting Controllers: Install VFDs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."

Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

Install fuses in each fusible-switch VFD.

Install fuses in control circuits if not factory installed. Comply with requirements in Division 16 Section "Fuses."

Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

IDENTIFICATION

Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

Label each VFD with engraved nameplate.

Label each enclosure-mounted control and pilot device.

Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

CONTROL WIRING INSTALLATION

Install wiring between VFDs and remote devices and facility's central-control system. Comply with requirements in Division 16.

Bundle, train, and support wiring in enclosures.

Connect selector switches and other automatic control devices where applicable.

Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.

Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

FIELD QUALITY CONTROL

Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

Perform tests and inspections.

Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

Acceptance Testing Preparation:

Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.

Test continuity of each circuit.

VFDs will be considered defective if they do not pass tests and inspections.

Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

STARTUP SERVICE

Engage a factory-authorized service representative to perform startup service.

Complete installation and startup checks according to manufacturer's written instructions.

ADJUSTING

Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

Set the taps on reduced-voltage autotransformer controllers.

Set field-adjustable pressure switches.

PROTECTION

Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

Replace VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

DEMONSTRATION

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFDs.

END OF SECTION 15750

SECTION 15815 - METAL DUCTS

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.

SUMMARY

This Section includes rectangular, metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 4.0-inch wg.

Related Sections include the following:

Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.

DEFINITIONS

Thermal Conductivity and Apparent Thermal Conductivity: As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.

Example: Apparent Thermal Conductivity: 0.26 or 0.037.

SUBMITTALS

Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

Shop Standards: Submit fabricators shop standards for this particular project. Include table of gauges, reinforcing, hanger sizes and spacing, sealing methods, etc. for each pressure class.
Shop Drawings: Submit shop drawings for engineer's review showing details of the following:

Fabrication, assembly, and installation, including 1/4" plans, 1/2" elevations, 1/2" sections, components, and attachments to other work and phases of construction

Duct layout indicating pressure classifications and sizes on 1/4"plans

Fittings

Reinforcement and spacing

Seam and joint construction

Penetrations through fire-rated and other partitions

Terminal unit and heating, coils, and humidifier installations

Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment

Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in "Quality Assurance" Article.

Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

QUALITY ASSURANCE

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

Installer's Qualifications: Firm with applicable installation experience on projects with metal ductwork systems similar to that required for project.

Codes and Standards:

Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.

Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.

Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

DELIVERY, STORAGE, AND HANDLING

Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

SHEET METAL MATERIALS

Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.

Except as otherwise indicated, fabricate ductwork from galvanized, sheet steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view. All ductwork shall have manufacturer's stamp, stencil, or other marking indicating metal gage thereon.

SEALANT MATERIALS

Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.

HANGERS AND SUPPORTS

Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.

Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for 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 complying with ASTM A 36/A 36M.

Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.

Supports for Stainless-Steel Ducts: Stainless-steel support materials.

RECTANGULAR DUCT FABRICATION

General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degree for contracting tapers and 20 degree for expanding tapers.

Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:

Supply ducts for constant volume systems: 1-inch wg.

Return Ducts: 1-inch wg, negative pressure.

Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area.

PART 3 - EXECUTION

DUCT INSTALLATION, GENERAL

Duct installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.

Construct and install each duct system for the specific duct pressure classification indicated.

Install ducts with fewest possible joints.

Install fabricated fittings for changes in directions, changes in size and shape, and connections.

Install couplings tight to duct wall surface with a minimum of projections into duct.

Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

Install ducts with a minimum clearance of 2 inches, plus allowance for insulation thickness.

Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

SEAM AND JOINT SEALING

General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

Pressure Classification Less Than 2-Inch wg (500 Pa): Transverse joints.

Seal externally insulated ducts before insulation installation.

HANGING AND SUPPORTING

Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

Support vertical ducts at a maximum interval of 16 feet (5 m) and at each floor.

Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

CONNECTIONS

Connect equipment mounted on vibration isolators, and/or equipment containing rotating machinery with flexible connectors according to Division 15 Section "Duct Accessories."

For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

CLEANING

Clean ductwork internally of dust and debris, unit by unit as it is installed. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal. Prepare surface for insulation application.

Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION 15815

SECTION 15820 - DUCT ACCESSORIES

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 includes the following:

Manual volume dampers
Flexible connectors

Related Sections include the following:

Division 15 Section "Basic mechanical Materials and Methods."

SUBMITTALS

Product Data: For the following:

Manual volume dampers
Flexible duct connectors

Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:

QUALITY ASSURANCE

NFPA Compliance: Comply with the following NFPA standards:

NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

SHEET METAL MATERIALS

Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

MANUAL VOLUME DAMPERS

General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking 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.

Pressure Classifications of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of opening shaft.

Standard Volume Dampers: Multiple parallel-or-opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

Steel Frames: Hat-shaped, galvanized, sheet steel channel, minimum of 0.064- inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

Roll-Formed Steel Blades: 0.064-inch (1.62 mm) thick, galvanized, sheet steel.

Blade Axles: Galvanized steel.

Jackshaft: 1-inch (25 mm) diameter, galvanized steel pipe rotating within in a pipe-bearing assembly mounted on supports at each mullion and at end of multi-damper assemblies.

Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4 mm) thick zinc-plated steel, and a 3/4-inch (19 mm) hexagon locking nut. Include center hole to suit operating-rod size. Include elevated platform for insulated duct mounting.

FLEXIBLE CONNECTORS

General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.

Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.

PART 3 - EXECUTION

INSTALLATION

Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

Install flexible connectors at ducts crossing building expansion joints and at connections to air handling equipment.

ADJUSTING

Adjust duct accessories for proper settings.

END OF SECTION 15820

SECTION 15900 - DDC BUILDING AUTOMATION SYSTEM

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.

Products furnished but not installed under this section:

Automatic dampers that are not an integral component of equipment be installed under Division 15 Section Duct Accessories.

Coordination with electrical:

Installation of line voltage power wiring by Division 16.

Each motor starter provided under Division 16, shall be furnished with individual control power transformer to supply 120-volt control power and auxiliary contacts (one N.O. and one N.C.) for use by Building Automation System (BAS) Contractor.

SUMMARY

The automated system shall be an extension/modification of the existing Trane Tracer Summit System. All control work shall be performed by Tampa Bay Trane. Their services shall be included in the project bid.

The BAS Contractor shall extend the existing building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control as herein specified. The system shall include all required computer software and hardware, controllers, sensors, transmission equipment, local panels, conduit, wire, installation, engineering, database and setup, supervision, commissioning, acceptance test, training, and warranty service. Systems shall be fully compatible with existing Trane Tracer System. Systems that require third party software, gateways or additional computers are not acceptable.

The system shall use LonTalk[7] as its native protocol. System components shall be certified by LONMARK[7] and display the LONMARK[7] logo where applicable. System components that do not have a LONMARK[7] profile shall be compatible with the LONMARK[7] standards. For each LonWorks device that does not have LonMark certification, the device supplier must provide DRF and XIF files for the device.

System Monitoring and Supervisor Control shall be provided through existing interfaces and configurations tools supported by the LNS database in a client server fashion.

The BAS shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet. No exceptions.

All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project.

QUALITY ASSURANCE

The system shall be furnished, engineered, and installed by the manufacturers' locally authorized representative. The controls contractor shall have factory-trained technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.

FMCS Application Specific Controllers and Programmable Equipment Controllers shall be listed as follows:

American Society for Testing and Materials, ASTM
Institute of Electrical and Electronic Engineers, IEEE
National Electrical Manufacturers Association, NEMA
Underwriters Laboratory, UL 916
FCC Regulation, Part 15, Section 156
National Fire Protection Association, NFPA

The Manufacturer of the BAS digital controllers shall provide documentation supporting compliance with ISO-9001, Model for Quality Assurance in Design/Development, Production, Installation and Servicing. Product literature provided by the FMCS digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar. Manufacturer shall be a firm regularly engaged in the manufacture of automatic temperature control systems similar to those indicated for this project with a record of three years of successful in-service performance.

SUBMITTALS

Submit the following in accordance with Division 1, Section 01300, “Submittals.”

Product Data: Include manufacturers technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

Each control device labeled with setting or adjustable range of control.

Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Schematic flow diagrams showing fans, coils, dampers, and control devices.

Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

Details of control panel faces, including controls, instruments, and labeling.

Written description of sequence of operation.

Schedule of dampers including size, leakage, and flow characteristics.

Trunk cable schematic showing programmable control unit locations and trunk data conductors.

Listing of connected data points, including connected control unit and input device.

System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

Software and Firmware Operational Documentation: Include the following:

Software operating and upgrade manuals.

Program Software Backup: On compact disc, complete with data files.

Device address list.

Printout of software application and graphic screens.

Software license required by and installed for DDC workstations and control systems.

Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or monitoring and control revisions.

Upon project completion, submit operation and maintenance manuals, consisting of the following:

Index sheet, listing contents in alphabetical order

Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams

Description of sequence of operations

As-Built interconnection wiring diagrams

Users documentation containing product, system architectural and programming information.

Trunk cable schematic showing remote electronic panel locations, and all trunk data

List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)

Copy of the warranty

Operating and maintenance cautions and instructions

Recommended spare parts list

Field Test Reports, indicating interpretation of test results for compliance with performance requirements.

DELIVERY, STORAGE AND HANDLING

Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

COORDINATION

Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

Coordinate equipment with Division 16 Section AFIRE ALARM SYSTEM@ to achieve compatibility with equipment that interfaces with that system.

Coordinate supply of conditioned electrical circuits for control units and power supplies.

Coordinate equipment with Division 16 Section AMOTOR STARTERS@ to achieve compatibility with starter coils and annunciation devices.

WARRANTY

The control system shall be warranted to be free from defects in both material and workmanship for a period of one year from date of Substantial Completion.

PART 2 - PRODUCTS

Acceptable Manufacturers:

Trane

NO OTHER MANUFACTURERS ARE ACCEPTABLE.

The existing BAS is comprised of a network of interoperable, stand-alone digital controllers. The BAS shall incorporate LonWorks7 technology using Free Topology Transceivers (FTT-10), and specific conformance to the LONMARK7 Interoperability Associations v3.0 Physical Layer guidelines in all unitary, terminal and other device controllers. The system shall include:

Expansion of the control system shall be designed such that mechanical equipment will be able to operate under stand-alone control. In general, the operation of any controllers on the network shall not rely on any other controller for its operation. Functionality such as scheduling, trending, and alarming shall be resident in the programmable controllers. Configurable controllers without scheduling, trending, and alarming shall use a programmable controller for alarm, schedule, trend, or data-logging module for these functions. In the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control of the resident time clock in each controller and the resident program stored in nonvolatile memory as detailed herein or in its last command state for configurable controllers. In such a case, where applicable, each individual controller shall continue to trend and alarm data commensurate with the data storage capabilities of each controller until a network connection can be restored.

WEB Servers for distributed system applications, databases and networking functions.

Programmable Equipment Controllers (PECs) for control of primary mechanical systems and distributed system applications. Controllers shall be fully programmable to create custom control solutions.

Application Specific Controllers (ASCs) for control of air handling units, fans and other terminal equipment.

Graphical User Interface (GUI), which includes the hardware and software necessary for a user to interface with the control system and devices via a static IP address to be provided by the Owner.

The physical network shall use polarity insensitive twisted pair wiring and support star, home run, multi-drop, loop, or a mixture of these wiring topologies. The network shall communicate at a minimum 78Kbps.

All components and controllers supplied under this contract shall be true Apeer-to-peer@ communicating devices. Components or controllers requiring Apolling@ by a host to pass data shall not be acceptable.

Communication and integration of 3rd party LONMARK7 or BACNET7 products shall be accomplished without gateways or interface devices. The 3rd party product supplier shall provide DRF and XIF files for each device.

Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

WEB Server

The existing WEB Server shall provide the interface between the field control devices, and provide global supervisory control functions over the control devices connected to the Web Server. It shall be capable of executing application control programs to provide:

Calendar functions
Scheduling
Trending
Alarm monitoring and routing
Time synchronization
Integration of LONWORKS7 or BACNET7 controller data
Network Management functions for all LONWORKS7 or BACNET7 based devices

The WEB Server supports standard Web browser access via the Intranet/Internet.

The WEB Server provides alarm and/or alert recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

The WEB Server routes any alarm or alert condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.

Alarm generation shall be selectable for annunciation type and acknowledgment requirements including but limited to:

To alarm
Return to normal
To fault

Provide for the creation of an unlimited number of alarm and/or alert classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.

Provide timed (schedule) routing of alarms by class, object, group, or node.

Provide alarm generation from binary object Aruntime@ and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

Alarms shall be annunciated in any of the following manners as user defined:

Screen message text

Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

Day of week
Time of day
Recipient

Pagers via paging services that initiate a page on receipt of email message

Graphic with flashing alarm object(s)

The following shall be recorded by the WEB Server for each alarm (at a minimum):

Time and date

Location (building, floor, zone, office number, etc.)
Equipment (e.g. air handler #, etc.)

Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

A log of all alarms shall be maintained by the LNS Server and/or a server (if configured in the system) and shall be available for review by the user.

Provide a Aquery@ feature to allow review of specific alarms by user defined parameters.

Data Collection and Storage:

The WEB Server shall have the ability to collect data for any property of any object and store this data for future use.

The data collection shall be performed by log objects, resident in the LNS Server that shall have, at a minimum, the following configurable properties:

For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

All log data shall be stored in a relational database in the WEB Server and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

All log data shall be available to the user in the following data formats:

XML
Plain Text
Comma or tab separated values

Copies of the current database shall be stored in the WEB Server

The WEB Server database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

Programmable Equipment Controllers (PEC):

Programmable Equipment Controllers (PECs) shall be stand-alone, multi-tasking, real-time digital control processors with an embedded network database.

The PECs shall communicate via native LonTalk protocol and be compatible with the LONMARK[7] standards. Provide a minimum of 4MB Random Access Memory in each PEC.

The PEC must communicate peer-to-peer with the all of the network application specific and programmable controllers sharing alarming, trending, scheduling and totalization information.

PECs that do not reside exclusively on the LonTalk network and/or cannot provide direct distribution of the system level applications must be configured to co-function with an additional operational back-up PEC.

The PEC software database must be able to execute all of the specified mechanical system controls functions. The programming software shall be able to bundle software logic to simplify control sequencing. All values, which make up the PID output value, shall be readable and modifiable at a workstation or portable service tool. Each input, output, or calculation result shall be capable of being shared/bound with any controller or interface device on the network.

PECs shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

A single process shall be able to incorporate measured or calculated data from any and all other PECs on the network. In addition, a single process shall be able to issue commands to points in any and all other PECs on the network.

Processes shall be able to generate operator messages and advisories to operator I/O devices.

Each PEC shall support firmware upgrades without the need to replace hardware. The upgrades can be accomplished remotely over the LonTalk network and/or by visiting each controller.

Each PEC shall continuously perform self-diagnostics, which include communication diagnosis and diagnosis of all components. The PEC shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

In the event of the loss of normal power, there shall be an orderly shutdown of all PECs to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

Upon restoration of normal power, the PEC shall automatically resume full operation without manual intervention.

All PECs control programming and databases must be stored in Flash memory, therefore eliminating data loss, downtime and re-load time.

Provide a separate PEC for each AHU or other HVAC system. Each unique systems points shall reside on a single controller.

Historical data collection utilities shall be provided to manually or automatically sample and store system data for selected points. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored. Two methods of collection shall be allowed either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of l minute to 7 days shall be provided. The PEC shall have a dedicated RAM-based buffer for trend data. All trend data shall be available for transfer to a Workstation without manual intervention.

Application Specific Controllers (ASC):

Each Application Specific Controller (ASC) shall operate as a stand-alone LonMark7 compliant controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a minimum 16-BIT microprocessor based, multi-tasking, multi-user, real time digital control processor.

Flash memory reload or updating of an existing control algorithm shall be completed over the network.

Network access shall be accomplished at the ASC room sensor or the ASC. System node access shall be available from connecting to the room sensor jack. Systems that do not have a system access jack from the room sensor shall provide a dedicated network jack next to each room sensor.

Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry standards types. Inputs shall be electrically isolated from outputs, communications and power. All inputs shall be provided with an auto-calibrate function to eliminate sensing errors.

All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the network is not acceptable.

The ASC must be mounted remotely from the room sensor. ASCs, that are wall mounted with integral room sensors, are not acceptable.

The control program shall reside in the ASC. The application program configuration information shall be stored in non-volatile memory with no battery backup.

After a power failure the ASC must run the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

Graphical User Interface Software (GUI):

Operator workstations must be capable of supporting any LonMark7 compliant product. The operator shall not be able to distinguish the DDC points from different manufacturers when commanding, monitoring points or acknowledging alarms.

The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software shall run on a Windows 2000 32-bit operating system. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line FMCS alarms and monitoring information. If the software is unable to display several different types of displays at the same time, the FMCS contractor shall provide at least two operator workstations at each location specified.

Real-Time Displays: The GUI, shall at a minimum, support the following graphical features and functions:

Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures. **Use of proprietary graphic file formats shall not be acceptable.**

A gallery of HVAC and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The user shall have the ability to add custom symbols to the gallery as required.

Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and links to other graphic screens.

Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

System Configuration: At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

Create, delete or modify control strategies.

Add/delete objects to the system.

Tune control loops through the adjustment of control loop parameters.

Enable or disable control strategies.

Generate hard copy records or control strategies on a printer.

Select points to be alarmable and define the alarm state.

Select points to be trended over a period of time and initiate the recording of values automatically.

Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

Web Browser Clients:

The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet ExplorerJ or Netscape NavigatorJ. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.

The Web browser client shall support at a minimum, the following functions:

User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

Real-time values displayed on a Web page shall update automatically without requiring a manual Arefresh@ of the Web page.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

View logs and charts

View and acknowledge alarms

The system shall provide the capability to specify users (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

Network Management:

The Graphical User Interface software (GUI) shall provide a complete set of integrated network management tools for working with LONWORKS7 networks. These tools shall manage a database for all devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between devices, known as Abinding@. Network management tools shall be based on Echelon Lon Network Services (LNS) or equivalent BACNET7 tools. Systems requiring the use of third party network management tools shall not be accepted.

Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

The network management database shall be resident in the WEB Server, ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system shall not be accepted.

Field Devices:

Provide automatic control valves, automatic control dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturers standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. At the option of the BAS Contractor, combination temperature and humidity sensors may be used.

Temperature Sensors:

Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application. All ASC room sensors shall provide for direct connection and access to the network. Sensors that provide access only to their connected controller shall not be acceptable@

Space (room) sensor shall have a portable service tool jack to allow communication with the system space sensor (labeled on drawings as AT@). Space sensors shall include timed override button, and set point slide adjustment override options. The set point slide adjustment shall have software limits by the automation system to limit the range of temperature setpoint adjustment.

Pipe temperature sensors shall contain a RTD sensing element to monitor water temperature. The Contractor shall provide brass wells of sufficient size for the pipe to be installed. The output shall be compatible with the panel it serves. Sensor shall be factory calibrated to an accuracy of ± 1% over the full range.

Humidity sensors shall be of the solid-state type using a capacitance-sensing element. The sensor shall vary the output voltage with a change in relative humidity. Room humidity sensors shall have a minimum range of 10% to 90% ∀5%. Supply air humidity sensors shall have a range of 10% to 90% ∀ 5%.

Switches and Thermostats:

The BAS Contractor shall furnish all electric relays and coordinate with the supplier of magnetic starters for auxiliary contact requirements. All electric control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.

Differential Pressure Switch:

Rating: NEMA 1
Mounting: Duct Insertion
Range: 0.05" to 5.0" WC, complete with field adjustable setpoint.
Protection: Overpressure to 1PSIG
Output: Form C Contact, minimum 50VA
Special: Automatic reset, provide complete installation kit including static pressure tips, tubing, fittings, and air filters.

Liquid Presence Sensor:

Liquid presence sensor shall be capable of detecting liquid accumulation of 1/16 inch and require no external power supply. Sensor shall include normally open contacts that close when liquid is

sensed. Sensor shall include minimum 6 feet of low voltage cable to connect to field installed control wiring.

Damper Actuators:

Actuators shall be of the rotary type of modulating or 2-position control as required by the application. The actuator shall use an overload-proof synchronous motor or an electric motor with end switches to de-energize the motor at the end of the stroke limits. Control voltage shall be 24VAC, 0-10VDC, or 4-20ma as required. Actuators shall be available with spring return to the normal position when required. Actuators shall have a position indicator for external indication of damper position. Actuators shall have manual override capability without disconnecting damper linkage. Actuators shall be Belimo or accepted equivalent.

CONTROL VALVES

Furnish pressure independent 2-way and 3-way modulating control valves for chilled water and hot water coils. Valves shall be of the characterized ball valve design with forged brass body and integral regulator and be rated for 150 psig working pressure. Ball shall be stainless steel or chrome plated brass. Valves shall feature a blow-out proof stem with double O-rings and teflon seats. Valves shall have equal percentage characteristics. Valves shall be manufactured by Belimo or accepted equivalent.

VALVE ACTUATORS

Furnish actuators that directly couple to valves. Actuators shall be factory installed and shall modulate the valve from 0% to 100% of design flow while rotating the valve through 90 degrees. Actuators shall provide a close-off rating of 200 psig. Actuators shall be 24 VAC and accept either 4-20mA or 0-10VDC. Actuators shall include spring return feature, adjustable direction of rotation, overload protection and a maximum full stroke time of 100 seconds. All electrical components of the actuator shall be housed inside a water resistant enclosure. Actuators shall be manufactured by Belimo or accepted equivalent. For valve actuators installed outdoors, furnish weather enclosure.

PART 3 - EXECUTION

Project Management:

Provide a project manager who shall, as a part of his duties, be responsible for the following activities:

Coordination between this Contractor and all other trades, Owner, local authorities and the design team.

Scheduling of manpower, material delivery, equipment installation and checkout.

Maintenance of construction records such as project scheduling and manpower planning and AutoCAD or Visio for project co-ordination and as-built drawings.

Coordination/Single point of contact

Installation Methods:

Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications.

The term _control wiring_ is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devices provided under this section.

Line voltage wiring to control system power supplies, except dedicated power supplies to the AHU DDC panels, shall be obtained from spare circuits in electrical panels and shall be the responsibility of the BAS Contractor. Power supplies for AHU controllers shall be obtained through control transformers furnished in the AHU Control Panel by the AHU manufacturer. Coordinate specific power requirements.

Line voltage control wiring shall be installed in conduit in accordance with applicable Division 16 Sections.

Control wiring in mechanical rooms, outdoor locations, above ceilings and concealed within walls shall be installed in conduit. Do not install control wiring in same conduit as power wiring.

All Controllers, Relays, Transducers, etc., required for unique systems control shall be housed in a NEMA 1 enclosure with a lockable door.

System Acceptance:

General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.

Field Equipment Test Procedures: DDC control panels shall be demonstrated via a functional end-to-end test. Such that:

All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.

All analog input channels shall be verified for proper operation.

All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displayed value.

If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.

Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.

Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.

As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval by the Engineer of Record. After receiving final approval, supply six (6) complete 11x17 as-built drawing sets, together with AutoCAD or Visio diskettes containing the electronic drawing files, to the Owner.

Operation and Maintenance Manuals: Submit three copies of operation and maintenance manuals. Include the following:

Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.

An operator's manual that will include detailed instructions for all operations of the system.

A programmer's manual that will include all information necessary to perform programming functions

Flow charts of the control software programs utilized in the DDC system.

Flow charts of the custom software programs utilized in the DDC system as approved.

Complete program listing file and parameter listing file for all programs.

A copy of the warranty.

Operating and maintenance cautions and instructions.

Training:

Contractor shall provide to the engineer a training class outline prior to any scheduled training of the Owners personnel.

Factory trained control engineers and technicians shall provide training sessions for the Owners personnel.

The control contractor shall conduct training courses for the designated Owner’s personnel in the maintenance and operation of the control system. Classes shall be for no longer than four hours each and shall be conducted upon system completion. Training services shall be provided as necessary up to a maximum of eight hours. Additional training shall be made available as necessary.

The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:

HVAC system overview
Operation of Control System
Function of each Component
System Operating Procedures
Programming Procedures

Maintenance Procedures

Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owners personnel in making program changes and in adjusting sensors and controls to suit actual conditions

Sequence of Operation:

The sequence of operation is indicated on the drawings.

END OF SECTION 15900

SECTION 15990 - TESTING, BALANCING, AND COMMISSIONING OF HVAC SYSTEMS

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.

TESTING, BALANCING, AND COMMISSIONING OF HVAC SYSTEMS:

Selection: The Construction Manager or Contractor, herein referred to as Contractor, shall procure the services of, and have a contract with, an independent Test, Balance, and Commissioning Agency (Agency), which specializes in the balancing, testing, and commissioning of heating, ventilating, and air conditioning systems. The Agency shall balance, adjust, and test air moving equipment, air distribution, and exhaust systems, and temperature control equipment as herein specified and shown on the drawings.

The Contractor shall award the test, balance and commissioning contract to the Agency as soon as possible to allow them to schedule the work in cooperation with other trades and to meet the completion date.

Work performed under those sections in Division 15 is herein referred to as the Installer. Refer to specific items of work provided by each installer, and outlined in this section, "MECHANICAL CONTRACTORS RESPONSIBILITIES". Installers shall cooperate with the Agency as required during execution of the work under this section.

The Agency shall inspect all work under the above sections as it relates to work under this section and report in writing to the Contractor and Architect any deviations from plans and specifications that will affect the performance of the systems.

AGENCY QUALIFICATIONS

The Agency shall be a member in good standing with The Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) and shall provide AABC National Project Certification Performance Guaranty or equivalent to the Owner. The Agency must be totally independent, having no affiliation with any contractor, design engineer, or equipment manufacturer/supplier of HVAC related equipment.

The Agency shall have a fully staffed office and have been regularly
engaged in the testing, balancing, and commissioning of heating, ventilating, and air conditioning systems.

The Agency shall have a Florida Registered Professional Engineer on its staff.

All instruments used shall be accurately calibrated within six months of balancing and maintained in good working order. If requested, the test shall be conducted in the presence of the Architect/Engineer and/or his representative.

AGENCY SUBMITTALS

Provide a plan review within thirty days upon receipt of contract. The plan review should include comments and recommendations on any discrepancies that may hinder balancing. This plan review shall be transmitted directly to the Contractor.

Submit to Contractor, equipment start-up forms. After receipt from the contractor of the submittal data, forms will be transmitted by the Agency to the Mechanical Contractor for use in equipment start-up. The completed forms will be turned over to the Agency prior to the beginning of the test and balance phase.

AGENCY INSPECTIONS AND TESTS

Perform Final Test & Balance work associated with the HVAC system as described herein.

A minimum of one after-occupancy inspection shall be made within 90 days of the final test and balance. At this time, any minor adjustments shall be made for occupant comfort. Major problems, which will require major readjustments, shall be addressed to the Architect / Engineer prior to any readjustments. Any alterations to the final test and balance report shall be transmitted as a revised report to the Owner / Architect / Engineer.

Provide for checking balance during opposite season (if tested in winter, recheck and update data during summer and vice versa). Report in writing new and revised data collected during opposite season testing.

AGENCY GUARANTEE AND REPORTS

Provide AABC National Project Certification Performance Guarantee or equivalent.

Include a one year warranty commencing after acceptance of final test, balance, and commissioning work, during which time the Owner, at his discretion, may request a recheck or resetting of any equipment or device listed in test report.

Provide five copies of tabulated report in neatly organized typed form with AABC approved minimum data, within fifteen working days after completion of test. Report will include start-up reports and drawings to coincide with the test report. All commissioning tests will be included in a separate report format. In addition, all reports shall incorporate a summary page(s) which shall include:

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

CONTRACTOR'S RESPONSIBILITIES

Final testing, balancing and commissioning of the HVAC systems shall be performed as specified above. It is the responsibility of the Mechanical Contractor to be completely familiar with all the provisions and responsibilities of the Agency, and to provide such certification, cooperation, and support required.

HVAC systems will not be accepted as complete, or the project accepted as substantially complete, until such time as the Agency reports that the HVAC systems are operating within acceptable limits, are in accordance with the contract documents, and are in receipt of approved duct leakage reports.

The Contractor shall repair all deficiencies noted by the Agency in a timely manner. The Agency will notify the contractor in writing, on a daily basis, of any deficiencies discovered and Contractor will notify the Agency in writing when the repairs are made. The cost for extra re-testing by the Agency due to un-repaired items that were certified as repaired, will be the responsibility of the Contractor.

The Mechanical Contractor shall:

Provide adequate time in the construction schedule to perform the Testing & Balancing and Commissioning work.

Notify the Architect / Engineer and the Agency immediately after the installation of work related to the HVAC is started.

Provide test openings as required for testing and balancing HVAC systems.

Provide updated job schedule and timely notice prior to scheduled events.

Provide test openings and temporary end caps or otherwise seal off ends of ductwork to permit leakage testing prior to installation of diffusers, grilles, and similar devices.

Make preliminary tests to establish adequacy, quality, safety, completed status, and satisfactory operation of HVAC systems and components. The systems shall be free of electrical grounds and short circuits.

Perform duct leakage tests, in the presence of the agency, on all supply, return, outside air make-up systems.

Within the intent of the contract documents, provide, at the request of the Agency, all equipment, material, supplies, workmen, and supervisions necessary to provide a satisfactory, operating system.

During the test and balance period, operate all HVAC equipment as necessary to permit systems to be tested and balanced as fully operating, functional systems.

Remove and replace equipment, lights, or other items which obstruct testing and balancing operations. Where equipment, lights, or other items will interfere with future adjustments of the HVAC system, such equipment, lights, or other items shall be relocated as directed by the Architect / Engineer.

Provide completed start-up forms on each piece of equipment.

Replace belts and drives as required for proper balancing. Drives shall be adjusted and aligned to prevent abnormal belt wear and vibration.

Adjust fan speed to full load motor amperage, but, not over full load.

Open all manually adjustable dampers and test dampers for smooth, vibration-free operation.

Verify that all controls are installed and operating in accordance with the control sequence of operation.

Before requesting final testing and balancing, submit signed statement that HVAC systems are installed, adjusted, fully lubricated, operating satisfactorily, and are ready for use.

AGENCY'S RESPONSIBILITIES

Air Balance: The Agency shall perform the following tests, and balance system in accordance with the following requirements:

Record minimum data required by AABC forms.

Test and adjust fan rpm to design requirements.

Test and record motor full load amperage/voltage and operating amperage/voltage.

Make pitot tube traverse of main supply, return, OA and obtain design cfm at fans (where possible).

Test and adjust system for design cfm recirculated air.

Test and adjust system for design cfm outside air.

Test and record system static pressure profile.

Adjust all main supply and return air ducts to proper design cfm.

Adjust all zones to proper design cfm, supply, return.

Provide suggestion/corrective measures pertaining to performance related issues.

Test and adjust fan to within 100%-110% of design.

In cooperation with the controls contractor, set adjustments of automatically operated dampers to operate as specified, indicated, and / or noted.

Check all controls for proper calibrations, and list all controls requiring adjustment by control installers. A software point by point check-out and test, along with verification forms, will be required.

Advise Mechanical Contractor in writing of all ductwork that shall be repaired to reduce air leakage. Retest to confirm minimum allowable leakage. The cost of retest of failed systems will be the responsibility of the Mechanical Contractor.

Controls Testing: Test and record control temperature or pressure readout of each device and compare to actual measured condition. Include in report.

Test Each Sequence Of Operation for all systems to verify proper operation. Include description of operation in report.

Record The Dry Bulb Temperature in each space and in addition, record a wet bulb temperature at each thermostat or sensor.

Deficiencies: All deficiencies shall be noted by the Agency in a field report and submitted to Contractor and the Architect on a daily basis.

Upon Correction of the Deficiency, the Contractor shall notify the Agency in writing that the problem is resolved. If the deficiency is not corrected, the Contractor will be responsible for the cost of additional re-testing.

Equipment: All information required as shown, but not limited to, shall be compiled in a neat, orderly, itemized format on 8½" x 11" test forms. The following data shall be submitted to the Owner through the Contractor. This data is the minimum required data except where specified standard (i.e. AABC) requires additional data. In addition, any HVAC equipment specified for the project, but not indicated below, is required per AABC form.

Air Handlers and Rooftop Units:

Mark number
Unit manufacturers and model number
Total supply air cfm and rpm - specified and actual
Return air cfm - specified and actual
Outside air cfm - specified and actual
Unit static pressure profile, including total fan static
Specified total and external static pressure
Coil pressure drop, and entering and leaving temps - specified and actual
Coil - entering and leaving air DB/°F and WB/°F - specified and actual
Outside air DBF and WBF at time of test
Voltage, phase, and cycle specified load conditions
Btu per hour at test conditions
Btu per hour when converted to specified load conditions

END OF SECTION 15990

SECTION 16010 - GENERAL PROVISIONS

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.

DEFINITIONS AND REQUISITES

The term Engineer shall be defined as Long & Associates, Architects/Engineers, Inc., Tampa, Florida.

The term provide shall mean furnish and install.

The phrases where shown or where indicated refer to Drawing items.

The phrase or equal shall mean equivalent as approved by the Engineer.

Division 16 specification Sections are interrelated and what is called for by one section shall be deemed as required by the other sections. An individual Section that lists other specific Sections as RELATED DOCUMENTS is done so for the convenience of the reader and is not to be construed as the only related Sections.

PART 2 - PRODUCTS

Throughout the Specifications, types of material may be specified by manufacturer's name and catalog number in order to establish standards of quality and performance and not for the purpose of limiting competition. Unless specifically stated otherwise, the Bidder may assume: or equivalent as approved by the Engineer. However, the burden is upon the Bidder to prove such equivalence. He must request the Engineer's approval (in writing) to substitute such item for the specified item, with supporting data (and samples, if required) to permit a fair evaluation of the proposed substitute with respect to quality, serviceability, warranty and cost. Submit proposed substitutions to the Engineer no later than ten (10) days prior to bid date in accordance with Division “1” Specification sections.

PART 3 - EXECUTION

The work to be done under this Section of the Specifications shall include the furnishing of all labor, material, equipment and tools required for the complete demolition (where required and indicated) and the installation of systems for power, signals and all other work indicated on the drawings or as specified herein. All fire alarm system work shall be provided by Siemens, the Contractor currently servicing the facility. Include their cost in the bid.

Where indicated, equipment shall be disconnected and associated disconnects, starters and other accessories removed for relocation. Where indicated, re-install such devices and re-connect the equipment and restore operation. Provide new cords and plugs where necessary.

All materials and appliances, obviously a part of the electrical systems and necessary to its proper operation, but not specifically mentioned or shown on the drawings, shall be furnished and installed without additional charge.

The Drawings and Specifications are complimentary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be bid, and the Engineer shall be notified of the discrepancy.

HANDLING OF MATERIALS

Receive and accept at the site, properly handle, house and protect from damage and the weather until ready for installation all materials, equipment and apparatus furnished under this Section of the Specifications.

Equipment damaged in the course of handling, installation or test shall be replaced or repaired to the satisfaction of the Engineer without any additional charge.

EXAMINATION OF SITE

Each bidder shall visit the site of the project to acquaint himself with the difficulties which may attend the execution of work as shown on the drawings and as specified herein. The submission of the Bid proposal shall be construed as evidence that such a visit and investigation has been made. Claims for labor, equipment or materials required for difficulties encountered shall not be considered.

ELECTRICAL DRAWINGS

Drawings are generally diagrammatic and show the arrangement and location of fixtures, equipment and conduit. Carefully investigate the structural and finish conditions affecting this work and arrange this work accordingly. Should conditions on the job make it necessary to rearrange conduit or equipment, so advise the Engineer and secure approval before proceeding with such work.

Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, request shop drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured.

COORDINATION OF THE WORK

Check the drawings of the various trades before submitting a bid and be responsible, under this Section of the Specifications, for the proper coordination of the Electrical work with the installations under other Sections for clearances. Any changes required to avoid interferences shall be submitted to the Engineer for approval and shall be made as approved, without additional cost to the Owner.

Examine the drawings for the location of suitable openings and aisles for the passage of equipment to be installed under this Section. The Contractor shall be responsible for having suitable openings, blockouts and aisles left open until equipment has been properly installed.

REMOVAL OF MATERIALS

Disposal costs shall be borne by the Contractor and included in his bids. No electrical devices, wire conduit, or equipment shall be re-used unless otherwise noted on the drawings.

SUBSTITUTIONS

Where equipment is identified by manufacturer and catalog number, it shall be construed as the minimum base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Contractor may submit for approval, similar equipment of other manufacturers as substitution. The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding. See APPROVAL OF SYSTEM AND EQUIPMENT.

All changes necessary to accommodate the substituted equipment shall be made at the Contractor's expense, and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted to the Engineer for approval.

If substitutions are made in lieu of equipment specified, form, dimension, design and profile shall be submitted to the Engineer for approval. All substitutions shall be made only in accordance with Division "O" specifications and contract requirements.

RECORD DRAWINGS

Provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract drawings, including changes in sizes, locations and dimensions. Changes in circuitry shall be clearly and completely indicated as the work progresses.

These progress prints shall be available for inspection by the Engineer and shall be used to determine the progress of electrical work.

General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

Record Drawings: Maintain and submit one set of blue or black-line white prints of Contract Drawings and Shop Drawings. Submit record documents in accordance with Division "O" specifications and contract requirements.

Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity to prepare the marked-up Record Prints.

Give particular attention to information on concealed elements that cannot be readily identified and recorded later. Include dimensioned location of underground conduits.

Accurately record information in an understandable drawing technique.

Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

Mark Contract Drawings or Shop drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

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

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

Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

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

Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

Note related Change Orders, record Drawings, and Product Data, where applicable.

Miscellaneous Record Submittals: Assemble miscellaneous records required by other specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference."

APPROVAL OF SYSTEM AND EQUIPMENT

Submit for approval, details of all materials, equipment and systems to be furnished under this section in accordance with Division "1" Section 01300 - Submittals. Submittal package shall include all materials, equipment and systems indicated below:

1. Submit a listing of all the materials indicated below, with the type of material, manufacturer and catalog or model number for each.

   Junction Boxes
   Wireways
   Raceways
   Nameplates
   Outlet Boxes
   Fuses
   Wire and Cables

2. Submit complete shop drawings of the following:

   U.L. listed fire stopping assemblies and products.
   Individual Motor Starters and Controllers
   Wiring Devices and Plates

Disconnect Switches
Motor Starter/disconnect switches
Fire Detection and Alarm System Components

See individual specification sections for form and content of each shop drawing submittal. Facsimile copies shall not be acceptable.

One manufacturer shall be selected for any specific classification of material, equipment or systems. For example, all starters, disconnects, etc., one manufacturer. If more than one manufacturer is submitted, the Engineer shall select one and disapprove the others.

Any materials and equipment listed which are not in accordance with the specification requirements may be rejected. FAILURE TO SUBMIT WITHIN THE TIME LIMIT (30 DAYS) WILL BE CONSIDERED A CONTRACT VIOLATION and waiver of substitution rights and any subsequent submittal may be rejected.

The review of systems, equipment and shop drawings is a general review subject to the contract drawings, specifications and verification of all measurements at the job. Review does not relieve the Contractor from the responsibility of shop drawing errors. The Contractor shall carefully check and correct all shop drawings prior to submission for review. Each shop drawing submittal shall bear the stamp and signature of the Contractor indicating he has checked and corrected all shop drawings.

WARRANTY

SEE GENERAL AND SUPPLEMENTARY CONDITIONS AND GENERAL REQUIREMENTS.

OPERATING AND MAINTENANCE MANUAL

After completion of the work, furnish and deliver to the Engineer four (4) copies of a complete operating and maintenance manual. Each manual shall include one (1) copy each of all approved shop drawings, catalog pages, instruction sheets, operating instructions, installation and maintenance instructions, and spare parts bulletins. A system wiring diagram shall be furnished for each separate system, i.e. fire alarm.

ELECTRICAL TESTS

Furnish all labor, materials, instruments, supplies, and services and bear all costs for the accomplishment of the tests herein specified or requested at job site. Correct all defects appearing under test, and repeat the tests until no defects are disclosed, leaving the equipment clean and ready for use.

All grounds, crosses, shorts, etc., must be eliminated from the wiring. Test out all switches and controls; test the operation of all motors, controllers, and other electrical equipment devices. Each piece of equipment, including motors, and controls, shall be operated continuously for a period of not less than one (1) hour in the presence of the Engineer or his representative before acceptance.

SYSTEM AND HVAC COMMISSIONING

The electrical contractor shall provide an electrician, supervision and materials as required to assist the test and balance, mechanical contractor, and/or commissioning agent during the testing and start-up phases of the project. Such work may include, but not be limited to, providing or changing thermal overload elements or settings, demonstrating proper start-up and shut-down sequences of systems and equipment, de-energizing circuits as required for equipment access or observation, correcting fuse sizes

per code, operating fire alarm initiation devices and shut-down interfaces and other work as required to complete the start-up, verification of operation or completion of systems commissioning.

END OF SECTION 16010

SECTION 16020 - STANDARDS

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.

All materials and equipment furnished under this section shall be new and comply with the applicable standards of the following authorities, except where the contract documents prescribe more rigorous qualifications, the documents shall govern:

Florida Fire Prevention Code 201

.0

Florida Building Code 2014, Buildings
Florida Accessibility Code for Building Construction
ADA Accessibility Guidelines
Underwriters' Laboratories, Inc.
National Electrical Manufacturer's Association
Institute of Electrical and Electronic Engineers
American Society for Testing and Materials
American Standard Association
National Fire Protection Association (NFPA)
National Electrical Code, 2011
Occupational Safety and Health Act
Other codes as specified in individual sections of this division

CODE RULES AND WORKMANSHIP

The installation shall comply with the above codes and standards and all legally constituted authorities having jurisdiction. Where the drawings and/or Specifications exceed these requirements then the drawings and/or specifications shall take precedence.

The certificates of final inspection and certificates of approval of all authorities shall be delivered to the Engineer.

All work shall be executed and finished in a practical and workmanlike manner to the satisfaction of the Engineer and shall present a neat appearance when completed.

All work shall be readily accessible for operation, maintenance and repair after installation. Minor deviations from the arrangement indicated on the drawings may be made to accomplish the above, but if such changes are of "considerable magnitude", they shall not be made without the approval of the Engineer. (Considerable magnitude is as determined by the Engineer or greater than 10'-0" in any direction).

END OF SECTION 16020

SECTION 16030 - EXISTING CONDITIONS

PART 1 - GENERAL

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

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

Verify existing conditions and locations in field prior to submitting proposal. Failure to do so shall not relieve the Contractor from performing the work required under this contract.

EXISTING CONDITIONS

The project documents are diagrammatic in nature and indicate existing conditions based on casual observation and Owner's as-built documents.

END OF SECTION 16030

SECTION 16050 - BASIC ELECTRICAL 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.

Requirements specified in the following Division 16 Sections apply to this Section:

General Provisions
Supporting Devices
Existing Conditions

SCOPE OF WORK

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

Selective demolition including:

Nondestructive removal of materials and equipment for reuse or salvage as indicated.

Dismantling electrical materials and equipment made obsolete by these installations.

Excavation for underground raceways.

Miscellaneous metals for support of electrical materials and equipment.

QUALITY ASSURANCE

Installer Qualifications: Engage an experienced Installer for the installation and application of joint sealers, and equipment.

SEQUENCE AND SCHEDULING

Coordinate all work with other trades and the Owner.

PART 2 - PRODUCTS

Fire-Resistant Joint Sealers: Use listed products formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Provide fire stopping “putty pads” around the exterior of junction boxes in rated walls. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters; Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

Submit U.L. listed firestopping assemblies and products.

PART 3 - EXECUTION

Where conduits, cables, or boxes penetrate fire rated walls, ceilings, or floors, provide firestopping in accordance with the Florida Building Code.

The exterior of all junction boxes in rated walls shall be covered by moldable fire stop putty pads.

ERECTION OF METAL SUPPORTS AND ANCHORAGE

Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. When required, see project drawing detail for transformer trapeze mounting detail.

Fastening to Hollow Core Slabs: Refer to detail on project drawing for allowable fastening methods.

Attach to substrates as required to support applied loads.

Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical 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. All installations shall be a U.L. listed assembly.

EQUIPMENT IDENTIFICATION

Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

Engraved Plastic-Laminate Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners. Embossed tape or adhesive fastening will not be acceptable.

Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, non-fading, preprinted cellulose acetate butyrate signs with 20 gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4" grommets in corners for mounting.

Fasteners for Plastic Laminate and Metal Signs: Self-tapping stainless steel screws or number 6/32 stainless steel machine screws with nuts and flat and lock washers.

Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

Emergency Operating Signs: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

Install equipment/system circuit/device identification as follows:

Apply equipment identification labels of engraved plastic laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2" high lettering on 1 1/2" high label (2" high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

Electrical cabinets, and enclosures.
Motor starters.
Disconnect switches.
Duct detector housing.
Duct detector indicator stations.
Control devices.

Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

JUNCTION BOXES

Paint Junction boxes and covers to identify systems.

Fire alarm Red

All power and lighting junction boxes covers shall be legibly marked with the branch circuit conductors contained therein.

All receptacle outlets, switches and motor control enclosure cover shall be labeled with source circuit using 1/4" high printed labels, Brady or equivalent, black on yellow.

PANELBOARDS AND BUS DUCTS

All panelboard directories shall be copied and marked with revisions. Turnover marked copy to Owner for revision of records. Where a bus duct switch is abandoned by this work, it shall be left in place and marked as "spare" by printed Brady labels visible from the floor.

END OF SECTION 16050

SECTION 16111 - CONDUIT AND FITTINGS

PART 1 - GENERAL

RELATED DOCUMENTS

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

SCOPE OF WORK

The work of this section includes furnishing and installing complete raceway systems for all, power, signal and communications.

All raceway systems shall be complete with fittings, boxes or cabinets and necessary connections to result in a complete system.

APPLICATION

Except where otherwise specified herein electric metallic tubing may be used for receptacle and motor branch circuit conductors.

Rigid galvanized steel conduit and fittings shall be used in areas classified as hazardous by the National Electrical Code.

All raceways of a given type shall be the product of one manufacturer.

Couplings, connectors and fittings shall be of the types specifically designed and manufactured for this purpose.

U.L. Listed expansion/deflection fittings shall be used where any conduits cross structural expansion joints. Refer to structural Drawings for expansion joint locations.

PART 2 - PRODUCTS

CONDUIT

Rigid heavy wall steel conduit shall be hot dipped galvanized as manufactured by the Youngstown Sheet and Tube Co., Allied Tube and Conduit Corp., Wheeling-Pittsburgh Steel Corp., or equal.

Electrical metallic tubing shall be hot-dipped galvanized steel as manufactured by the Youngstown Sheet and Tube Co., Allied Tube and Conduit Corp., Wheatland Tube Co., or equal.

LIQUID-TIGHT METAL CONDUIT AND FITTINGS

Liquid-tight conduit shall be U.L. listed, flexible, fabricated of inter-locked galvanized strip steel, incorporating a copper bonding strip, and covered with a synthetic liquid-tight jacket.

Fittings shall be galvanized steel and suitable for providing conduit terminal with a liquid-tight seal.

An equipment grounding conductor sized in accordance with N.E.C. Table 250-122 shall be installed within the conduit to form a continuous solid metallic path.

Liquid-tight metal conduit shall be used for final connections to air handlers and motors. Conduit shall be mechanically secured per Code.

FLEXIBLE METAL CONDUIT

Flexible metal conduit shall conform to Underwriters' Laboratories Standards for flexible steel conduit.

Conduits shall not come in contact with ceiling grid or grid tiles.

Flexible metal conduit shall not be permitted as a grounding means. A grounding conductor shall be installed per specification Section 16480 - Flexible Conduit.

WIREWAYS

Wireways for general purpose shall be steel with both hinged and screw down cover. Wireways shall be U.L.

Listed as steel enclosed wireway and auxiliary gutter. Finish shall be baked enamel or galvanized.

Wireways installed in damp or wet locations shall be raintight type with drip shield cover and constructed of 16 gauge galvanized steel and finished with baked enamel finish over a rust inhibiting primer. Wireways shall be U.L. Listed as Steel Enclosed Wireways and Auxiliary Gutter.

FITTINGS

Steel elbows and couplings shall be hot-dipped galvanized.

EMT fittings shall be compression type as manufactured by the Appleton Electric Co., Crouse-Hinds Company, Steel City, O.Z. Manufacturing Co., or equal.

PART 3 - EXECUTION

Runs shall be straight and true, offsets and bends shall be uniform and symmetrical.

Connections to control and interlock devices subject to vibration or movement shall be as indicated above for motors.

All conduit stub-ups shall be installed plumb and flush to mounting surface if installed against a wall or column. None of the conduit bend shall be exposed. All conduit stub-ups not properly installed shall be corrected at the Contractor's expense including any additional concrete work.

Couplings, connectors and fittings shall be types specifically designed and manufactured for the purpose.

Conduits shall be of such size and shall be so installed that the required conductors may be drawn in without injury or excessive strain to the conduit or conductors. Where size is not given, the latest issue of the National Electrical Code shall be followed.

All conduits not properly capped immediately after installation shall be cleaned with a wire brush 1/2" larger than the bore of the conduits. The wire brush shall be passed through the conduits in order to remove all foreign matter. If obstructions are found which cannot be removed by cleaning, the conduits shall be removed and reinstalled.

Conduit work shall be concealed in all finished portions of the building and elsewhere where practicable, unless otherwise noted.

Conduits shall not cross pipe shafts or vent duct openings, but shall be routed to avoid such present or future openings in floor or ceiling construction.

Conduit runs shall be laid out and installed to avoid proximity to steam and hot water pipes. Conduits shall be kept a minimum of 3" from such pipes, except where crossings are unavoidable, then the conduit shall be kept at least 1" from the covering of the pipe crossed.

The use of running threads is prohibited. Where such threads appear to be necessary, a 3 piece union shall be used.

All galvanized rigid steel and intermediate metal conduits entering sheet metal boxes (i.e. junction boxes, pull boxes, panelboards, etc.) shall be secured in place with one (1) galvanized steel bonding type locknut.

All E.M.T. entering sheet metal boxes (i.e. junction boxes, pull boxes, panelboards, etc.) shall be secured in place with a compression connector and a locknut as manufactured by steel City. Insulated connectors or insulated bushings shall be used when #4 AWG or larger conductors are pulled through fitting per NEC Article 300-4(f). Insulating material shall be minimum 105 degrees C rated. Field installable inserts shall be acceptable.

Conduit shall be run parallel or perpendicular to walls, beams or columns, whether above suspended ceilings or in exposed structure areas.

Conduit Sizes	Spacing of Supports in Feet
Up through 1"	6
1-1/4" and 1-1/2"	8
2" through 4"	10

Horizontal or cross runs in building type partitions or sidewalls shall be avoided. All conduit to outlets in building type partitions shall run down from ceiling into partition. Provide listed conduit clips at every stud location to secure conduits routed horizontally thru wall studs.

All conduits shall be securely fastened to walls or the building structure. Under no circumstances shall conduits be fastened to suspended ceilings or the suspension system for a suspended ceiling. “Wire ties” shall not be permitted to fasten or secure conduits, use listed clips or clamps.

All conduits shall be securely fastened within 36" of each outlet box, junction box, cabinet or fitting.

A conduit expansion/deflection fitting shall be installed in each conduit run wherever it crosses an expansion joint in the concrete or steel structure. The expansion fittings shall be installed on one side of the joint with its sliding sleeve end flush with the expansion joint and with a length of bonding jumper in the expansion joint equal to at least three times the nominal width of the joint.

A conduit expansion/deflection fitting shall be provided in each conduit run which is mechanically attached to separate structures to relieve strain caused by shifting of one structure in relation to the other.

All empty conduits shall include a 200 pound minimum nylon pull line and be labeled as to source and capped.

For conduit runs in excess of 100 feet in length, provide an appropriately sized pull box every 100 feet.

END OF SECTION 16111

SECTION 16117 - FASTENINGS

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.

PART 2 - PRODUCTS

As indicated herein.

PART 3 - EXECUTION

Except where otherwise shown or specified, the following shall be observed throughout the work:

Fastenings to wood shall be made with long wood screws or lag screws.

Fastenings to brickwork masonry or concrete shall be made with the use of approved expansion bolts or inserts, or self-drilling Bulldog type anchors and drive pins. Inserts shall be of the type to receive machine bolt head or nut after installation. Plastic inserts will not be acceptable.

Under no circumstances shall fastenings be made to the underside of the roof deck.

The use of wood plugs and nailing will not be permitted.

Perforated iron for supporting will be permitted only as noted on drawings. Fastenings to steel structures and iron work shall be made by the use of granular flux filled welded studs or mechanical supports similar to "C" clamps and/or pipe straps. All supports for transformers, and conduits 2" and larger, suspended from structural bar joists, shall be fastened at the bar joist panel points. Equipment shall not be hung from bar joist bridging.

Powder activated fasteners shall not be permitted for use on precast concrete panels or columns. Powder activated fasteners shall only be used where permitted by the structural engineer.

"C" Clamps may be used as a means of fastening horizontal runs of conduit to purlins, deep steel members and the upper sections of column flanges. The use of "C" type clamps will not be permitted as a means of permanent support of vertical conduit risers at columns.

One-hole push-on conduit straps shall be used where conduits are exposed on walls or columns. Minerallac straps with bolt (conduit clamps) and "Caddy Fasteners" shall not be installed on walls or columns.

Raceways shall not be fastened or clipped to ceiling grid support wires. “Wire ties” shall not be acceptable.

Steel channels and flat iron should be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc., for a rigid installation.

Miscellaneous steel for the support of fixtures, boxes, transformers, starters, panels and conduit shall be furnished and installed. Steel supports may be welded in place in accordance with applicable sections of the American Welding Society.

Approval must be received from the Engineer before welding to any structural member.

The installation of all fastenings and inserts shall be included as part of the work under this Section of the Specifications.

END OF SECTION 16117

SECTION 16118 - CONDUIT SLEEVES

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.

SCOPE OF WORK

Furnish and install all required sleeves and fireproofing material for raceways and cables penetrating floors, walls, foundations, etc. and locate all necessary slots for electrical work before concrete is poured.

PART 2 - PRODUCTS

Exterior Membrane Openings: Provide sleeves passing through exterior membrane waterproofed above grade walls, floors, and roof with integral flashing flange and clamping ring. Make conduit watertight in sleeve with oakum packing and caulked lead joint. Materials used shall be compatible with roofing materials.

Fire Rated Assemblies: Sleeves in slabs or in fire rated walls shall be sealed the full depth of wall or floor with an intumescent material and caulked at ends with an intumescent compound. Provide a watertight seal at top of sleeves in slab. Seal off excess areas of openings around conduit and cable risers at each floor slab. Provide fire safing construction which has the same fire rating as the work penetrated. Use fire barrier caulk, putty, strip or sheet. All installations shall be a U.L. listed assembly.

In machine or HVAC equipment room sleeves: Set sleeves with their top end set at least five inches above finished floor. In addition, where sleeves pierce slabs or walls separating such rooms from Office Areas or other quiet areas, sleeves shall be packed with Fiberglass Insulation to prevent noise transfer.

Provide flashing fittings for passing through roofs, set at a suitable level above the roof to terminate the base flashing. Arrange conduit passing through the roofs to be a minimum of twelve inches from walls or other obstruction so as to permit proper flashing. Flashing system shall be compatible with roof system materials.

Roof penetrations shall only be used where permitted by the Architect or Engineer. Submit proposed systems for review. Pitch pockets are not permitted.

Where more than two conduits go through a drywall rated fire wall and if the conduits are within 6" outside to outside of each other, rectangular hole in the wall shall be cut out. The hole shall be lined with a sheet metal collar. The cavity shall be completely packed with fireproof insulation. Each side of the hole shall be covered with a split sheet metal cover with proper size pre-punched holes for whatever conduits penetrate the wall.

When this division cuts a hole in the floor slab for any reason, there shall be a curb or sleeve installed so that water to a depth of 2-1/2" will not run through the hole except where cores are made in office areas for power or signal monuments.

PART 3 - EXECUTION

Necessary openings for this work must be built into the floors and walls. Minimize cutting of walls and floors.

Fireproofing material shall be installed in accordance with manufacturer's installation recommendations.

Where conduit, cables or boxes penetrate fire rated walls, ceilings or floors, provide firestopping in accordance with standards and using U.L. listed assemblies.

END OF SECTION 16118

SECTION 16120 - WIRES AND CABLES - 600 VOLTS MAXIMUM

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.

All wire and cable systems necessary for a complete installation and wiring and connecting of all electrical equipment and devices shall be provided complete as specifically called for herein or on the Drawings.

PART 2 - PRODUCTS

Conductors shall be of annealed, 98 percent conductivity, soft drawn Copper and manufactured by Cablec, ITT Royal Electric, Okonite, Rome, American Insulated Wire Corp. or equal. Conductors will be used as indicated in this section.

Only U.L. approved lubricants may be applied to the wire during the pulling-in process.

All conductors shall be copper.

Insulation shall be 600 volt and shall conform to the following Underwriter's Laboratories approved types and specifications:

ABOVE GRADE

Branch Circuits - Type THHN or XHHW

Signal Systems - minimum #14 AWG - Type THHN unless otherwise specified by the equipment manufacturer

WET LOCATIONS

Branch or Feeder Circuits: Type XHHW or THWN

The outer jacket of all interior branch wiring and cable systems irrespective of any Local or National Code that now allows decoding shall be color coded to denote polarity as follows:

208/120V SYSTEM		480/277V SYSTEM	
Phase A	Black	Phase A	Brown
Phase B	Red	Phase B	Orange
Phase C	Blue	Phase C	Yellow
Neutral	White	Neutral	Grey
Equip.Grounds	Green		

All wire and cable not properly color coded shall be removed and replaced. No wire smaller than No. 12 AWG shall be used for power and no wire smaller than No. 14 AWG shall be used in any control or signal circuit, unless smaller wire is specifically called for herein or on the Drawings.

Grounding conductors up through #6 AWG shall have continuous color code insulation. Grounding conductors larger than #6 AWG may be identified with tape as described for ungrounded conductors. Colored taping for #6 or smaller shall not be acceptable per NEC250-119.

Branch circuit homeruns exceeding (100 feet in length for 120 volt circuits and 200 feet for 277 volt circuits) shall be No. 10 AWG minimum or as indicated on the Drawings.

Provide solid or stranded conductors No. 14 through No. 10. Provide stranded conductors No. 8 and larger.

PART 3 - EXECUTION

Conductors shall be continuous from outlet to outlet and no splices shall be made, except within outlet or junction boxes.

The use of Non-metallic sheath multi-conductor cable (Romex) shall not be permitted.

Armored multi-conductor type N.F.U. Type (AC) (BX) and (MC) shall not be permitted.

Wire colors other than those specified will be considered only if approval is sought in writing.

All feeder, branch circuit or auxiliary system wiring passing through pull boxes and or being made up in panels, switchboards, distribution panels and/or terminal cabinets shall be properly grouped, bound and tied together in a neat and orderly manner, with "TY-Raps". Loose ends of the "TY-Raps" shall properly cut after making up separate wire bundles. "TY-Raps" shall be manufactured by Thomas & Betts or approved equal. Branch circuit and auxiliary system wiring shall be extended out of the wiring gutters of the terminal cabinets and panels at 90 deg. to breaker terminal lugs.

Conductors shall be installed in a manner which will not injure their insulation or covering. The bending radius for jacketed cabled shall not be less than six times the outside diameter of the cable. Conduit, or wireway run shall be complete before any conductors are installed therein. All burrs and rough spots shall be removed before the cables are installed in order to prevent any damage to the cable insulation.

END OF SECTION 16120

SECTION 16121 - COPPER WIRE/CABLE CONNECTIONS 600 VOLT AND 250 VOLT SYSTEMS

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.

PART 2 - PRODUCTS

INDOORS

Wire and cable connectors for #10 AWG and smaller shall be of the pressure indent type with an insulating cover equal to Thomas and Betts Co., Sta-Kon or of the pre-insulated, permanent pressure, electrical spring connector type encased in a metal housing and insulating cover equal to Scotchlock Type "R" of the Minnesota Mining and Manufacturing Company.

Wire and cable connectors for #8 AWG and larger shall be of the split bolt type. Connections shall then be insulated with vinyl mastic pads Scotch Series 2100, or insulating compound, then taped with 3 wraps of Scotch 33 vinyl plastic tape. #1/0 AWG cables and larger shall be fastened with a connector requiring two (2) bolts, then insulated and protected as noted for the single bolt connector.

All motor leads shall be connected to their respective branch circuits via nylon self-insulated ring "STA-KON" terminals, as manufactured by Thomas and Betts, bolted together. Connection shall then be protected and insulated as indicated in paragraph above.

PART 3 - EXECUTION

Solderless connectors shall be used for connecting and splicing all conductors regardless of size.

Resultant insulation over a splice or tap shall provide a dielectric level equal to that of the conductor insulation.

END OF SECTION 16121

SECTION 16131 - OUTLET, PULL AND JUNCTION BOXES

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.

PART 2 - PRODUCTS

OUTLETS

Each outlet and/or fixture in the wiring or raceway systems shall be provided with an outlet box to suit the conditions encountered.

Boxes installed where they are exposed, in normally wet locations shall be of the cast-metal type having threaded hubs. Concealed boxes shall be of the cadmium-plated or zinc-coated sheet metal type.

Each outlet box shall have sufficient volume to accommodate the number of conductors entering box in accordance with the requirements of the National Electric Code.

Boxes shall be not less than 1-1/2 inches deep unless shallower boxes are required by structural conditions.

Ceiling and bracket outlet boxes shall not be less than 4 inch octagonal. Flush or recessed fixtures shall be provided with separate junction boxes where required by the fixture terminal temperature requirements.

Switch and receptacle boxes installed in concealed locations shall be provided with the proper type extension rings or plaster covers where required to set flush with the finished surfaces of the walls, ceilings and floors.

All boxes shall be installed in a rigid and satisfactory manner and shall be supported by bar hangers in frame constructions or shall be fastened directly with bolts with expansion shields in concrete or brick, toggle bolts on hollow masonry units, and machine screws or welded threaded studs on metal.

Provide outlet box far side supports for all outlet boxes mounted in stud walls. Steel City Cat. No. SS-1 or equivalent.

Plaster rings shall be provided for square boxes where required. Box edges shall be within ¼" of finished wall surface per NEC 314-20. Field installed "spark rings" shall not be acceptable. All boxes not in compliance shall be cut-out, removed and re-installed to comply with the code and requirements listed herein.

All switch outlets, junction or pull boxes shall be rigidly secured, set, plumb and straight. Provide any special fittings necessary for proper conduit connections.

Floor outlets shall be watertight with cast iron boxes and forged brass covers with adjustable angular and vertical leveling features and shall house the electrical device and fitting required for the installation.

All empty boxes shall be provided with a flat blank cover.

Boxes installed outdoors shall be provided with cover gaskets of neoprene or other approved material.

Screws for boxes shall be made of corrosion resisting material electrochemically compatible with adjacent materials.

Outlet boxes for general use surface mounted in non-classified unfinished locations shall be manufactured by RACO, type 191, one piece pressed steel with rounded corners. Covers shall be Appleton Series 8360, 8361, 8365 or 8379.

Outlet boxes for wet locations shall be surface mounted and shall be of the cast metal type manufactured by Crouse-Hinds, Appleton, Red Dot or Russell and Stoll with gasketed cover and threaded fitting inlets. Where mounted to the exterior of the RTU, they shall be located only on non-removal panels and shall be sealed. After the installation of conductors, install pliable electrical duct putty to seal conduit.

Outlet boxes for general use flush mounted in concrete walls and metal or wood stud walls in non-classified areas shall be manufactured by Steel City, Appleton or RACO.

Outlet boxes in hazardous rated locations shall be so listed for the application.

PULL AND JUNCTION BOXES

Shall be installed where shown on the drawings and/or as required by Code and as required to facilitate pulling of wires and cable without damaging the insulation and stretching at conductors. Where conduit runs exceed 100 feet, provide an appropriately sized pull box every 100 feet.

Pull and junction boxes shall be constructed of code gauge galvanized sheet metal, of not less than the minimum size required by Code and shall be furnished with screw fastened covers, boxes exceeding 48" in any direction shall be properly reinforced with angle iron stiffeners.

All pull and junction boxes of standard manufacturer’s trade sizes shall be manufactured by Hoffman or approved equal.

NON-METALLIC JUNCTION BOXES

In specific locations as shown on the drawings all exposed junction boxes associated with a specified non-metallic raceway system shall be installed. All junction, device, and backboxes shall be U.L. listed to 600 Volts and be mechanically screw fastened to the wall or supporting surface, non-metallic boxes shall be as manufactured by the raceway system for use therewith. Color shall match raceway system. All boxes shall have color matching non-metallic covers.

PART 3 - EXECUTION

GENERAL

Location of outlets shown on drawings are approximate. Study the building plans in relation to the spaces and equipment surrounding each outlet so that receptacles, switches are symmetrically located and mounted in and/or on the walls, ceiling and floor.

The locations of all wall switch boxes shall be coordinated with the Architectural drawings before installation of same. All switch boxes unless specifically noted otherwise on the drawings shall be opposite the hinged side of the door for all single doors.

Boxes shall not be installed back-to-back in walls. Provide not less than 6" horizontal separation.

All conduits to roof mounted equipment shall be routed within the rooftop equipment curb.

GROUNDING

Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with grounding and bonding requirements. See Section 16480 - GROUNDING SYSTEMS.

END OF SECTION 16131

SECTION 16180 - SAFETY TYPE DISCONNECT SWITCHES

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.

All safety type disconnecting switches indicated on the drawings, specified or required by the National and/or State Electrical Code shall be furnished and installed under this Section unless noted as being furnished under other sections, in which case they shall be installed under this section. Switches shall be externally operable. If the size is not shown on the drawings, subcontractor shall size the disconnect switch in accordance with the nameplate data and horsepower of the equipment they serve.

PART 2 - PRODUCTS

Safety type disconnecting switches shall be heavy duty industrial type with quick-make, quick-break mechanism and interlocking cover which normally cannot be opened when the switch is in the "ON" position. Switches shall be single throw, fusible switches shall be equipped with U.L. Class R fuse clips to receive Class RK1 or RK5 and reject all other Classes. Switches shall have provision for padlocking in the open and closed positions.

Switches shall be in general purpose enclosures NEMA-1 for indoor installations and watertight enclosures, NEMA-3R for all outdoor installation.

Disconnecting switches shall be as manufactured by GE, Cutler-Hammer, Square D, or Siemens.

PART 3 - EXECUTION

All safety type disconnect switches indicated on the drawings, specified or required by the National, or local Electrical codes shall be furnished and installed.

Switches shall be installed readily accessible such that center of operating handle grip is not greater than 6'-0" above floor or working platform. All disconnect switches mounted above 6'-0" shall be hook stick operable.

Submittals shall clearly indicate voltage, phase, enclosure type and fuse clip class.

END OF SECTION 16180

SECTION 16181 - FUSES

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.

PART 2 - PRODUCTS

All fuses shall be current limiting, dual element, as manufactured by Gould Shawmut or Bussmann Manufacturing Co., U.L. Class RK1 or Class RK5 or as indicated on drawings. Fuses in bolted pressure switches shall be U.L. Class L or as indicated on the drawings. All ungrounded poles shall be fused to properly protect the circuits in which they are inserted.

PART 3 - EXECUTION

Furnish and install fuses where required for all electrical equipment which is to be installed under this Section of the Specifications. Unless otherwise indicated on the drawings all fuses shall be sized in accordance with equipment, nameplate data and recommendations of the fuse manufacturer. Coordinate fuse sizes for equipment served with equipment shop drawings prior to ordering fuses.

If the Contractor wishes to use another manufacturer in lieu of the two approved he shall submit other fuse manufacturers to the Engineer for approval prior to installation. Submittal shall include fuse melting curves and fuse clearing curves for every fuse size required.

Replace all fuses that open (melt) up to the time that work under this Section is entirely finished and accepted.

Furnish Owner with minimum three (3) spare fuses of each class and ampere rating used.

END OF SECTION 16181

SECTION 16190 - SUPPORTING DEVICES

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.

Requirements of the following Division 16 Sections apply to this section:

General Provisions
Basic Electrical Materials and Methods

SCOPE

This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

Related Sections:

Refer to other Division 16 sections for additional specific support requirements that may be applicable to specific items. Refer to other Division 16 Sections for additional support requirements that may be applicable to specific items.

SUBMITTALS - Not Required

QUALITY ASSURANCE

Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 - PRODUCTS

MANUFACTURERS

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

Slotted Metal Angle and U-Channel Systems:

Allied Tube & Conduit
American Electric
B-Line Systems, Inc.
Cinch Clamp Co., Inc.
GS Metals Corp.

Haydon Corp.
Kin-Line, Inc.
Unistrut Diversified Products

Conduit Sealing Bushings:

Bridgeport Fittings, Inc.
Cooper Industries, Inc.
Elliott Electric Mfg. Corp.
GS Metals Corp.
Killark Electric Mfg. Co.
Madison Equipment Co.
L.E. Mason Co.
O-Z/Gedney
Producto Electric Corp.
Raco, Inc.
Red Seal Electric Corp.
Spring City Electrical Mfg. Co.
Thomas & Betts Corp.

COATINGS

Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

MANUFACTURED SUPPORTING DEVICES

Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

Fasteners: Types, materials, and construction features as follows:

Expansion Anchors: Carbon steel wedge or sleeve type.

Toggle Bolts: All steel spring head type.

Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service. Powder activated fasteners shall not be permitted for use on precast concrete panels or columns.

Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

U-Channel Systems: 16-gage steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

FABRICATED SUPPORTING DEVICES

General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

Pipe Sleeves: Provide pipe sleeves of one of the following:

Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:

3-inch and smaller: 20-gage.
4-inch to 6-inch: 16-gage.
Over 6-inch: 14-gage.

Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

PART 3 - EXECUTION

INSTALLATION

Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

Coordinate with the building structural system and with other electrical and mechanical installation.

Fastenings to brickwork masonry or concrete shall be made with the use of approved expansion bolts or inserts, or self-drilling Bulldog type anchors and drive pins. Inserts shall be of the type to receive machine bolt head or nut after installation. Plastic inserts will not be acceptable.

Under no circumstances shall fastenings be made to roof deck underside.

Raceway Supports: Comply with the NEC and the following requirements:

Conform to manufacturer's recommendations for selection and installation of supports.

Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.

Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide trapeze hangers for support of cable tray. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

Support parallel runs of horizontal raceways together on trapeze-type hangers.

Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

Space supports for raceways in accordance with applicable NEC Articles.

Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, where allowed by the NEC, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with close nipples or threadless box connections.

In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

All supports suspended from structural bar joists for 2" and larger conduits shall be fastened from the bar joist panel points. Equipment shall not be hung from the bar joist bridging.

"Wire Ties" shall not be permitted (metal or plastic). Use listed clips and brackets.

"C" Clamps may be used as a means of fastening horizontal runs of conduit to purlins, deep steel members and the upper sections of column flanges. The use of "C" type clamps will not be permitted as a means of permanent support of vertical conduit risers at columns.

One-hole push-on conduit straps shall be used where conduits are exposed on walls or columns. Minerallac straps with bolt (conduit clamps) and "Caddy Fasteners" shall not be installed on walls or columns.

Vertical Conductor Supports: Install simultaneously with installation of conductors.

Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices. Steel supports may be welded in place but written approval from the Engineer must be received prior to welding to any structural member. The welding procedure to be used and the performance of all welders shall meet or exceed the requirements of American Welding Society Standard AWS D10.9, Level AR-3.

In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant full depth of wall or floor in gaps between sleeves and enclosed conduits and cables. Use fire barrier caulk, putty, strip or sheet.

Conduit Fasteners: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. In partitions of light steel construction, use sheet metal screws.

Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

Ensure that the load applied to any fastener does not exceed 25 percent of the rated pull-out resistance. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

TESTS: Test pull-out resistance of one of each type, size and anchorage material for the following fastener types:

Expansion anchors.
Toggle bolts.
Powder-driven threaded studs.

Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

No conduits, raceways or devices shall be fastened, clipped to, or supported by ceiling grid support wires.

No raceways shall be permitted to be fastened with metal tie wires; listed mounting clips and devices shall be used for attachment.

END OF SECTION 16190

SECTION 16480 - GROUNDING SYSTEMS

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.

DESCRIPTION

The building electrical system shall have the following ground system:

Electrical equipment ground.

The system indicated shall be effectively connected to ground as required by the National Electrical Code, as specified and as indicated.

PART 2 - PRODUCTS

All materials involved must be from the same source to insure compatibility. Connections made from this process must meet requirements of IEEE Standards 80 and 837 and as listed in MIL419 and the National Electrical Code.

Factory or field installed terminal ground bars and ground lug kits provided in electrical equipment shall be permitted as a grounding connection.

PART 3 - EXECUTION

ELECTRICAL EQUIPMENT GROUND

Metallic raceway shall not be used as the sole ground current return path. A green colored insulated grounding conductor shall be installed within all raceways and electrically parallel with all metallic raceways.

1. Flexible Conduit: Ground continuity shall be maintained across sections of flexible conduit by means of a green colored insulated conductor sized in accordance with Table 250-122 of the N.E.C. and installed within the flexible conduit. This conductor shall be terminated at each end by means of approved grounding connectors attached to fixed portions of the raceway system and the circuit grounding conductor (attachment to box or equipment cover mounting screws is unacceptable).

2. Receptacles: Connect the grounding conductor from the receptacle branch circuit to the receptacle grounding terminal and to the box by a special grounding screw. Grounding clips are unacceptable.

3. Frames and metal enclosures of all electrical equipment shall be metallically connected together and to the equipment ground system.

ELECTRICAL SYSTEM GROUND

The system ground shall be provided by solidly grounding the neutral conductor of the Wye service. This ground connection shall be made on the supply side of the main overcurrent device. The system grounding conductors shall be connected to the equipment ground, but only at the following points.

1. The ground bus of the main disconnecting and overcurrent device.

2. The transformer secondary neutral from which subsequent systems are derived.

IDENTIFICATION

Conductors up to and including #6 AWG shall have a continuous green outer finish. Only conductors larger than #6 AWG shall be permitted to be marked with green tape.

END OF SECTION 16480

SECTION 16721 - FIRE ALARM SYSTEM

PART I - 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.

SCOPE

This specification provides the requirements for minor work on a portion of a proprietary Fire Detection Alarm and Evacuation System. The work shall include, but not be limited to minor modifications to alarm initiating and indicating devices, conduit, wire and accessories required to provide a completely operational voice evacuation fire alarm system.

Remove, relocate and reinstall equipment as required. Provide new devices as indicated on drawings.

Provide all system reprogramming and testing as required to restore system to proper operation.

PROJECT SCOPE

The STAR Center has a building-wide master fire alarm system. The present operating fire alarm system is a model MXL/MXLV, microprocessor based, intelligent, addressable, voice evacuation alarm and notification system as manufactured by CERBERUS PYROTRONICS.

Work under this project shall include the removal of noted existing devices, wire and conduit and the furnishing and relocation or installation of all new required devices, interface wire and conduit, and all system control programming as required for the complete implementation of the system as specified herein and as shown on the drawings.

The existing MXL/MXLV fire alarm system was installed and is maintained by SIEMENS BUILDING TECHNOLOGIES, INC., CERBERUS DIVISION, 8403 Benjamin Road, Suite F, Tampa, FL 33634. This contractor/installer shall be the only contractor/installer permitted to do work on this existing system. Contract bid shall include the services of this contractor to perform the related fire alarm system work including the installation, programming and testing on these installed systems. Contact Mr. John Bourdeau, (813) 261-8744. (John.bourdeau@siemens.com). STAR Center contact is Dave Merens (727)545-6325. All devices shall be as manufactured by SIEMENS, CERBERUS DIVISION, to be compatible with the existing fire alarm systems. When this work is completed, the existing fire alarm system shall be recertified as required in NFPA 72.

OWNER OCCUPANCY

The Owner shall retain full occupancy and use of this facility during the work of this project. Provide all safety devices such as barricades and warning signs to protect the Owner and Tenant's personnel. As full use of the facility must be maintained at all times, the Contractor shall include in his bid all necessary labor costs associated with off-hours work, including evenings, overnight, weekends, holidays and as required to accomplish the work of this project. Requests for additional compensation after bid, due to premium work hours shall not be accepted. As this is a large, occupied facility, all testing of audible and visual alarms shall be performed at off-hours and coordinated with the Owner when the facility has

minimum occupancy. The Owner shall provide 24 hour, 7 day access to the facility for construction and testing operations. Contractor shall give the Owner a minimum of 72 hours advance notice to coordinate access into secured tenant areas. Existing fire alarm system and fire sprinkler system shall be maintained in operation at all times.

STANDARDS

The equipment and installation shall comply with the latest edition of the following standards:

Americans with Disabilities Act Accessibility Guidelines.

National Fire Protection Association Standards:

NFPA 72, 2002 National Fire Alarm Code
NFPA 101, 2006 Life Safety Code
NFPA 90A, 2002 Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 70, 2005 National Electrical Code.

Local and State Building Codes.

Local Authorities Having Jurisdiction, which is Seminole Fire Rescue.

The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

UL 864/UOJZ, APOU	Control Units for Fire Protective Signaling Systems
UL 268	Smoke Detectors for Fire Protective Signaling Systems
UL 268A	Smoke Detectors for Duct Applications
UL 217	Smoke Detectors Single Station
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 228	Door Holders for Fire Protective Signaling Systems
UL 464	Audible Signaling Appliances
UL 1971	Visual Signaling Appliances
UL 38	Manually Activated Signaling Boxes
UL 346	Waterflow Indicators for Fire Protective Signaling Systems
UL 1481	Power Supplies for Fire Protective Signaling Systems

WARRANTY

Warranty all materials, installation and workmanship for one (1) year from date of acceptance by the Owner.
Subject to specification and drawings, system and equipment shall be that manufactured by Siemens Building Technologies, Inc. Cerberus Division. No other manufacturers shall be considered.

CONTRACTOR

The contractor installer of the fire alarm work shall be a State of Florida Certified Alarm System I Contractor in accordance with Florida Statutes, Chapter 489, Part II.

PART 2 - PRODUCTS

INITIATING DEVICES

Furnish and install smoke detectors where shown on the drawings. The combination detector head and twist-lock base shall be UL listed compatible with the fire alarm control panel. The detector head shall be of the photoelectric, dual-chamber type with automatic compensation. The detectors shall obtain their operating power from the fire alarm control panels supervised detection loop. Removal of the detector head shall interrupt the supervised circuit of the fire alarm detection loop and cause a trouble signal to be generated at the control panel.

The smoke detector shall use analog/addressable technology to allow device pin-point identification along with the chamber sensitivity. The detector shall be capable of warning the maintenance personnel of dirty detectors.

Detectors shall be interchangeable without the need to reset the detectors address. Detector heads that have address setting features in them are not acceptable.

The detector shall have a flashing LED for visible supervision. When the detector is actuated, the flashing LED will latch on steady brilliance. The detector may be reset by actuating the control reset switch.

The detector shall physically be of the low profile type. Detectors that do not physically have a low profile appearance are not acceptable. Detectors shall not be installed within 3'-0" of an air supply or return grille.

AIR DUCT SMOKE DETECTORS

The duct mounted smoke detector(s) shall operate on analog/addressable communications with the FACP. The detector shall use the photoelectric principle for detecting smoke.

The detector housing shall be metal with a clear lexan cover to visually monitor the air flow through the detector housing. Detector shall be suitable for 400 to 4,00 fpm air velocities.

All wiring connections between the FACP and the analog air duct smoke detector shall be made on a screw down terminal strip. Pigtail connections will not be acceptable.

Air sampling tubes shall be properly sized and installed per manufacturer’s instructions.

A remote alarm LED indicator shall be provided with the appropriate air duct smoke detector as indicated on the drawings. Mount test stations 5'-0" AFF in an area accessible to general as well as maintenance personnel.

REMOTE RELAYS

The addressable remote relays shall be UL listed for rated and continuous duty, and mounted in an enclosure. Paint enclosure red and mount within 3'-0" of air handler controller. Provide units as required for shutdown and other auxiliary operations. A LED shall indicate communication with control panel. On rooftop units, mount shutdown relay inside controller and label.

PART 3 - EXECUTION

INSTALLATION

The signaling line circuits shall be consistent with installation throughout entire plant.

The work shall be installed in accordance with approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout. Junction box covers throughout the conduit system shall be painted red.

Installation of electrical support devices such as raceways, junction boxes, backboxes, wire and cable, shall be in accordance with all other specification sections contained herein and drawing general and construction notes.

All existing devices, wire and conduit designated to be removed shall be removed completely and surfaces patched to match existing and roof openings sealed in accordance with all other specification sections contained herein and drawing general and construction notes.

Verify operation of existing devices to be relocated. Provide new devices where required.

TESTS

Testing, General:

All (including those provided under this project contract as well as those from previous project contracts) intelligent analog devices shall be tested and logged for correct address and sensitivity using test equipment specifically designed for that purpose. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the system address, initials of the installing technician and date.

Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.

A systematic record shall be maintained of all readings using schedules or charts of tests and measurements. Areas shall be provided on the logging form for readings, dates and witnesses.

The Engineer shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the Owner or Engineer, shall be corrected.

Test reports shall be delivered to the Owner as completed.

All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:

Ladders and scaffolds as required to access all installed equipment.

Multimeter for reading voltage. current and resistance.

Laptop computer with programming software for any required program revisions.

In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the Engineer and the Fire Inspector (Authority Having Jurisdiction).

System Wiring: Fire alarm circuits shall be tested for continuity, grounds, and short circuits.

ACCEPTANCE TESTING

A written acceptance test procedure (ATP)for testing the fire alarm system components and installation will be prepared by the Contractor in accordance with NFPA 72 and this specification for review and acceptance by the Engineer. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming. System and system components shall be construed to include all new components, hardware and software as well as same provided under previous project contracts.

System evacuation alarm indicating appliances shall be demonstrated as follows:

All alarm notification appliances actuate as programmed.

In the event of system failure to perform as specified and programmed during the ATP procedure, at the discretion of the project manager, the test shall be terminated.

The installing contractor shall retest the system, correcting all deficiencies and providing test documentation to the Engineer.

The Engineer may elect to require the complete ATP to be preformed again if, in his opinion, modifications to the system hardware or software warrant complete retesting.

In addition to acceptance testing in the presence of the Owner and Engineer, a separate test and acceptance demonstration shall be provided for the Fire Inspector (Authority Having Jurisdiction).

DOCUMENTATION

System documentation shall be furnished to the Owner and shall include but not be limited to the following:

A certificate complying with NFPA 72, shall be prepared for the fire alarm system.

WARRANTY

Warranty for labor and materials shall be in accordance with Contract GENERAL TERMS AND CONDITIONS.

END OF SECTION 16721

SECTION 16900 - HVAC SYSTEMS

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.

SCOPE OF WORK

The electrical contractor shall furnish and install all wiring, conduit, circuit breakers, disconnects, fuses, and motor starters required to connect and make fully operational all HVAC equipment furnished and installed by others under Division 15 or other Divisions of these Specifications. Work shall include, but not be limited to, wire, raceways, and panelboard circuit breakers for all motors and equipment. Also provide all wire and conduit for motorized dampers (where they are 120V), energy management systems control power (120V), and other accessories required and indicated on the Drawings, to make these systems fully functional.

Some basis of design HVAC equipment indicated includes factory mounted disconnects, circuit breakers and fused disconnects supplied as part of the equipment. Where alternate or substitute equipment is installed by Division 15 that does not include such factory installed electrical devices, the electrical contractor shall furnish and install all required disconnects, fuses, or circuit breakers. Furnish and install all other devices where shown on the drawings.

Low voltage control transformers, required for operation of low voltage (24V) VAV boxes and dampers shall not be provided under this Section but shall be supplied along with the 24 volt power/control wiring, and connections by the HVAC controls equipment supplier. Division 16 electrical contractor shall provide empty conduits, liquid tight flex conduits and all junction boxes for low voltage and DDC control wiring. Locations of such devices may not be shown on the electrical drawings. Coordinate with mechanical and controls contractors to locate these devices and install required conduits and junction boxes. All wire and cable will be installed by controls contractor. All 120V work shall be furnished by the Division 16 Electrical contractor.

SUBMITTALS

None required.

PART 2 - PRODUCTS

Materials as specified in other Sections of Division 16.

PART 3 - EXECUTION

All work shall be installed in accordance with Division 16 requirements, manufacturer's recommended installation instructions, and the National Electrical Code.

All power and signal system wire and conduit serving rooftop equipment shall be routed through roof curb. Pitch pockets are prohibited. It shall be the responsibility of the Division 16 contractors to coordinate their power and signal rough-in and installation with manufacturer's approved shop drawings. All conduits shall have pliable electrical duct-seal putty and caulk/sealant installed after conductors are installed to prevent air infiltration. All penetrations into equipment shall be in a location approved by the manufacturer, see details on drawings and equipment shop drawings.

Coordinate all work with other trades. Locations of outlets for equipment is diagrammatic on the Drawings. Obtain dimensioned shop drawings to coordinate rough-in with equipment being supplied. Confirm specific motor starter type requirements with mechanical equipment shop drawings.

Listed raceways shall be used for all HVAC control and monitoring devices and for all circuits 120 volt and higher or as otherwise required by code. Refer to Division 15 for raceway requirements for HVAC control wiring.

After completion of installation, all work shall be completely checked-out to verify that all equipment and systems are fully functional and installed in accordance with the manufacturer's instructions and all applicable codes.

END OF SECTION 16900