DIVISION 15

MECHANICAL

SECTION 15010 - GENERAL MECHANICAL PROVISIONS

PART 1 - GENERAL

1.01 SYSTEM DESCRIPTION

A. Consult Plans and Specifications in Division 15.

B. Drawings:

1. Drawings are schematic and show approximate locations of ducts, piping and equipment. Coordinate and field verify exact locations with other trades.

2. Obtain Engineer's approval for significant deviations from drawing locations and layout.

3. The Engineer reserves the right to make minor changes in the location of mechanical work or equipment prior to roughing-in without additional cost.

4. Examine the Contract Documents and immediately report any error, discrepancy or omission. The Engineer will determine which interpretation shall take precedence where two or more conflicting statements occur. Otherwise, the Contractor is responsible for the more stringent (or expensive) interpretation. In general, schedules, wherever they appear, supersede specifications, and specifications supersede plans.

5. Contractor shall make use of all data in all Contract Documents and shall verify this information at the building site. All Drawings of the Contract set are hereby made a part of these Specifications and shall be consulted by Contractor and his work adjusted to meet the conditions shown thereon.

1.02 QUALITY ASSURANCE

A. Materials, equipment and installation shall meet the requirements of the following as applicable:

1. American Gas Association (AGA)

2. American National Standards Institute (ANSI).

3. American Society for Testing and Materials (ASTM).

4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

5. American Society of Mechanical Engineers (ASME).

6. National Fire Protection Association (NFPA).

7. Sheet Metal and Air-Conditioning Contractor's National Association (SMACNA).

8. Underwriters Laboratories (UL).

B. All equipment shall bear the label of an approved independent testing laboratory (e.g. UL), where such standards exist.

C. All equipment shall be supplied with integral fusing as required for compliance with its listing.

D. Performance of work shall be in strict accordance with the best common practices of the trades involved, in a thorough, substantial, neat, and workman-like manner by competent,

qualified workmen. No trainees or apprentice workmen shall be allowed at the job site unless under the direct, continuous supervision of a qualified journeyman. All work on HVAC, plumbing, fire protection or electrical systems shall be supervised and performed by individuals properly licensed, where required by state law, or as otherwise indicated in these Documents.

1.03 REGULATORY REQUIREMENTS

A. The work in this Division shall meet the requirements, as applicable, of the following Codes and regulatory bodies:

1. Kentucky Building Code (KBC).

2. Kentucky Department for Natural Resources and Environmental Protection.

3. Kentucky Department of Public Protection and Regulation, Department of Housing, Buildings, and Construction (State Fire Marshal, Plumbing Div., Building Code Enforcement).

4. Life Safety Code - NFPA 101.

5. Local Building Codes and Health Department.

6. Local Utility Regulations.

7. ANSI 17.1 Elevator Code as adopted by KBC.

8. Americans with Disabilities Act (ADA) - Where referenced, product design and installation shall meet minimum requirements of the Act.

B. Conformity with code requirements shall be maintained whether or not official inspections, fees or certificates are required due to project not falling under scope or jurisdiction of regulatory agencies.

1.04 REFERENCES

A. With regard to this Project and these Contract Documents, the following specific definitions shall apply:

1. "Furnish": To purchase and deliver products to the project site and prepare for installation.

2. "Install": To take furnished products, assemble, erect, secure, connect and place into operation.

3. "Provide": To furnish and install.

4. "Products": Includes materials, systems, equipment and accessories, as specified.

5. "Work": The providing of products for any or all of the entire Contract.

6. "Project": The sum total of all work by all parties, to be accomplished as directed in the Contract Documents.

7. "Documents", "Contract Documents": All Plans, Specifications, addenda, bid packages and any other enclosures, agreements or instruments specifically included in the Contract.

8. "Division(s)": Means the generally accepted subdivisions of the Specifications, usually according to the CSI scheme of organizing construction documents, such as Division 15 - Mechanical, Division 16 - Electrical, etc. Also refers to all work covered within the referenced Division(s) of the Specifications.

9. "Section(s)": Means the subdivisions of the "Division" of construction specifications, such as, under Division 15, Section 15010 - General Mechanical Provisions, etc. Also refers to all work covered within the referenced Section(s) of the Specifications.

10. "Engineer", "Architect", "E/A", "A/E": The engineering, architectural or architectural/engineering firm with design authority for the Project.

11. "Contractor": Means the General Contractor and also the Plumbing, Fire Protection, Controls, HVAC or any other Mechanical Contractor, individually or collectively.

12 "Concealed": Embedded in or installed behind walls, within partitions, above ceilings, in trenches, in tunnels and crawl spaces. Areas above lay-in ceilings, in crawl spaces or in service tunnels and trenches, other than stand-up utility tunnels, chases or vaults, may be considered concealed with reference to appearance or finish but not concealed with respect to accessibility. Check for specific exceptions.

13. "Exposed": Not installed underground or "concealed" as defined above. Generally, systems in all mechanical spaces, including mechanical or boiler rooms, stand-up or walk-thru chases and utility tunnels or vaults shall be considered to be exposed with respect to finish or accessibility requirements.

14. "Equivalent" or "Equal": In the opinion of the Engineer, acceptably comparable in concept, form, quality, performance and compatibility with the design.

15. "Mechanical": May refer to all mechanical trades, including HVAC, plumbing, fire protection, ventilation, odor control, or may refer to HVAC work as opposed to say plumbing, the difference being necessarily taken from context.

16. “Plans”, “Drawings”: Mean all information presented in a drawing or graphical format, which have been included in the Contract, including but not limited to plans, sections, elevations, details, diagrams, schedules, notes, legends and addenda thereto.

17. “Specifications”: Means all information pertaining to performing the Work, presented in text format and in the accepted organization of Divisions and Sections and in the addenda thereto.

18. “Addendum”, “Addenda”: Means information published after the original distribution of Documents (but before the Bid Opening), which may contain changes to Drawings, Specifications or the bidding process. Such information carries the same weight as if originally included in the Documents.

B. Abbreviations and Symbology:

1. Refer to the following references for any abbreviations, acronyms or symbols not defined in the Contract Documents:

   a. ASHRAE Fundamentals Handbook, current edition, chapter on Abbreviations and Symbols.

2. The following abbreviations may be used throughout the mechanical Documents. Refer also to legends or symbol lists on Drawings and to architectural abbreviations. Note that all abbreviations are not necessarily used. If a discrepancy exists between abbreviations contained in the list below and drawings, the abbreviations on the drawings shall be used.

A, AMP	Ampere	AAE	Automatic Air Eliminator
AV	Air Vent		
AAV	Automatic Air Vent	ABV	Above
AC	Alternating Current Air Conditioning	ACCU	Air Cooled Condensing Unit
AD	Access Door	ADDL	Additional
ADJ	Adjustable Adjacent	ARL	Above Roof Level
A/E	Architect/Engineer	AFF	Above Finished Floor
AHU	Air Handling Unit	ALT	Altitude Alternate
AL	Aluminum		
ALTN	Alternate	ANOD	Anodized, Anode
AP	Access Panel	APPROX	Approximate
ARCH	Architect(ural)	ATM	Atmosphere
AUTO	Automatic	AV	Acid Vent
AVG	Average	AW	Acid Waste
AWG	American Wire Gauge	AWT	Average Water Temperature
AFD	Adj. Freq. Drive		
BDD	Backdraft Damper	BD	Board
BEL	Below	BHP	Brake Horsepower
BLDG	Building	BOD (Elevation)	Bottom of Duct
BOP	Bottom of Pipe (Elevation)	BRK	Break, Breaker
BRKT	Bracket	BRZ	Bronze, Braze
BS	Bird Screen	BSMT	Basement
BTU	British Thermal Unit	BTUH	BTU/HR
		BFP	Backflow Preventer
CAP	Capacity	CB	Catch Basin
CC	Center to Center	CD	Ceiling Diffuser
CEIL	Ceiling	CENT	Central
CFH	Cubic Feet/Hour	CFM	Cubic Feet/Minute
CHG	Charge, Change	CG	Ceiling Grille
CI	Cast Iron	CKT	Circuit
CLG	Cooling	CLO	Closet
CLR	Clear	CO	Carbon Monoxide
CO	Cleanout	CO2	Carbon Dioxide
COL	Column	COMP	Compound Compressor (ed)
CONC	Concrete		
COND	Condensate, Condensation Condenser	CONFIG	Configuration
		CONN	Connection
		CONST	Construction
CONT	Control(s), Continuous	CONTR	Contractor
		COP	Coefficient of Performance, Copper
CPLG	Coupling		
CT	Cooling Tower		
CTR	Center	CU	Copper, Condensing Unit, Cubic
CUH	Cabinet Unit Heater	CIRC	Circular
CW	Cold Water	CWR	Chilled Water Return
CWS	Chilled Water Supply	CR	Ceiling Register
D	Depth, Diameter Differential	dB	Decibels
		DOUB	Double
DB	Dry Bulb	DC	Direct Current

DCW	Domestic Cold Water	DD	Direct Drive
DET	Detail	DDC	Direct Digital Control
DF	Drinking Fountain	DG	Door Grille
DHW	Domestic Hot Water	DHWR	Domestic Hot Water Return
DI	Double Inlet		
DIA	Diameter	DIFF	Diffuser
DIM	Dimension	DISC	Disconnect
DISCH	Discharge	DL	Door Louver
DN	Down	DP	Double Pole
DS	Downspout	DT	Double Throw
DW	Double Width	DWG	Drawing
DWH	Domestic Water Heater	DWV	Drain, Waste and Vent
DR	Drain	DHBC	See HBC
E	East	EA	Each, Entering Air
EER	Energy Efficiency Ratio		Exhaust Air
		EF	Exhaust Fan
		EGW	Ethylene Glycol/ Water Mixture
EL	Elevation		
ELEC	Electric	EMD	End of Main Drip
EMER	Emergency	ENTR	Entrance
ENT	Entering	EQUIP	Equipment
EQ	Equal, Equivalent	ET	Entering Temperature
EVAP	Evaporative		Expansion Tank
EW	Eye Wash	EWC	Electric Water Cooler
EWH	Electric Wall Heater		
EWT	Entering Water Temperature	EXH	Exhaust
		EXIST	Existing
EXP	Expansion, Exposed, Explosion	EXT	Exterior, External, Extruded
		EAT	Entering Air Temperature
EDB	Entering Dry Bulb		
EWB	Entering Wet Bulb	ESP	Ext.Static Pres.
F	Fahrenheit Temperature	FCU	Fan/Coil Unit
		FD	Floor Drain
FDN	Foundation		Fire Damper
FE	Fire Extinguisher	FEC	Fire Extinguisher Cabinet
FF	Fouling Factor	FH	Fire Hydrant
FHC	Fire Hose Cabinet	FIG	Figure
FIN	Finish	FL, FLR	Floor
FLA	Full Load Amps	FLEX	Flexible
FLUOR	Fluorescent	FOR	Fuel Oil Return
FOS	Fuel Oil Supply, Suction	FP	Fire Protection
		FPF	Fins Per Foot
FPH	Frost-Proof Hydrant	FPM	Feet Per Minute
		FPS	Feet Per Second
FPT	Female Pipe Thread	FR	Frame
		FT	Feet
FTR	Finned Tube Radiation	FVC	Fire Valve Cabinet
		FSD	Fire/Smoke Damper
FCV	Flow Cont. Valve		
GA	Gauge	GAL	Gallon
GALV	Galvanized	GI	Grease Interceptor
GL	Glass	GND, GRD	Ground

GPD	Gallons Per Day	GPH	Gallons Per Hour
GPM	Gallons Per Minute	GR	Grade, Grille
H	Height, Horizontal	HB	Hose Bib
HT, HGT	Height	HD	Head
HIGH	Height	HDWE	Hardware
HEX	Hexagonal	HOA	Hand/Off/Automatic
HORIZ	Horizontal	HP	High Pressure Horsepower Heat Pump
HPR	High Pressure Steam Condensate Return	HPS	High Pressure Steam
HI	High		
HR	Hour	HS	Hair Strainer
HTG	Heating	HTR	Heater
HUH	Horizontal Unit Heater	HVAC	Heating, Ventilating and Air Conditioning
HVY	Heavy		
HW	Hot Water	HWR	Heating Hot Water Return
HWS	Heating Hot Water Supply	HZ	Hertz = CPS = Cycles/Sec.
HBC	Ky. Dept. of Housing, Buildings, Const.		
ID	Inside Diameter, Inside Dimension	ID	Identification
		IDENT	Identification
IFB	Integral Face and Bypass Damper	IN	Inches
		INCAND	Incandescent
IN.Hg	Inches of Mercury	INSUL	Insulation
INJ	Injection, Injector	IN.W.C.,	
IND	Indirect Drain	IN.W.G.	Inches of Water column
IR	Infrared		
INV	Invert	IMC	International Mechanical Code
JT	Joint		
KIT	Kitchen	KV	Kilovolt
KVA	Kilovolt Amps	KW	Kilowatt
KWH	Kilowatthour	KBC	Ky. Bldg. Code
L	Long, Louver, Latent	LB, #	Pound
LFS	Low Fire Start	LG	Length
LAT	Leaving Air Temperature Latent	LAV	Lavatory
		LIQ	Liquid
LP	Low Pressure Liquified Petroleum (Gas)	LPR	Low Pressure Steam Condensate Return
LPS	Low Pressure Steam	LT	Light, Leaving Temperature
LTG	Lighting		
LWT	Leaving Water Temperature	LVG	Leaving
		LDB	Leaving Dry Bulb
LWB	Leaving Wet Bulb	LO	Low
MA	Milliampere	MACH	Machine
MAN	Manual	MATL	Material
MAV	Manual Air Vent	MAX	Maximum
MBH	Thousand BTU Per Hour	MD	Manual Damper
		MECH	Mechanical

MET	Metal	MEZZ	Mezzanine
MFR	Manufacturer	MH	Manhole
MIN	Minimum, Minute	MISC	Miscellaneous
MK	Mark	MO	Motor-Operated Month
MOD	Motorized Damper Modulating	MPH	Miles Per Hour
MPR	Medium Pressure Steam Condensate Return	MPS	Medium Pressure Steam
		MPT	Male Pipe Thread
MS	Motor Starter	MT	Mount
MTD	Mounted	MTG	Mounting
MV	Millivolt	MW	Megawatt
MCC	Motor Control Ctr.		
N	North, Neutral	NC	Noise Criteria Normally Closed
NEUT	Neutral		
NIC	Not In Contract	NO	Normally Open Number
NOM	Nominal		
NPSH	Net Positive Suction Head	NTS	Not To Scale
O2	Oxygen	OA	Outside Air
OBD	Opposed Blade Damper	OD	Outside Diameter Outside Dimension
OC	On Center (s)	OPN	Operation
OPP	Opposite	OPNG	Opening
OVHD	Overhead	OZ	Ounces
P	Pressure, Pump	PD	Pressure Drop
PERF	Perforated	PH	Phase
PIV	Post Indicator Valve	PL	Plate, Property Line
PLBG	Plumbing	PNEU	Pneumatic
PNL	Panel	PPM	Parts Per Million
PR	Pair	PRELIM	Preliminary
PRES	Pressure	PRI	Primary
PRV	Pressure Regulating Valve	PSC	Permanent Split Capacitor
PSF	Pounds Per Square Foot	PSI	Pounds Per Square Inch
PSIG	Pounds Per Square Inch, Gauge	PT	Plaster Trap Point
PVC	Polyvinyl chloride	Ø	Phase
PCR	Pumped Condensate Return	POC	Point of Conn.
QT	Quart	QTY	Quantity
QUAL	Quality	QX	Heat Exchanger
R	Thermal or Electrical Resistance, Radius	RA	Return Air
		RAD	Radius
		RCP	Reinforced Concrete Pipe
RD	Roof Drain		
RECIRC	Recirculating	RECOV	Recovery
RED	Reducing	REG	Register Regulator
REINF	Reinforced		
REQD	Required	REV	Revised, Revision
RH	Relative Humidity	RM	Room
RND, Ø	Round	RPM	Revolutions Per Minute
RPS	Revolutions Per		

	Second	RWC, RWL	Rainwater Conductor
RG, RAG	Return Air Grille	RPZ	Reduced Pressure Zone (BFP)
RF	Return Fan		
RECT	Rectangular		
S	South, Sensible	SA	Supply Air
SAN	Sanitary	SCH	Schedule
	SCHED	Schedule(d)	
SCR	Silicon-Controlled Rectifier	SD	Smoke Detector Storm Drain
SEC	Secondary	SECT	Section, Sector
SENS	Sensible	SERV	Service
SF	Square Feet	SGL	Single
	Supply Fan	SG, SAG	Supply Air Grille
SH	Sheet	SHT	Sheet
SING	Single	SIM	Similar
SOL	Solenoid	SP	Static Pressure
SPEC(S)	Specification(s)		Space
SP.GR.	Specific Gravity		Single Pole
SQ	Square	STRUCT	Structural
SS	Stainless Steel	ST	Sound Trap, Single Throw
	Sanitary Sewer or Storm Sewer (See Legend)	SWP	Steam Working Pressure
STD	Standard	STL	Steel
STM	Steam	STOR	Storage
STR	Straight	STRL	Structural
SUP	Support(ed)	SUSP	Suspend(ed)
SW	Switch	SYS, SYST	System
T	Temperature, Total	T&B	Top and Bottom
TAB	Testing Adjusting & Balancing		Testing & Balancing
		TOT	Total
TD	Temperature Difference	TDH	Total Dynamic Head
TEFC	Totally Enclosed Fan Cooled	TEMP	Temperature Temporary
TERM	Terminal	THK	Thick
THRU	Through	TYP	Typical
TG, TAG	Transfer Grille		
U	Overall Heat Transfer Coefficient	UC	Undercut
		UGND	Underground
UH	Unit Heater	UR	Urinal
UTIL	Utility, Utilities	UV	Ultraviolet Unit Ventilator
V	Volts, Vent Vertical, Velocity	VAC	Vacuum
VCP	Vitrified Clay Pipe	VEL	Velocity
		VENT	Ventilat(or), (ion), (e)
VERT	Vertical		
VOL	Volume	VSP	Vitrified Sewer Pipe
VTR	Vent Thru Roof		
VUH	Vert. Unit Heater	VSD, VFD	Variable Speed Drive
W	Waste, Water Watt, West, Width	W/	With
		WB	Wet Bulb

WC	Water Column Water Closet	WOG	Water, Oil or Gas
WG	Water Gauge	WH	Wall Hydrant
WL	Water Level	WO	Waste Oil
W/O	Without	WP	Working Pressure
WSHP	Water Source Heat Pump	WT	Weight
		WTR	Water
XFMR	Transformer	XBRA	Cross Bracing
XT	Expansion Tank	XFER	Transfer
XA	Transfer Air		
YD	Yard	YH	Yard Hydrant
YR	Year		
Z	Impedence		

C. Organizational Acronyms

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ADC	Air Diffusion Council
AEE	Association of Energy Engineers
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
BOCA	Building Officials & Code Administrators International, Inc. (ICC)
CISPI	Cast Iron Soil Pipe Institute
CS	Commercial Standards (sometimes known as commodity standards') produced by the U.S. Department of Commerce
FM	Factory Mutual System
FS	Federal Specification
IBR	Hydronics Institute
ICC	International Code Council
IRI	Industrial Risk Insurers (Formerly FIA)
MIL	Military Specifications
MSS	Manufacturer's Standardization Society of the Valves and Fitting Industry
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code (NFPA)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration or Occupational Safety and Health Act
PS	Product Standard, produced by U.S. Department of Commerce
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SFPE	Society of Fire Protection Engineers
UL	Underwriters Laboratories, Inc.

D. Technique:

1. HVAC Metal Duct Standards - SMACNA

2. Industrial Duct Construction - SMACNA

3. Industrial Ventilation - ACGIH

4. Welding Pressure Piping - ASME

1.05 SUBMITTALS

A. Refer to Division 1 for submittal procedures and references.

B. Otherwise, submit 8 to 12 copies of information to the Engineer for approval. Check each Specification Section for all items to be included

C. Submit all required items within sixty (60) days of Contract date or Notice to Proceed, whichever is later, unless otherwise specifically instructed. Approval of the Engineer must be obtained to submit later on any item.

D. Submittals are required for all items of mechanical equipment and products provided by the Contractor which are called out in individual sections of the specifications. In general, do not submit product data on pipe, pipe fittings, sheet metal, sleeves, lubrication or packing unless specifically directed in these Contract Documents, but do submit schedules listing materials to be used.

E. All drawings or other material submitted on sheets larger than 8 1/2" X 11" (or 11" X 17" foldout) shall be submitted as one set of paper sepia or mylar sepia reproducibles and one set of blueline prints. Corrections and approvals will be indicated on the sepias and returned to the Contractor for copying and distribution.

F. Submittals shall be referenced correctly to the appropriate Sections of the Specifications.

G. Manufacturer's catalog cuts, instead of complete shop drawings, may be submitted for all standard cataloged equipment, provided that the item required to meet the project specifications is not modified in any way from the standard catalog version of said item. Cuts shall be clearly marked to indicate the version of said item, including the exact size, type, rating, capacity, accessories, etc., of the item to be furnished. Do not use the term “furnished by others” or similar designations, as this may imply that the item is not being provided in the Contract.

H. No faxed (Facsimile Transmitted) material will be accepted for submittals and all drawings and text shall be clear original printed material or low-generation copies with no blurred, blotched or unreadable areas.

I. Bind shop drawings/catalog cuts in folders with a title sheet and identification on front of the folder. Allow space for Contractor, Architect and Engineer review stamps.

J. All submittals must bear the dated, handwritten signature of the Contractor and his stamp of approval before being considered for review.

K. See additional requirements in individual Sections of these Specifications.

1.06 SAMPLES AND MOCK-UPS

A. Samples of any product called for by individual sections of the specifications shall be delivered to the Engineer at the time of submittal on that item. Submittals, in those cases, will not be approved until the samples have been examined.

B. Where called for in the specifications, the Contractor shall construct a sectional mock-up of equipment installations using actual equipment or equipment cabinets of the type to be used for purposes of checking appearance, fit of piping, ductwork, controls or structural elements. Mock-ups shall be inspected and approved by the Engineer prior to release for shipment of the material in question.

1.07 CERTIFICATES, LICENSES AND FEES

A. The Contractor shall pay all fees, stand all required inspections, obtain all necessary licenses, and obtain all required certificates for the work at his own expense.

B. Certificates requiring display shall be suitably framed and mounted in the mechanical room or other appropriate location. Copies of the certificate shall be included in each copy of the maintenance and operating manuals.

C. Certificates not requiring display shall be delivered to the Engineer for transmittal to the Owner, and copies of the certificate shall be included in each copy of the maintenance and operating manuals.

1.08 PROJECT RECORD DOCUMENTS

A. Record Drawings

1. Comply with Division 1 for record document procedures and requirements.

2. Maintain and protect one complete set of drawing prints on job site to record any deviations from Contract drawings.

3. Neatly and correctly enter with multicolored pencils any deviations on drawings and keep drawings available for inspection.

   a. Record locations of concealed ducts, piping and valves.

   b. Record Addendum and Change Order items.

4. Record deviations made necessary to incorporate equipment different from base equipment specified.

5. Drawings shall be available at the site at all times for inspection by the Engineer during normal project working hours.

6. At completion of Project and before final approval, make any final corrections to drawings, certify to the accuracy of each print by signature thereon and deliver same to Engineer for approval and drafting.

7. Underground site utilities shall be located by survey. Actual inverts and elevations shall be recorded.

1.09 MAINTENANCE AND OPERATING MANUALS

A. Submit four (4) bound copies, 8-1/2" x 11", in hard back 3-ring binders to the Engineer for review and obtain receipt for delivery.

B. Format of the manual shall be as follows:

1. First page, Each Volume: Title of Project, Owner, Address, Date of Submittal, Name and Address of Contractor, Name of Engineer.

2. Second page, Each Volume: Index of manual contents.

3. First section: A copy of each shop drawing and reviewed submittal with an index at the beginning of the section. Include operating and maintenance instructions, wiring/control diagrams, spare parts lists for each type of equipment.

4. Second section: A list of all major equipment used on the job, together with supplier's name and address and servicing agency's name and address.

5. Third section: Copies of Contractor and manufacturer warranties.

6. Fourth section: Test and balance reports, construction test reports, start-up reports, water treatment reports.

7. Fifth section:

   a. Include a list of any special keys, tools and wrenches required for operation.

   b. Include a list of all lubrication procedures, special lubricants and equipment.

   c. Include a list of all tagged valves with tag number, valve description, location, and function. Include a revised flow chart, obtained from the Engineer to show valve identification.

C. No faxed (Facsimile Transmitted) material will be accepted for M & O submittals and all drawings and text shall be clear original printed material or low-generation copies with no blurred, blotched or unreadable areas.

D. Final payments cannot be made and Project cannot be closed out until Maintenance and Operating Manuals have been approved.

1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Arrange deliveries of products in accordance with construction schedules to avoid conflict with work and site conditions.

1 Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Immediately on delivery, inspect shipments to assure compliance with the requirements of the Contract Documents and approved submittals, and that products are properly protected and undamaged.
3. Provide equipment and personnel to handle products by methods to prevent soiling and damage to products or packaging.

B. Store products in accordance with manufacturer's instructions with seals and labels intact and legible.

1. Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings. Provide adequate ventilation to avoid condensation.

2. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specific conditions, and free from damage or deterioration.

3. Provide substantial coverings as necessary to protect installed products from damage. Remove when no longer needed.

1.11 ENVIRONMENTAL REQUIREMENTS AND EXISTING CONDITIONS

A. Locate existing utilities prior to beginning work. Reroute or replace existing utilities where necessary to permit installation of the work. Provide adequate means of protection during work operations. Repair existing utilities damaged during work operations to the satisfaction of the utility owner and at Contractor's expense.

B. Should uncharted or incorrectly charted piping or other utilities be encountered during work operations, notify the Engineer immediately for procedure directions. Cooperate with utility companies in maintaining active utilities in operation.

C. Contractor shall not remove or disturb any known or suspected existing hazardous materials in buildings, above ground or underground, except work performed in compliance with EPA requirements, as instructed in this Contract, including, but not limited to, asbestos, lead-based paints, PCB's and radioactive materials. If such materials are encountered during the course of the Work, the Engineer shall be immediately notified and the materials shall be avoided.

D. All materials removed from the site including scraps, construction materials, excavated or demolished materials shall be disposed of in a legal manner.

1.12 WARRANTY

A. The Contractor shall guarantee all work, both labor and products against defects and failure under normal use for the period of one year from the official date of Substantial Completion, the date of official acceptance by the Owner or the date of occupation by the Owner of the complete project area, whichever is earliest. The Contractor shall leave the entire installation in complete working order and free from any and all defects in materials, workmanship or finish. He shall repair or replace at his own expense any part that may develop defects due to faulty material or workmanship during construction and the warranty period and shall guarantee also to repair or replace with like materials any existing work of the building or equipment which is damaged during the repairing of such defective apparatus, materials or workmanship. The signing of the Contract for this Work, covered by these Documents of which they shall become a part, shall become a written guarantee on the part of the Contractor to carry out all the provisions of this Division of these Specifications.

B. Refer to Division 1 for other specific requirements.

C. Refer to each Section of Division 15 for additional requirements.

1.13 AREA CLASSIFICATIONS - ENVIRONMENTS

A. Electrical classifications: Refer to electrical plans for the electrical classification of the spaces. Mechanical equipment supplied shall conform to the electrical classification of the spaces. The classification shall be based on the ventilated rating where noted. Where indicated, provide explosion proof rated motors, and components in the air stream shall be rated to comply with the electrical rating of the room (Class I, Division I / Class 1, Division II). For supply fans, exhaust fans, or vents serving Class I, Division 1 rated spaced, components within 3’ radius of the discharge or other opening in equipment including shafts and actuators shall be rated Class I Division 1 and components with 6’ radius shall be rated for Class I, Division II. For supply fans, exhaust fans, or vents serving Class I, Division II spaces shall be rated Class I, Division II if located with a 3’ radius of ductwork work opening, fan inlet, or fan discharge.

B. Corrosive areas: The following areas are considered to be corrosive environments. Equipment, piping, fittings, valves, and related components shall be constructed on materials or coated to resist corrosion. The spaces listed below are considered to contain hydrogen sulfide which when condenses with water can form sulfuric acid.

1. Truck Load Bay
2. Grit and Screen Handling Area
3. Grit Tanks
4. Flumes
5. Wet Well
6. Odor Control air stream.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS, STANDARD PRODUCTS AND SUBSTITUTIONS

A. All material and equipment shall be new and in good condition. Refer to Division 1 for additional requirements.

B. Design is based upon a specific make and model of equipment. However, except where noted, the specifications are not intended to limit competition or the Contractor's option to use alternate products of equivalent concept, quality, and performance.

C. Products of alternate manufacturers listed may be substituted without approval prior to the Bid, if they are regularly catalogued items and meet the criteria of equivalence in concept, quality, and performance in the opinion of the Engineer. It is recommended that the opinion of the Engineer be solicited prior to the bid if there are any questions. This opinion does not guarantee approval of the submittals at a later time. In the case where the equipment is unfamiliar to the Engineer, all vendors desiring to furnish equipment other than that specified must submit, in addition to ordinary shop drawings, a complete verification specification for the substituted equipment along with catalogs, literature, wiring diagrams, piping diagrams, and a list of similar sized installations where the proposed equipment is installed. This information may be required to be presented immediately after the Bid and lack of information or of qualifications, as judged by the Engineer, may result in a Bid not being accepted.

D. All products which require submittals, whether design basis or otherwise accepted, must be formally approved by the Engineer before shipment to the job.

E. The Contractor is responsible for any and all costs for changes to the mechanical work or the work of other trades necessitated by the optional substitution of approved alternate equipment. Approval of alternate equipment or modifications to the plans by the Engineer are not to be construed as relief from this responsibility. In the case of significant modification to the design, the Contractor may also be required to pay for the cost of design review and/or redesign by the Engineer.

F. Listing: The successful bidder shall furnish to the Engineer within one hour of the Bid opening, or as indicated in bidding instructions, a list of all major items of mechanical equipment to be provided, indicating the manufacturer and the general type. List shall include all items of major equipment such as boilers, chillers, towers, pumps, tanks, air handlers, packaged equipment, controls, plumbing fixtures, or other items to which whole Sections of Specifications are devoted. Do not include piping, sheet metal, small specialty items or the like unless specifically requested. In addition, a list of all Subcontractors to be involved in the project shall be furnished to include, in addition to the prime mechanical contractor, as a minimum, the plumbing, pipe fitting, sheet metal, controls, water treatment, thermal balancing, insulating, fire protection and asbestos removal subcontractors, as utilized in the project. Any list of required items included in the Bid Form, Instructions to Bidders or other Bid documents shall supercede these items. Changing manufacturers or subcontractors after the listing will not be acceptable, unless initiated by the Owner or the Engineer. Final acceptance of the bids is contingent upon submission and approval of these lists.

2.02 QUANTITIES AND COMPLETENESS

A. Items may be referred to as singular or plural on drawings and specifications. Contractor is responsible for determining quantity of each item.

B. All components required for the complete installation and legal, proper and safe operation of equipment and systems indicated in the Documents shall be provided by the Contractor. Optional accessory items shall be included only as specified.

2.03 TESTING AND CERTIFICATION

A. Conduct tests and adjustments of equipment as specified and necessary to verify performance requirements. Submit test data to the Engineer. Pay all fees involved in required testing of equipment.

B. Provide necessary personnel and testing instruments required to perform test(s) of installation.

C. Refer to individual Sections for additional requirements.

D. Submit copies of all test reports, manufacturer's certifications and inspection reports to the Engineer. Include copies of each in each copy of the Maintenance and Operating Manual (Section 15010, Paragraph 1.10).

2.04 NOISE AND VIBRATION

A. Equipment shall be free of unusual or excessive noise and vibration in the opinion of the Engineer. No amount of rattling of loose, improperly isolated or ill-fitting parts will be acceptable. Vibration transmitted to the structure shall be reasonable and within recognized and specified limits.

2.05 HAZARDOUS MATERIALS

A. No materials or products containing known regulated hazardous materials shall be used in the Project, including asbestos, paint containing lead or products containing PCB's in amounts grater than current standards allow.

B. No solder containing lead shall be used on the Project.

C. Chemical products used in the construction process or for water treatment purposes shall be used in a manner in complete compliance with all OSHA and EPA regulations and guidelines. Formal Material Safety Data (MSD) Sheets shall be provided for each product used and shall be posted in the work area most accessible to the place of use of the product. In addition, MSD sheets shall accompany and be attached to water treatment products from the time they arrive on site through the end of Warranty.

PART 3 - EXECUTION

3.01 TEMPORARY SERVICES

A. Refer to Division 1 for specific requirements, responsibilities and methods for temporary water service, sanitation, heat and ventilation.

3.02 COORDINATION

A. The Contractor is responsible for sequencing of the work and coordination with all trades to prevent delays in the project. No extras will be allowed for changes made necessary by interference of work between trades.

B. Carefully check and coordinate location and level of all pipes, ducts, etc. Run preliminary levels and check with all trades so that conflicts in all locations may be avoided. Contractor shall rough sketch sections through the corridors or other tight mechanical/electrical spaces when requested to do so, in order to show that any possible conflicts have been resolved among all the trades. Where conflicts occur, if any, the following preference schedule shall be followed:

1. Recessed electrical light fixtures.

2. Sanitary and storm drainage piping on critical grade.

3. Ductwork.

4. Large HVAC or domestic water mains.

5. Sprinkler piping.

6. Communications wireway

7. Small HVAC piping.

8. Domestic water piping.

9. Electric and communications conduits.

C. Ductwork or Heating Main: No ductwork or heating main shall have preference over plumbing lines below plumbing fixtures, or over electrical conduits above or below electric switchgear and panels. No piping conveying fluids shall be installed directly over electrical equipment.

D. Unless otherwise indicated, coordinate all work with the arrival of materials on the site to prevent unnecessary delays between demolition or other preliminary phases of work and the installation of new materials. Periods of abandonment of work area, once work has begun shall be avoided unless necessary to allow other trades to complete their work.

E. The storage of materials on site shall be minimized. Materials delivered to the site far in advance of construction, and/or exposed to weather, mud or construction abuse for long periods, will not be eligible to be included in pay requests, and will be accepted for use in the project at the time of construction based upon condition at that time. Generally, rusted, beat-up products, including large equipment, will not be accepted for use.

3.03 INSPECTIONS

A. The Engineer or his representative may inspect the work at any time and for any reason, but, generally, inspections will be arranged to coordinate with phasing of the work and with regularly scheduled Project meetings. The Engineer will attempt to accommodate the Contractor where possible, but in general, it is the Contractor's responsibility to schedule the work in such a manner that inspections are not required more often than the regular meetings, except for substantial completion and final inspections.

B. No work shall be permanently concealed (underground, behind drywall or masonry, or any other inaccessible location) without being inspected by the Engineer or his representative, unless specific permission is granted to do so by the Engineer.

C. In general, piping and ductwork must be inspected by the Engineer or his representative before insulation is applied, unless specific permission to do otherwise is given by the Engineer.

D. The Contractor shall supply lights, ladders, tools, equipment and assistance to the Engineer, as required, for performing inspections and verifying the operation of mechanical systems.

3.04 CONCRETE WORK

A. Provide all concealed concrete work required for Division 15, including but not limited to pipe and duct anchors, foundations and encasement, inertia bases, and pads. Coordinate with other divisions.

B. Equipment pads, slabs and bases exposed to view and not part of the building structure (see architectural/structural plans) shall be provided by the Contractor. Coordinate with other divisions. The Contractor shall locate, dimension and furnish sleeves and anchors as required.

C. Concrete shall conform to Division 3 requirements.

3.05 PROTECTION

A. Protect equipment and materials during construction from damage from water, dirt, welding and cutting, spatters, paint droppings, etc., by use of shield and drop cloths. Damaged equipment or materials shall be repaired or replaced by the Contractor. Rusting, corroded or damaged materials or equipment is not acceptable, whether installed or not.

B. Products stored outside or in unheated spaces shall be covered with water-proof drop cloths or tarpaulins. Condensation shall be prevented by heating and ventilating. Method shall be acceptable to the Engineer. (See Section 15010, Paragraph 1.11).

C. During construction, maintain all materials and equipment in an orderly manner.

D. Protect floors from soiling and damages caused by tools, chips, cutting oil, pipe compound, paint and the like.

E. The Contractor shall use OSHA-approved ladders and lifts for Division 15 work. Workmen shall not be allowed to stand or sit on the unprotected surfaces of insulation, equipment jackets, conduit, control panels or any other location not intended for traffic.

3.06 CUTTING AND PATCHING

A. Avoid cutting of concrete, masonry and other finished work by use of sleeves and inserts.

B. Perform cutting and patching required for installation of the work. Methods and procedures shall be acceptable to the Engineer. Obtain written permission before any cutting.

C. Cut holes through concrete, brick, tile, etc., when necessary, by rotary core drilling or masonry saw.

D. Damages, patches, or work in areas previously finished under the work of other Divisions shall be repaired at the expense of the Contractor and to the satisfaction of the Engineer.

3.07 CLEANING

A. Upon completion, ductwork, piping and equipment shall be thoroughly cleaned of dirt, grease, rust and oil, primed where necessary, and left ready for painting. Vacuum clean the inside and outside of fan plenums, air handling units and equipment cabinets. Vacuum clean coils and comb out damaged fins.

B. Clean galvanized piping and ductwork in exposed areas with diluted acetic acid.

C. Clean copper piping in exposed areas with emery cloth and solvent.

D. Clean gauges, thermometers, traps, strainers and fittings.

E. Install new filters in throwaway and replaceable filter frames. Properly clean permanent filters.

F. Upon completion of Work, the Contractor shall remove all resulting rubbish, debris, and surplus materials from the premises, together with all disused instruments and equipment and shall leave the site in a neat, clean, and acceptable condition as approved by Engineer. Contractor shall maintain Work areas of existing facilities in a reasonably clean condition on a daily basis, and shall not allow debris to create operational or safety problems for the Owner.

3.08 PAINTING AND FINISHING

Painting shall meet the requirements of Section 09961.

3.09 ACCESS

A. Equipment has been chosen to properly fit into the physical spaces provided and indicated, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearance in accordance with Code requirements. Physical dimensions and arrangements of equipment to be installed shall be subject to Engineer approval. Submit shop drawings of equipment layout for approval where it does not comply with plans.

B. Space Requirements: In the preparation of Drawings, a reasonable effort has been made to include all equipment manufacturer's recommendations. Since space requirements and equipment arrangement vary according to manufacturer, the responsibility for initial access and proper fit rests with the Contractor. The final arrangement of equipment and service connections shall allow the unit to be serviced. This shall include space to pull motors, filters, coils, tubes, etc. Contractor shall demonstrate that proper access has been provided to inspectors.

3.10 CONSTRUCTION DIRT, DUST AND NOISE CONTROL

A. All cutting or drilling of concrete, masonry, steel or wood shall be performed with absolute control of dirt and dust resulting from the cutting or drilling operation. Workers performing operations or in the immediate vicinity shall wear OSHA approved protective equipment.

B. The Contractor is required to minimize construction noise levels in all locations adjacent to or in occupied areas.

C. The Owner reserves the right to prevent use of any tools which cause detrimental vibration or noise.

3.11 TRAINING

A. Training and instruction to the Owner shall be provided for all Division 15 equipment, systems and controls. See individual Sections for additional specific requirements. Contractor shall submit a training agenda to the Engineer for approval, prior to Substantial Completion, including a proposed schedule, all items to be covered and who is to make the presentations.

If the Owner chooses to decline training, or any part thereof, the Contractor will credit the Project for the cost of any unused hours of training and instruction. Contractor shall keep record of attendance at the training sessions and submit to the Engineer upon completion.

B. Instruction shall be based upon material in the Maintenance & Operating Manuals, described above, which shall be approved by the Engineer, prior to the training. Any supplemental information required shall be provided by the Contractor.

C. Training and instruction to the Owner shall be video recorded at the Contractor's expense, in DVD format, and the original and one copy shall be submitted to the Engineer for approval, prior to Project Closeout. Video is not required to be made by professional photographers, but shall show technical competence, with clear pictures and sound, and useable for future personnel training by the Owner.

3.12 LEAKS

A. During the time period from date of Contract until termination date of the guarantee, Contractor shall be responsible for damages to the building, grounds, walks, roads, piping systems, insulation, electrical systems, refrigeration, heating, ventilating and air conditioning systems, building equipment, furniture, and other building contents caused by leaks in piping systems or equipment being installed or having been installed by him. All repair work shall be done as directed by, and in a manner satisfactory to the Engineer and at no cost to the Owner.

END OF SECTION

SECTION 15015 - SLEEVES AND PENETRATIONS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide sleeves for all piping passing through walls, partitions, beams, floors, and roof in new masonry and concrete construction above grade or in basements. Holes through existing masonry or concrete construction shall be core drilled.

B. Use sleeves where round or oval duct openings are required through exposed walls, smoke or fire walls, and equipment room walls.

C. The Contractor is responsible for correct location, size, and delivery of the sleeves so as not to delay construction. If sleeves are not properly installed and cutting and patching becomes necessary, it shall be done at no expense to the Owner by parties approved by the Engineer. Contractor shall undertake no cutting or patching without first securing the Engineer's written approval.

D. Provide seals and collars for rectangular duct penetrations of walls and floors. Coordinate openings with other divisions.

E. Provide flashings or pitch pockets where required around structural roof curbs or frames (See Section 15090 - Hangers, Supports and Anchors) for mechanical equipment.

F. Provide flashings or curbs for piping or duct penetrations of the roof.

PART 2 - PRODUCTS

2.01 SLEEVE MATERIAL

A. Sleeves up thru 8" diameter shall be Schedule 40 steel pipe, machine cut, and galvanized.

B. Sleeves, 10" diameter and larger, shall be fabricated from 10 gauge steel sheet, continuously welded seams and galvanized.

C. A pipe sleeve shall be one size larger than the size of pipe it serves, or 1/2" all around. Insulated pipe shall have sleeves 1/2" or larger all around than insulation, except for penetration of fire-rated assemblies. Sleeves set in concrete floors shall extend 1 1/2"- 2" above the finished floor.

D. Sleeves to Gas Tight walls shall be constructed of Stainless Steel and contain ring that shall be sealed to the Air Barrier on the gas tight wall. Sleeves shall be sized to allow link seals between the sleeve and the pipe. Link Seals shall be provided on sides of the wall.

2.02 WATERTIGHT SEALS

A. Provide for outside and underground wall and floor penetrations.

B. "Linkseal" by Thunderline Corporation or approved equivalent as alternate to above. Provide correct sleeve size to match.

2.03 ESCUTCHEONS (Except Refrigerant Piping)

A. Provide heavy chrome-plated or nickel-plated plates of approved pattern on pipe passing through walls and ceilings in finished areas. Escutcheons shall be chrome-plated steel plates

with concealed hinges. Pattern shall be approved by the A/E, and shall be firmly held on pipe by springs or set screws.

2.04 FLASHINGS

A. Provide galvanized, stainless steel, or copper flashings and storm collars or counter-flashings for pipes and ducts penetrating the roof or outside walls.

B. Provide seamless lead flashings or previously approved alternate flashings for plumbing vents which are in compliance with the plumbing code of the project jurisdiction.

C. For all other piping penetrations, furnish minimum 4 pound lead or 16 oz. copper flashing assembly with minimum 8" skirt, and permaseal waterproofing compound.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

A. Size sleeves to provide 1/2" minimum clearance all around passing pipe or pipe insulation. Insulation shall be continuous through sleeves unless prohibited by Code.

B. Fill space around ducts and pipes in sleeves in exposed areas and through slabs, fire walls and partitions with non-flammable sealing compound equal to Dow Corning Silicone RTV Foam.

C. Close off all openings around rectangular ducts through walls with sheet metal collars and sealing compound.

D. Sleeves in above grade floors of equipment rooms, and utility rooms shall extend 2" above floor and be cut flush with underside of floor construction.

E. Sleeves through walls shall be cut flush with each surface.

F. Install sleeves plumb and true to line, grade and position.

G. Unused sleeves shall be plugged and finished to match adjacent surface.

H. Sleeves and seals are not required on ducts passing through walls above ceilings, except for fire walls, if the penetrations are neatly cut. Rough, jagged or oversized penetrations will be provided with sleeves and patched.

I. Sleeving is not required for piping passing through underground foundation walls and footings except as required for sealing method.

J. Pipe sleeves penetrating outside walls shall be packed with insulating material, sealed and made waterproof. Option: Watertight seals specified above. Check for details.

K. Where a pipe passes through a sleeve, no joint in the pipe (or its insulation) shall touch the sleeve or be inside it.

L. Install all roof curbs and flashings required for mechanical equipment, including repair of existing roofs. For new work coordinate roof penetrations with Division 7 Sections rented to roofing.

M. Extend all pipes a minimum of 12" above finished roof line.

N. Wall sleeves thru gas tight walls shall be installed during construction. Where wall sleeves are installed after installation of the gas tight wall and air barrier, the wall sleeve shall be installed to maintain the integrity of the gas tight wall at no additional cost to the owner. The

sleeve shall be installed with a ring which is welded continuously around the sleeve. The wall opening on wall that does not contain the air barrier shall be cut oversized to allow the sleeve with ring to be installed and the ring sealed to the air barrier. Fill the area between the wall and the sleeve with non-shrink grout. Install link seals on both sides of wall penetration.

END OF SECTION

SECTION 15022 - LUBRICATION AND PACKING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Lubricate all equipment with correct grade, type and quantity of lubrication before placing equipment into service.

B. Damages caused by not providing proper lubrication shall be repaired at the Contractor's expense.

PART 2 - PRODUCTS

2.01 LUBRICANTS

A. Provide manufacturer's recommended specific lubricants.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Each shaft or valve stem containing a packing gland shall be checked for condition and examined for proper packing.

B. Maintain all lubrication and packing seals during construction, and assure that all are operating properly at the time of final acceptance.

C. When filling systems initially for hydrostatic pressure tests, adjust valve packing glands to fingertight, and allow packing to absorb water for 5 minutes prior to tightening packing nuts.

D. All rotating pieces of equipment shall be properly lubricated prior to start-up. Damage to shafts, bearings, seals, etc., caused by lack of proper lubrication or over-lubrication shall be repaired by the Contractor. Items requiring factory start-up shall have their lubrication verified by the manufacturer's representative.

E. Where necessary, provide means for lubricating all bearings and other machine parts. If a part requiring lubrication is concealed or inaccessible, extend a lubrication tube with suitable fitting to an accessible location and suitably identify it.

F. A list of all Division 15 items requiring periodic lubrication shall be included in the bound reference manuals prepared at the end of the job. List shall include equipment identification, lubricant type required, special tools, if any, required for application and manufacturer's recommendations for period (Section 15010).

END OF SECTION

SECTION 15060 - PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipe, fittings, and connections.

B. Unless otherwise indicated in the Documents, these specifications cover all mechanical piping on the Project, including site work. Should specifications for site mechanical piping appear in other Divisions of the Specifications, they shall supercede this Section for the exterior portion of the work only and the work of this Section shall only include piping to five ft. outside the building for those systems so specified.

1.02 RELATED WORK, AS INCLUDED

A. Section 15080: Piping Specialties - General

B. Section 15090: Hangers, Supports and Anchors

C. Section 15095: Expansion Compensation and Vibration Isolation.

D. Section 15100 - Valves

E. Section 15410 - Plumbing Piping

F. Section 15535 - Refrigeration Piping and Specialties

1.03 REFERENCES

A. Note that any one reference may not apply to a given portion of the work. See other Sections for piping types required for each system. References shall always be assumed to mean the current or most recent edition, unless otherwise indicated.

1. ANSI/ASME SEC. - Boilers and Pressure Vessels VIIID Code, Rules for Construction of Pressure Vessels, with addenda.

2. ANSI/ASME SEC. - Boilers and Pressure Vessels Code, IX Welding and Brazing Qualifications, with addenda.

3. ANSI/ASME B1.1 - Unified Screw Threads

4. ANSI/ASME B2.1 - Pipe Threads (Except Dry Seal)

5. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, 25, 125, 250, and 800 pounds

6. ANSI/ASME B16.3 - Malleable-Iron Threaded Fittings Class 150 and 300.

7. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

8. ANSI/ASME B16.5 - Steel Pipe Flanges and Flanged Fittings

9. ANSI/ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings

10. ANSI/ASME B16.11 - Forged Steel Fittings, Socket Welded and Threaded

11. ANSI/ASME B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings

12. ANSI/ASME B16.20 - Ring-Joint Gaskets and Grooves for Steel Pipe Flanges
13. ANSI/ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
14. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
15. ANSI/ASME B16.24 - Bronze Pipe Flanges and Flanged Fittings
16. ANSI/ASME B16.25 - Buttwelding Ends for Pipe, Valves and Fittings.
17. ANSI/ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes
18. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
19. ANSI/ASME B18.2.1 - Square Head Bolts and Screws
20. ANSI/ASME B18.2.2 - Square and Hex Nuts
21. ANSI/ASME B31.1 - Power Piping
22. ANSI/ASME B31.5 - Refrigeration Piping
23. ANSI/ASME B31.9 - Building Services Piping
24. ANSI/ASME B36.10 - Welded and Seamless Wrought Steel Pipe
25. ANSI/ASME Z49.1 - Safety in Welding and Cutting
26. ANSI/ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc- Coated, Welded and Seamless
27. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings
28. ANSI/ASTM A105 - Forgings, Carbon Steel, For Piping Components
29. ANSI/ASTM A106 - Seamless Carbon Steel Pipe for High-Temperature Service
30. ANSI/ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized), Welded and Seamless, for Ordinary Uses
31. ANSI/ASTM A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings
32. ANSI/ASTM A135 - Pipe, Steel, Black, Electric Resistance Welded
33. ANSI/ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
34. ANSI/ASTM A197 - Cupola Malleable Iron
35. ANSI/ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, For High Temperature Service
36. ANSI/ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
37. ANSI/ASTM A307 - Carbon Steel Externally and Internally Threaded Standard Fasteners

38. ANSI/ASTM A395 - Ferritic Ductile Iron Pressure Retaining Castings for Use at Elevated Temperatures

39. ANSI/ASTM A795 - Specification for Black and Hot-dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Prevention Use

40. ANSI/ASTM B32 - Solder Metal, 95-5 (Tin-Antimony - Grade 95-5TA).

41. ANSI/ASTM B36.10M - Wrought Steel Pipe

42. ANSI/ASTM B75 - Seamless Copper Tube

43. ANSI/ASTM B88 - Seamless Copper Water Tube

44. ANSI/ASTM B140 - Flexible Metal Hose

45. ANSI/ASTM B251 - General Requirements for Wrought Seamless Copper and Copper Alloy Tube

46. ANSI/ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

47. ANSI/ASTM B813 - Fluxes for Soldering Applications of Copper and Copper Alloy Tube

48. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe

49. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

50. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings

51. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated

52. ANSI/ASTM D1784 - Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds

53. ANSI/ASTM D1788 - Rigid Acrylonitrile-Butadiene-Styrene (ABS) Plastics

54. ANSI/ASTM D2104 - Polyethylene (PE) Plastic Pipe, Schedule 40

55. ANSI/ASTM D2146 - Polypropylene Plastic Molding and Extension Materials

56. ANSI/ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

57. ANSI/ASTM D2564 - Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

58. ANSI/ASTM D2657 - Heat Joining of Thermoplastic Pipe and Fittings

59. ANSI/ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite Sewer Piping

60. ANSI/ASTM D2729 - Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

61. ANSI/ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings

62. ANSI/ASTM D2855 - Practice for Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

63. ANSI/ASTM D3033 - Type PSP Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

64. ANSI/ASTM D3034 - Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

65. ANSI/ASTM D3138 - Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly Vinyl Chloride (PVC) Non-Pressure Piping Components.

66. ANSI/ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

67. ANSI/ASTM D3309 - Specification for Special Listed Polybutylene (PB) Pipe

68. ANSI/ASTM F437 - Specification for Schedule 80 Chlorinated Polyvinyl Chloride (CPVC) Threaded Fittings.

69. ANSI/ASTM F438 - Specification for Schedule 40 Chlorinated Polyvinyl Chloride (CPVC) Socket Type Fittings.

70. ANSI/ASTM F439 - Specification for Schedule 80 Chlorinated Polyvinyl Chloride (CPVC) Socket Type Fittings.

71. ANSI/ASTM F442 - Specification for Special Listed Chlorinated Polyvinyl Chloride (CPVC) Pipe

72. ANSI/AWS A5.8 - Brazing Filler Metal (Class BCuP-3 or BCuP-4)...

73. ANSI/AWS D.1.1 - Structural Welding Code, Steel.

74. ANSI/AWS D10.9 - Specification for qualification of Welding Procedures and Welders for piping and Tubing.

75. ANSI/AWWA C105 - Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids

76. ANSI/AWWA C111 - Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings

77. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast 0in Metal Molds or Sand Lined Molds, for Water or Other Liquids

78. ANSI/AWWA C606 - Grooved and Shouldered Type Joints

79. The Copper Development Association Publication: Copper Tube Handbook

80. NFPA 51B - Standard for Fire Prevention in Use of Cutting and Welding Processes

81. CISPI No. 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary System

82. FS WW-P-521 - Pipe Fittings, Flange Fittings, and Flanges: Steel and Malleable Iron (Threaded and Butt Welding) Class 150

83. ASTM C1053 - Borosilicate Glass Piping Systems.

84. ASTM D2447 - Polypropylene Chemical-Resistant Pipe

85. ASTM F 2389-06 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

86. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications

87. NSF/ANSI 14 – Plastic Piping System Components and Related Materials

88. NSF/ANSI 61 – Drinking Water Systems Components – Health Effects

1.04 QUALITY ASSURANCE

A. Codes and regulations referred to are minimum standards. Where the requirements of these Specifications or Drawings exceed those of the codes and regulations, the Drawings or Specifications govern.

B. Piping systems shall meet requirements of ANSI/ASME B31.9, Building Services Piping, ASME Boiler and Pressure Vessel Code, State Plumbing Code, State Boiler Code and Kentucky Building Code.

C. All plumbing work shall be accomplished by or under the direct supervision of a licensed plumber.

D. All fire protection work shall be accomplished by or under the direct supervision of a licensed sprinkler installer.

E. Welding Materials and Procedures: Conform to ASME Code and AWS standards referenced above. Employ certified welders in accordance with ASME Section 9, ANSI/AWS D1.1., ANSI/AWS D10.9 and Boiler Inspection Section, State Fire Marshal. Welders shall be certified under the rules of the National Certified Pipe Welding Bureau and qualified by either the National Certified Pipe Welding Bureau or an independent testing laboratory for the procedures used on this Project.

1.05 SUBMITTALS

A. In general, do not submit on ordinary pipe and fittings, except as noted in these Specifications. Submit on specialties per Section 15080.

B. See individual piping Sections for additional submittal requirements.

C. Submit a letter certifying that welders and welding procedures meet the requirements of AWS D10.9, Level AR-3.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide pipe and tubing systems of types called for in the individual piping system Sections of the Specifications. Provide materials and products meeting the standards referenced in those Sections and in Paragraph 1.03 above.

B. Provide work meeting the requirements referenced in this Section 15060 - Pipe and Pipe Fittings (General), and Sections 15080 - Piping Specialties (General), 15090 - Hangers, Supports and Anchors, 15095 - Expansion Compensation and Vibration Elimination, 15100 Valves.

C. Provide all new materials in good condition, unless otherwise indicated in the Documents. Rusted, dented, bent or otherwise damaged pipe and fittings will not be accepted and shall be removed from the site as soon as discovered.

D. Provide piping system components with appropriate identification, rating or approval labels, stamps or symbols as required by Code or to show compliance with the requirements of

these Documents. Unlabeled pipe, valves missing appropriate markings or any other non-identifiable items shall not be installed.

E. All piping, fittings, gauges, valves, meter, and related components that are installed on potable water service shall be lead free and shall be in compliance with NSF/ANSI 61 G and NSF ANSI 372 Drink Water System Components – Lead Content.

2.02 PRESSURE/TEMPERATURE RATINGS

A. Pressure/temperature ratings of all components and accessories shall meet or exceed design conditions for the system in which they are installed. All piping components, joints, valves, accessories and specialties shall be designed for operating conditions of not less than that indicated in individual piping Sections of the Specifications and shall be designed to withstand continuous use at the following conditions as a minimum:

1. Domestic Cold Water (DCW, MU, PW): 150 psig at 125 deg. F.

2. Domestic Hot Water (DHW, HMU, HW), Tepid Water (TW), and recirculated water (DRW, HWR): 150 psig and 250 deg. F.

3. Fire water service and distribution (F, FP): 175 psig and 125 deg. F.

4. Hydronic heating piping (HWS, HWR, HCWS, HCWR): 125 psig SWP and 250 deg. F.

5. Water source heat pump, heat recovery and condenser water lines (HPWS, HPWR, CWS, CWR, HRS, HRR): 125 psig and 140 deg. F. Drainage spec piping may be used for tower open returns where allowed by notes.

6. Chilled water lines (CHWS, CHWR): 125 psig and 100 deg.F.

7. Low Pressure Steam (LPS), Low Pressure Return (LPR), Pumped Condensate Return (PCR): 125 psig SWP and 250 deg. F.

8. Medium and High Pressure Steam and Return (MPS, HPS, MPR, HPR): 150 psig and 350 deg. F.

9. Fuel Oil Supply, Return and Vent lines in general (FOS, FOR, FOV): 125 psig 250 deg. F. Some burner piping requires 350 psig or more.

2.03 PIPE AND FITTINGS

A. Where no detailed specification of pipe or fittings is given for a type of system, either in the Specifications or the Drawings, use the following general recommendations for material type.

1. Steel Pipe: ANSI/ASTM A53 Grade B, black; galvanized; Schedule 40 or as indicated. Steel Pipe Fittings: ANSI/ASME B16.3 or ANSI/ASTM A126. Weld fittings for black steel pipe shall be Tube Turns, Bonney Forge, Capital, or WFI, black steel butt welded type ASTM A234 Grade WPB of a service class to match the adjacent pipe, except that connections to valves shall be made with ASTM A105 welding neck flanges. Flanges shall have ASTM A307 Grade B bolts with hexagon heads and nuts and shall be provided with gaskets as specified and insulating sleeves where required.

2. Cast Iron Soil Pipe: ANSI/ASTM A74; coated; standard weight or as indicated. Cast Iron Pipe Fittings: ANSI/ASTM A74; ASTM C564, rubber gasket joints; ANSI/AWWA C606, grooved and shouldered joints; ANSI/AWWA C111, rubber gasket joints.

3. Hubless Cast Iron Soil Pipe: CISPI 301.

4. Ductile Iron Water Pipe: ANSI/AWWA C151, Class 50, cement-lined, bituminous coated.

5. Copper Water Tube: ASTM B88, Type K soft temper underground direct bury, Type K hard drawn for underground prefab systems, Type L hard drawn in building; Types M, DWV only as indicated. Wrought Copper and Brass Pipe Fittings: ANSI/ASME B16.22, pressure fittings or ANSI/ASME B16.29, drainage fittings. Solder shall be 95/5 tin antimony or tin/silver alloy type. Flux shall be non-acid type, approved by solder manufacturer.

6. Concrete Pipe: ASTM C14, Class 3. Concrete Pipe Fittings: ASTM C443

7. ABS Plastic Pipe: ANSI/ASTM D1788. ABS Pipe Fittings: ANSI/ASTM D2751. Solvent for ABS Jointing: ASTM D2235

8. ABS Plastic Sewer Pipe: ANSI/ASTM D2751. ABS Pipe Fittings: ANSI/ASTM D2751. Solvent for ABS Jointing: ASTM D2235

9. PVC Plastic Pipe: ANSI/ASTM D1784, Schedule 40 or 80; SDR 26, ASTM D2241; Pipe Fittings: ANSI/ASTM D2729. Solvent for PVC Jointing: ANSI/ASTM D2564. Solvent for Joining ABS to PVC: ANSI/ASTM D3138, non-pressure.

10. PVC Plastic Sewer Pipe: ASTM D3033, Type PSP or D3034, Type PSM. Solvent for PVC Jointing: ANSI/ASTM D2564. Solvent for Joining ABS to PVC: ANSI/ASTM D3138, non-pressure.

11. Polyethylene Sewer Pipe: ANSI/ASTM D2104, Schedule 40. Heat fusion for joining polyethylene: ANSI/ASTM D2657

12. Polypropylene Sewer Pipe: ANSI/ASTM D2146. Heat fusion for joining polypropylene: ANSI/ASTM D2657

13. Glazed Vitreous Clay Pipe: ASTM C700 standard strength.

14. Polypropylene-Resin: Pipe shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Piping shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

    A. Basis of Design Manufacturer, Aquatherm Green Pipe with fiber layer.

15. PVC Coated Copper: PVC Coated Copper of use in corrosive environments. Type L: hard copper coated with Polypropylene coating made from low density LDPE with minimum wall thickness of 0.025” and UV inhibitors.

2.04 UNIONS, COUPLINGS AND JOINTS

A. Unions - Pipe Size Under 2 inches: 150 psi bronze ground joint malleable iron for threaded ferrous piping; bronze for copper or brass pipe soldered joints. No wrought copper unions shall be used above 3/4" pipe size.

B. Unions - Pipe Size Over 3 inches: 150 psi forged steel or cast iron slip-on, or weld neck flanges for ferrous piping; bronze flanges for copper or brass piping; synthetic rubber gaskets for gas service.

C. Unions - Pipe Sizes 2 and 2 1/2 inch: Either of the types in A. and B.

D. Dielectric Unions: Vogt, Dart, Capitol or approved equal dielectric insulated unions for all copper to ferrous metal connections.

E. Dielectric flanges: Provide flange insulation kit for each copper to ferrous joint or as otherwise shown. Include electrically insulating gaskets, inserts and washers as required for complete isolation.

F. Couplings: Threaded steel pipe - Provide malleable iron sleeve coupling with right hand pipe thread on each end, standard or extra heavy as required for service.

G. Couplings: Copper pipe - Provide copper sleeve coupling with shoulder, socket sized for sweat connection or brazing.

H. Welded Joints: Provide joints in steel pipe executed by a properly certified pipe welder. Provide welding as required per Part 3 of this Section.

I. Grooved and Shouldered Pipe Ends: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction and expansion; C-shape composition sealing gasket, steel bolts, nuts and washers; galvanized couplings for galvanized pipe.

J. Polypropylene Fittings, Fusion Welded: Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

PART 3 - EXECUTION

3.01 GENERAL

A. Joints in pipe and tubing shall be cut square with tubing or pipe cutter. Ends shall be reamed. Remove burrs. Bevel plain end ferrous pipe.

B. Remove filings, dust, scale and dirt, inside and outside, before assembly. Open ends of pipelines or equipment shall be properly capped or plugged during construction, until installation, to keep dirt and other foreign materials out of system.

C. Remove welding slag, splatter or foreign material from pipe and fitting materials before assembly and after joining.

D. Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, and properly clearing all windows, doors, and other openings.

E. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless approved in writing. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided and approved by the Engineer. Supports shall conform to Section 15090 - Hangers, Supports and Anchors.

F. Changes in direction shall be made with fittings unless otherwise indicated. Bent pipe showing kinks, wrinkles, flattening or other malformations will not be accepted.

G. Provide reducing fittings for changes in pipe sizes. Reducers (increasers) shall be concentric unless eccentric fittings are indicated or required for proper drainage.

H. Pipes shall be installed to permit free expansion and contraction without damage to joints or hangers. Expansion in the piping shall be accommodated by means of expansion loops and offsets or by expansion joints as indicated in the Documents. Refer to Section 15095 - Expansion Compensation and Vibration Elimination.

I. Flanges and unions shall be faced true. Flanges shall be provided with gaskets suitable for the fluid used and made square and tight. Except where copper tubing is used, unions or flange joints shall always be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, valves, and other similar items unless such items have integral flanges or unions.

3.02 COPPER PIPE CONNECTIONS

A. Form hot soldered joints in copper, brass, or bronze fittings with 95-5 solder for plumbing. Do not use for refrigeration or fuel lines. 50-50 solder or other lead-bearing solder shall not be used. Joints shall be soldered, using flux, with solder applied and drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens.

B. Joints for copper-copper, copper-brass, copper-bronze, shall be brazed where shown with specific alloy filler indicated (ANSI/AWS A5.8). During all brazing operations, the tubing and fitting being brazed shall have a continuous purge of dry nitrogen at a rate which will preclude oxidation of the tubing and fitting. All tubing and fittings shall be properly cleaned prior to brazing. All copper tubing joints that are assembled on the job site shall be assembled with fittings.

C. Joints for copper tubing may be made with flare fittings where indicated.

D. Work into place without forcing or springing.

3.03 STEEL PIPE CONNECTIONS - THREADED

A. Screw joint steel piping up to and including 1-1/2 inch, unless otherwise indicated. Weld piping 3 inch and larger, including branch connections. Screw or weld 2 or 2-1/2 inch piping.

B. Die cut screwed joints with full cut standard taper pipe threads, using cutting oil appropriate for operation.

C. Assemble with teflon paste joint compound applied to male threads only, unless otherwise indicated. Non-toxic compound shall always be used for water service piping.

3.04 STEEL PIPE CONNECTIONS - WELDED

A. Screw joint steel piping up to and including 1-1/2 inch, unless otherwise indicated. Weld piping 3 inch and larger, unless otherwise indicated, including branch connections. Screw or weld 2 or 2-1/2 inch piping.

B. Welding procedures shall be in accordance with ANSI/ASME B31.9 for the service involved. Welds shall be full penetration type, accomplished by proper beveling and spacing of pipe ends. Where backing rings are specified herein, root pass shall penetrate into the backing ring.

C. No field fabrication of jointed fittings, mitering or notching pipe to form elbows and tees or direct welding of pipe to pipe will be allowed unless specifically shown, except for buttwelding of properly aligned and prepared straight pipe sections.

D. Provide factory weld fittings for all turns in pipe. Weld bends may be field cut to proper angle as required for fit.

E. Provide manufactured weld tee fittings for branches from a main line which are main size or one size less for up to 6" pipe and for main size or up to two sizes less for 8 inch and larger mains, unless otherwise indicated. Take-off or saddle fittings such as "Weld-o-lets", "Thread-o-lets", "Latrolets", "Sweepolets", and "Elbolets" and the like may be used for smaller branch piping unless otherwise indicated. Do not project branch pipes or take-off fittings inside the main pipe.

F. Field and shop bevels shall be in accordance with the standards specified herein and shall be done by mechanical means or flame cutting. Where beveling is done by flame cutting, surfaces shall be cleaned of slag, scale and oxidation prior to welding.

G. Before welding, the component parts to be welded shall be aligned so that no strain is placed on the weld when finally positioned. Height shall be aligned so that no part of the pipe wall is offset by more than 20% of the wall thickness. Flanges and branches shall be set true. This alignment shall be preserved during the welding operations. Connections larger than 6" shall be made with backing rings at welds.

H. Where the temperature of the component parts being welded reaches 32ºF or lower, the material shall be heated to approximately l00ºF for a distance of 3' on each side of the weld before welding, and the weld shall be finished before the material cools to 32ºF.

I. Welders shall stamp each weld with their personal symbol or code number.

J. A random sample of completed pipe field welds may be chosen by the Engineer for non-destructive testing by an independent testing agency, not to exceed 5% of the total welds on the project. Costs for testing shall be borne by the Contractor. Test criteria shall be as specified by ANSI/ASME B31. If any of the tested welds are unsatisfactory, additional welds may be chosen for testing at the Contractor's expense. Defective welds shall either be cut out and rewelded or ground down to base metal and rewelded. All reworked welds shall be tested as specified herein.

3.05 STEEL PIPE CONNECTIONS - GROOVED

A. Groove type coupling system may be used wherever this piping type is specified as an option in the individual piping Sections listed in Paragraph 1.02.

3.06 PLASTIC PIPE CONNECTIONS

A. Use joint primer with dye (Oatey Purple Primer or equal) for all PVC or CPVC solvent welded joints. Follow manufacturer's recommendations in the use of primer.

B. Form solvent joints in PVC pipe and fittings to ANSI/ASTM D2855.

C. Form heat fusion joints in polyethylene and polypropylene pipe and fittings to ASTM D 2657.

3.07 VITREOUS PIPE CONNECTIONS

A. Joints for Bell and Spigot Pipe: Lead and oakum or patented Neoprene gasketing system.

B. Joints for Plain End Pipe: Neoprene gasket and clamp system.

3.08 POLYPROPYLENE CONNECTIONS, FUSION WELDING

A. Manufacturer’s recommended procedures shall be followed. Work shall be performed by manufacturer’s trained technicians. Training of technicians shall be at no cost to the owner.

B. Install fittings and joints using socket-fusion, elecrofusion, or butt-fusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer’s specifications and product standards.

B. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.

C. Prior to joining, the pipe and fittings shall be prepared in accordance with ASTM F 2389 and the manufacturer’s specifications.

D. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer’s specifications.

3.09 COPPER, PVC COATED

A. Follow the manufacturer’s recommended procedures for connecting PVC coated copper fittings. Fittings shall be wrapped with manufacturer’s recommended tape to form a continuous PVC coating on all fitting and piping.

3.10 PIPING SCHEDULE

A. Below is a table of the piping materials, piping systems, and areas. Where multiple materials are provided, the contractor may choose which material to use.

Area	System	Piping Materials	Comments
Corrosive Areas: Truck Loading Bay, Grit and Screen Handling Area, Grit Tanks, Wet Well, Flumes, Odor Control System	Sanitary, Industrial Waste, and Condensate piping / drains	PVC Schedule 40	
	Non-Potable Water, Potable Water, And Tepid Water	PVC Coated Copper (Type L) Or Fusion Welded Polypropylene with faser layer.	
	Compressed Air	See Specification 15212	
	Natural Gas	See Specification 15197	
General Above Ground Piping Areas: Office-RM 107, Sampler Room-RM 108, Restroom-RM 109, Storage-RM 110, Maintenance-RM 111, Pipe Gallery-RM 115, Grit Pump Room,	Sanitary, Industrial Waste, and Condensate piping / drains	PVC Schedule 40	
	Non-Potable Water, Potable Water, Hot Water, And Tepid Water	Copper Type L, PVC Coated Copper (Type L), Or Fusion Welded Polypropylene with faser layer.	
	Compressed Air	See Specification 15212	
	Natural Gas	See Specification 15197	
Underground Piping	Sanitary, Industrial Waste, and Condensate piping / drains	PVC Schedule 40	
	Non-Potable Water, Potable Water,	Soft Copper Type K, or Fusion Welded Polypropylene with faser layer.	
	Natural Gas	See Specification 15197	

END OF SECTION

SECTION 15080 - PIPING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Strainers.

B. Gauges.

C. Test plugs.

D. Thermometers.

E. Vacuum breakers.

1.02 RELATED WORK

A. Section 15060 - Pipe and Pipe Fittings.

B. Section 15100 - Valves.

C. Section 15410 - Plumbing Piping.

D. Section 15535 - Refrigeration Piping and Specialties

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01300 and 15010. Include component sizes, rough-in requirements, service sizes, temperature and pressure ratings, performance data and finishes. Include product description, model and dimensions. Submit proposed ranges of gauges and thermometers for each service.

B. Submit operation and maintenance data under provisions of Sections 01780 and 15010. Include manufacturer's installation and application instructions, assembly views, lubrication and service instructions, and replacement parts list.

PART 2 - PRODUCTS

2.01 STRAINERS

A. Mueller Steam, Keckley, Sarco or approved equal per Section 15010.

B. 2½" and below: Screwed-cast iron for 175 psig working pressure, Y pattern, with bronze, monel metal or 18-8 stainless steel perforated screen; 20 mesh for steam and 0.045 inch diameter perforations for liquid.

C. 2½" and above: Flanged-iron body for 175 psig working pressure, Y pattern, with bronze, monel metal or 18-8 stainless steel perforated screen; 0.045 inch diameter perforations for steam and 0.125 inch for liquids.

D. For high pressure steam (HPS), strainers shall be cast steel, rated for 300 psi and 500 deg.F.

E. Strainer element shall be removable without disconnecting piping.

2.02 GAUGES

A. Trerice, Ashcroft, Marsh, Marshalltown or approved equal per Section 15010.

B. Pressure, vacuum or compound gauges: 4 1/2 " diameter face, brass Bourdon tube type; aluminum, steel or phenolic case; 1/4" NPT bottom connection; dials black figures on white background, graduated as required for service and identity labeled; nonshatterable safety glass, and pressure blowout back in case of explosion. Range to suit application.

2.03 TEST PLUGS (P/T PLUGS)

A. Sisco BNO-25, Pete's Plug or equal per Section 15010.

B. Test plugs: ¼-inch MPT, brass body and cap, with Nordel self-closing valve cores, suitable for 250 deg. F. water, installed in water piping where shown.

C. Provide extended units for insulated piping as required.

2.03 THERMOMETERS

A. Trerice, Ashcroft, Marsh, Marshalltown or approved equal per Section 15010.

B. Dial thermometers: 3½" - 5" diameter adjustable angle face; mercury vapor tension or gas actuated; stainless steel, aluminum or black steel case, glass lens, black figures on white background, graduated with range as required, guaranteed to be accurate within one scale division; recalibration adjustment feature; adjustable angle head and capillary. Provide range suitable to the application.

C. Provide minimum 1/2" NPT separable brass well and heat conducting paste.

2.04 VACUUM BREAKERS

A. Johnson, Hoffman, Sarco or approved equal per Section 15010.

B. Use spring-loaded types unless otherwise indicated.

C. Brass body, stainless steel spring and ball, EPR "O" ring, Johnson VB-8 series, 3/4" or as indicated, opening pressure 5"-25" water.

D. Provide swing check valve only where indicated, per Section 15100.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all items in accordance with manufacturer's instructions. In case of conflict, notify Engineer at once.

B. Provide blowoff ball valve for each wye-pattern water strainer, full size of tapping, with reducer, hose connection and cap.

C. Provide blowoff gate valve for each wye-pattern steam or condensate strainer, full size of tapping, with reducer, hose connection and cap.

D. Provide 1/4" lever-handled brass gauge cock and snubber on all pressure gauge installations except steam, unless otherwise indicated. All gauge faces shall be upright.

E. Provide straight or angled pigtail siphon and needle valve, on all steam pressure gauge installations. Trim components shall match temperature and pressure ratings of piping.

F. Provide wells for all thermometers. Mount wells in piping deep enough to contact flow stream directly but not far enough to disturb flow. See details on Drawings. Use aluminum temperature-conducting paste (Honeywell or equal) in all thermometer wells to ensure contact with bulbs. Adjust the face of all adjustable angle thermometers to be visible from the floor and tighten locking screws or nuts for a rigid installation. Avoid excessive twisting or movement of thermometer heads.

G. Provide P/T plugs with caps at all points indicated. Mount P/T plug in such position as to allow insert thermometer to be placed in fluid stream.

H. Install vacuum breakers in the horizontal or vertical top outlet positions only, unless otherwise shown, and then only in the positions for which the valves are rated.

END OF SECTION

SECTION 15090 - HANGERS, SUPPORTS, AND ANCHORS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide support and hangers for all piping, piping system components, and ductwork.

B. Provide pads, curbs, supports, anchors, frames and hangers for all equipment.

C. Provide steel angles and channels between structural members, framework and reinforcement as necessary to support piping and equipment.

1.02 RELATED WORK

A. Section 15060 - Pipe and Pipe Fittings.

B. Section 15095 - Expansion Compensation and Vibration Elimination.

C. Section 15810 - Ductwork.

D. Division 3 - Concrete.

E. Division 5 – Metals

1.03 QUALITY ASSURANCE

A. Meet the requirements of the following:

1. MSS SP 58 Pipe Hangers and Supports - Material, Design and Manufacture.

2. MSS SP 69 Pipe Hangers and Supports - Selection and Application.

3. ANSI Code for Pressure Piping.

4. Hangers and supports shall have a stress safety factor of 5.

1.04 SUBMITTALS

A. Submit manufacturer's product data for the following:

1. Hangers.

2. Supports.

3. Inserts.

4. Anchors.

5. Structural Curbs.

1.05 COORDINATION

A. Obtain Engineer’s approval before welding, drilling or cutting any structural members.

B. Coordinate runs of piping and locate equipment to utilize structural members.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products are based on Anvil as a standard, unless specified otherwise.

B. Optional manufacturers: Automatic Sprinkler, Elcen, F & S, Fee & Mason, or Michigan.

2.02 MATERIALS GENERAL

A. Hangers, attachments, supports, anchors, and related support components in corrosive environments shall be constructed of corrosion resistant materials, stainless steel, epoxy coated galvanized. The following areas shall be considered corrosive:

1. Screening and Grit Handling areas
2. Wet Well
3. Grit Tank
4. Flume Channel

2.03 STRUCTURE ATTACHMENT DEVICES

A. Riser clamp, steel: Anvil Fig. 261. Provide masonry or concrete bearing. B. Riser clamp, copper: Anvil Fig. CT-121, copper plated. Provide masonry or concrete bearing.

C. Top beam clamp: Anvil Fig. 227 with Fig. 157 extension.

D. Bottom beam clamp: Anvil Fig. 229. (Use only where top clamps are not possible. Obtain approval from Architect).

E. Side beam bracket: Anvil Fig. 202. (For wood construction only).

F. Horizontal traveler: Anvil Fig. 170.

G. Concrete inserts: Anvil Fig. 282, galvanized.

H. Concrete fasteners: Phillips "Red Head".

I. Copper tube strap: Anvil Fig. 9124.

J. Pipe strap: Anvil Fig. 262.

K. Pipe hanger flange: Anvil Fig. 153.

L. Bottom channel clamp: Anvil Fig. 226 with 157 extension. (Obtain approval from Engineer prior to use.)

M. Bottom beam/joist C clamp: Anvil Fig. 87 with retaining clip and locknut (for use with pipes 2" and smaller, obtain approval from Engineer prior to use).

2.04 HANGERS AND ACCESSORIES

A. Adjustable copper tubing ring: Anvil Fig. CT-99, copper plated.

B. Adjustable swivel split ring: Anvil Fig. 104, black finish.

C. Adjustable pipe ring, plastic coated: Anvil Fig. CT-99c, plastic coated.

D. Heavy adjustable clevis: Anvil Fig. 260, black finish.

E. Lightweight adjustable clevis: Anvil Fig. 65, black finish.

F. Pipe roll stand: (base supported): Anvil Fig. 271, cast iron roll.

G. Adjustable pipe roll: Anvil Fig. 181.

H. Pre-engineered spring hanger: Anvil Figs. B-268, 82, or 98.

I. Insulated pipe saddle: Hot lines - high density precompressed fiberglass support segment with 18 ga. galvanized steel shield. Cold lines - provide "Foamglass" pipe insulation with jacket and 18 ga. galvanized steel shield. Insulation thickness shall be same as specified in 15900.

2.05 HANGER RODS AND ACCESSORIES

A. Provide plated steel threaded rods. Size according to 3.02 following.

B. Provide all necessary couplings, turn buckles, nuts, washers, and accessories for a complete installation.

C. Provide stainless steel, or PFTE (Teflon) coated steel threaded rods for corrosive areas.

2.06 TRAPEZE COMPONENTS

A. Horizontal trapeze member: Unistrut P-2700 series channel, standard or heavy duty according to load.

B. Trapeze clamp: Unistrut two piece bolted pipe clamp; steel for steel pipes, copper for copper pies, stainless steel, epoxy coated galvanized, or FRP for corrosive areas.

2.07 EQUIPMENT SUPPORTS

A. Provide 3 x 3 x 1/4 angles or heavier, if required, spanning 3 structural joists to support hung equipment.

B. Provide channels (strength as required) to span between beams. Weld to beams. Obtain approval of Engineer before proceeding.

2.08 ROOF SUPPORTS

A. If not furnished with the equipment or otherwise detailed, provide 8" high support curbs of proper length to support piping and equipment. Curbs shall span 3 joists when supporting equipment. Curbs shall be Pate ES-1A, galvanized steel with wood nailer.

PART 3 - EXECUTION

3.01 PIPE SUPPORT METHODS

Condition	**Support Method**
Uninsulated copper pipe, horizontal hung	Adjustable copper tubing ring and hanger rod
Uninsulated copper pipe, horizontal bottom support	Copper tube strap. Provide necessary angle braces
Uninsulated copper pipe, vertical	Copper tube strap to walls with anchors. Riser clamp, copper at floors.

Condition	Support Method
Uninsulated metal drain pipe horizontal hung	Heavy adjustable clevis, hanger rod.
Uninsulated metal drain pipe vertical	One hold clamp (at walls). Riser clamp, steel (at floors).
Insulated pipe horizontal, hung	Insulation pipe saddle, heavy adjustable clevis, hanger rod.
Insulated pipe horizontal, bottom support	Insulated pipe saddle, pipe roll stand.
Insulated pipe horizontal, hung with movement	Adjustable pipe roll hanger and with rod.
Insulated pipe vertical	Pipe strap to walls. Appropriate riser clamp, with sleeve at floors.
Bottom of storm and waste stacks at slab on grade floors	Concrete pipe foundation, poured after pipe is in place

Notes:

1. Install pipe saddles as pipe is installed.

2. Trapeze hangers may be used for multiple horizontal hung pipe runs. Trapeze consists of hanger rods, horizontal trapeze member, and trapeze clamps. Each pipe individually attached to trapeze.

3.02 SUPPORT SPACING AND HANGER ROD DIAMETERS

A. Cast iron, ductile iron, and copper pipes:

Pipe Size	Maximum Vertical And Horizontal Support Spacing	Rod Diameter
½", ¾"	5'	3/8"
1", 1¼ "	6'	3/8"
1½ ", 2"	9'	3/8"
2½", 3"	10'	½"
4", 5"	10'	5/8"
6", 8"	10'	¾"

Notes:

1. Maximum support spacing for horizontal cast iron drain and vent lines is one support at each joint. (i.e., 5' spacing for 5' lengths, 10' spacing for 10' lengths).

2. Provide additional supports at turns, valves, concentrated loads, connections to equipment and where necessary for proper alignment.

B. Plastic pipe:

1. All fluid filled services: Follow Paragraph A above. Maximum support spacing on horizontal lines shall be 4 ft.

2. Drain and vent lines: Support 4 ft. maximum centers with 3/8" diameter hanger rods.

3.03 STRUCTURE ATTACHMENT METHODS

Condition	Support Method

Hanger rod to steel bar joist or truss	Top beam clamp
Hanger rod to steel beam (corrugated metal deck above)	Top beam clamp
Hanger rod to steel beam (concrete deck above, temporary form)	Bottom beam clamp
Hanger rod to precast or existing concrete deck	Concrete fasteners, pipe hanger flange
Hanger rod to new cast-in-place concrete deck	Concrete insert
Hanger rod to wood beam	Side beam bracket, lag bolt to beam (use bolt through entire beam when load exceeds manufacturer's recommended load for lag bolt application)
Hanger rod to any structure at elbows with significant lateral movement	Horizontal traveler
Hanger rod to any structure at risers with significant vertical movement	Pre-engineered spring hanger
Hanger rod to any structure at risers from vibrating equipment	Pre-engineered spring hanger

Notes:

1. Do not install hangers from metal roof deck.
2. Avoid drilling concrete by using inserts.
3. Explosive powder driven fasteners are allowed.
4. In wood construction: Where pipe is parallel to, and hanging form joists, rafters, or beams, bolt angles to side of members vertically, bolt horizontal angles to vertical angles, attach hanger rods to horizontal angles.
5. Check structural and mechanical details for methods of support.

3.04 VIBRATING EQUIPMENT

A. In-line pump support: Contractor shall provide a calibrated spring-hanger when recommended and approved by the pump manufacturer. The spring shall support the pump at approximately the center of gravity and shall reduce the piping load to less than 10% of the weight of the pump at room temperature.

B. Support piping at pumps and equipment from floor, ceiling, or walls, so that piping weight is not supported from pumps or equipment.

3.05 WET AREA AND EXTERIOR SUPPORTS

A. Use nonferrous, FRP, stainless steel, epoxy coated galvanized steel, or plastic coated steel supports and hangers in kitchens, locker rooms, shower rooms, and in exterior applications.

3.06 ANCHOR BOLTS

A. Furnish and install anchors bolts for all equipment placed on concrete equipment pads or on concrete slabs.

B. Bolts shall be of the size and number recommended by the manufacturer of the equipment and shall be located by means of suitable templates.

C. When equipment is placed on vibration isolators, the equipment shall be secured to the isolators and the isolator secured to the floor, pad, or support as recommended by the vibration isolation manufacturer.

3.07 SEISMIC REQUIREMENTS

A. Provide seismic restraints to all mechanical systems (equipment, pipes, ducts, etc.) in accordance with the latest edition of SMACNA Guidelines for Seismic Restraints and Mechanical Systems, where called for in individual sections of the specifications.

3.08 ADDITIONAL REQUIREMENTS

A. Properly support pipe to maintain required alignment, slopes, and expansion capabilities.

B. Piping and ductwork shall be supported independently from the building inner structure. Where interferences occur, provide trapeze type hangers or other suitable supports for each system. Locate hangers and supports where they will not interfere with access to air device boxes, fire dampers, valves, and other appurtenances requiring servicing.

1. Ceiling grid systems shall not be supported from ductwork, conduits, heating or plumbing lines and vice versa.

C. Refer to Section 15095 for vibration isolation requirements for ductwork and piping.

END OF SECTION

SECTION 15095 - EXPANSION COMPENSATION AND VIBRATION ELIMINATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Flexible pipe connections.

B. Pipe expansion joints and compensators.

C. Pipe expansion loops, off-sets, and swing joints.

D. Vibration isolators.

1.02 RELATED WORK

A. Section 15060 - Pipe and Pipe Fittings.

B. Section 15090 - Hangers, Supports, and Anchors.

C. Division 15 - Other Sections

1.03 REFERENCES

A. ASHRAE - Wide to Average Noise Criteria Curves.

1.04 STANDARDS AND CODES

A. Conform to standards of Expansion Joint Manufacturer's Association.

1.05 DESIGN CRITERIA

A. Base expansion calculations on 50 degrees F installation temperature to 210 degrees F for hot water heating, 300 degrees F for steam, 110 degrees for condenser water, and 140 degrees for domestic hot water, plus 30 percent safety factor.

1.06 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01300 and 15010.

B. Indicate vibration isolator locations, with static and dynamic load on each, on shop drawings, and described on product data.

C. Submit manufacturer's installation instructions under provisions of Sections 01300 and 15010.

D. Flexible pipe connector shop drawing data to include maximum allowable temperature and pressure rating, overall face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure and total number of wires in braid.

E. Expansion joint shop drawings to include maximum allowable temperature and pressure rating, and maximum expansion compensation.

1.07 CERTIFICATES

A. Submit manufacturer's certificate under provisions of Section 15010 that isolator bases are properly installed and properly adjusted to meet or exceed specified requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Flexible connections: Flexonics, Keflex, or United Metal Hose.

B. Pipe expansion joints: Keflex, Flexonics, or Grinnell.

C. Vibration isolators and bases: Vibration Eliminator, Vibration Mountings and Controls, Peabody Noise Control, Korfund.

D. Alternate manufacturers will be considered per Section 15010.

2.02 VIBRATION ELIMINATING MOUNTINGS

A. Vibration Isolators

1. Type 1: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

2. Type 2: Open spring mount with stiff springs (horizontal stiffness equal to vertical stiffness).

3. Type 3: Open spring mount with stiff springs, heavy mounting frame, and limit stop.

4. Type 4: Closed spring mount with stiff springs and limit stop.

5. Type 5: Closed spring hanger with acoustic washer.

6. Type 6: Closed spring hanger with one inch thick acoustic isolator.

7. Type 7: Elastomer mount with threaded insert and hold down holes.

8. Type 8: Neoprene jacketed pre-compressed molded glass fiber.

9. Type 9: Rubber waffle pads, 30 durometer, minimum 1/2 inch thick, maximum loading 40 psi. Use neoprene in oily or exterior locations.

10. Type 10: 1/2 inch thick rubber waffle pads bonded each side of 1/4 inch thick steel plate.

B. Fabrication

1. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.

2. Color code spring mounts.

3. Select springs to operate at 2/3 maximum compression strain, with 1/4 inch ribbed neoprene pads.

2.03 FLEXIBLE PIPE CONNECTIONS

A. For steel piping construct with stainless steel inner hose and braided exterior sleeve.

B. For copper piping construct with bronze inner hose and braided exterior sleeve.

C. Use connectors suitable for minimum 125 psi WSP and 450 degrees F and 200 psi WOG and 250 degrees F.

2.04 EXPANSION JOINTS

A. Steel piping 3 inch and under: Stainless steel bellows type with anti-torque device, limit stops, and internal guide.

B. Steel piping over 3 inch: External ring controlled type with hydraulically formed stainless steel bellows.

C. Steel piping 2 inch and over: Spool type expansion, flexible compensator with tapped steel flanges, teflon or neoprene and nylon body suitable for minimum 125 psi working pressure and 250 degrees F.

D. Copper Piping: All bronze type with two-ply bronze bellows, anti-torque device limit stops, internal guides, and solder joint end.

E. Use joints suitable for minimum 125 psi WSP and 400 degrees F, and 200 psi WOG and 250 degrees F.

F. Copper or steel piping 2 inch (50 mm) and under: Low pressure compensators with two-ply bronze bellows suitable for minimum 75 psi pressure and 250 degrees F, and maximum 1/2 inch expansion.

G. Copper or steel piping 2 inch and over: Copper type with packed sliding sleeve suitable for minimum 125 psi working pressure and 250 degrees F.

2.05 EQUIPMENT CONNECTIONS

A. Provide flexible pipe connections where shown suitable to connect to adjoining piping as specified for pipe joints. Use pipe sized units.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install vibration isolators for all motor driven equipment supported from structure.

1. Air handlers and fans - use type appropriate to unit weight.

2. Provide spring isolators on piping connected to isolated equipment as follows: Up to 4 inch diameter, first three points of support; 5 to 8 inch diameter, first four points of support; 10 inch diameter and over, first six points of support. Static deflection of first point shall be twice deflection of isolated equipment.

B. Flexible Pipe Connectors

1. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation.

2. Accomplish structural work and provide equipment required to control expansion and contraction of piping, loops, pipe offsets, and swig joints, and provide bellows type

expansion joints where shown.

3. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

4. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so that movement takes place along axis of pipe only.

END OF SECTION

SECTION 15100 – VALVES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Gate valves.

B. Globe or angle valves.

C. Check valves.

D. Rubber check valves.

E. Plug cocks.

F. Butterfly valves.

G. Ball valves.

H. Drain valves.

1.02 RELATED WORK

A. Section 15060 - Pipe and Pipe Fittings (General)

B. Section 15080 - Piping Specialties (General)

C. Section 15410 - Plumbing Piping

D. Section 15535 - Refrigeration Piping and Specialties

1.03 REFERENCES

A. AWWA C500 - Gate Valves, 3 through 48 inch NPS, for Water and Sewer Systems.

B. MSS SP-67 - Butterfly Valves.

C. MSS SP-70 - Iron Body Gate Valves.

D. MSS SP-71 - Iron Body Check Valves.

E. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

F. MSS SP-85 - Iron Body Globe and Angle Valves.

G. MSS SP-110 - Ball Valves.

H. NSF/ANSI 372 – Drinking Water System Components – Lead Content.

1.04 SUBMITTALS

A. Submit copies of valve ordering schedule for approval before ordering valves.

B. Submit detailed shop drawings under provisions of Sections 01300 and 15010. Clearly indicate make, model, location, type, trim, size, pressure rating and optional features.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide valves of same manufacturer throughout where possible.

B. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.

C. Provide valves as manufactured by Apollo, Aquatherm, Stockham, Lunkenheimer, Crane, Powell, Kennedy, Hammond, Nibco, Watts, Grinnell, Homestead, Conbraco, Keystone, Mueller or approved equal.

2.02 VALVE CONNECTIONS

A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use valve sizes same as pipe.

B. Valves 2 inches and smaller shall be threaded type, unless otherwise shown. Use threaded adapters for sweat copper construction. Do not use sweat-type valves.

C. Valves 3" and larger (4" and larger on Domestic Water) shall be flange connected type, unless otherwise shown.

D. Valves 2 1/2" (or 3" on Domestic Water) may be either screwed or flanged.

E. Use grooved body valves with mechanical grooved jointed piping, where indicated.

F. Provide butterfly valves with tapped lug body, unless otherwise indicated.

G. For PP-R (Fusion welded Polypropylene piping) use fusion welded valve connections on valve, stainless steel threaded insert for threaded connections, or flanged connections.

2.03 VALVES - GENERAL

A. Unless otherwise indicated in individual piping Sections, valves shall meet the following minimum standards:

B. Unless otherwise indicated, use Class 125 valves suitable for minimum 125 psig WSP and 400 degrees F. Valves for fire protection shall be suitable for 175 psig WOG (See Section 15310).

C. For smaller domestic water piping, screwed gate, globe and check valves with supply pressures over 100 psi shall be valved with Class 150. For lower pressures, Class 125 may be used. For Larger lines, AWWA cast iron valves shall be used, rated 200 or 150 psig non-shock c.w.

D. For HVAC piping, including low pressure steam, all screwed gate, globe and check valves shall be Class 150. Larger valves shall be cast iron Class 125.

E. Spring-loaded or silent-type check valves shall be used on all pump discharge applications.

F. For pumped sump, sewage and storm drain lines larger than 2", a swing check with outside lever and spring shall be used. 3" and above should be AWWA type.

G. Provide rising stem (R.S.) or outside screw and yoke (O.S.& Y.) valves unless otherwise designated. Buried valves, or valves in shallow pits or manholes, shall be non-rising stem (N.R.S.).

H. For valves in Potable Water systems, the valves shall comply with NSF/ANSI 372 – Drinking Water System Components – Lead Content.

I. Valves in corrosive areas shall be constructed of Polypropylene, Stainless Steel, or epoxy coated steel rated for corrosive environments.

2.04 SCREWED-CONNECTION VALVES FOR GENERAL SERVICE

A. Ball Valves: Valves shall be rated 125 psi SWP and 400 psi non-shock WOG, minimum, 2-pc., end-loaded, cast bronze bodies, TFE seats, standard port, separate packnut with adjustable stem packing, anti-blowout stems and stainless steel, chrome-plated brass or bronze ball. Provide 3-piece cartridge and/or full port design where indicated. Valve ends shall have full ANSI threads and be manufactured to comply with MSS-SP110. Lever operator shall be plated and/or polymer-coated. Where piping is insulated, ball valves shall be equipped with 2" extended handles of non-thermal conductive material or provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included where indicated. Valves for gas service shall be in compliance with NFPA 54 and listed by UL, meet the requirements of AGA and the local fuel supplier.

1. For corrosive environment, valves shall be constructed on stainless steel or PP-R (polypropylene with faser layer) compliant with the piping materials.
    a. Stainless Steel: Apollo Series 76A-100 two piece, full port ball valve or equal
    b. PP-R Valves: alves with PP-R bodies shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. Aquatherm Fusiotherm or piping manufacturer's recommended ball valve.

B. Gate Valves: Valves shall be Class 125 or 150, union bonnet, rising stem, inside screw, split wedge and manufactured in accordance with MSS-SP80. Body, bonnet and wedge shall be of bronze per ASTM B-62. Stems shall be of dezincification-resistant silicon bronze, ASTM B-371 or low-zinc alloy, B-99, non-asbestos packing and malleable or ductile iron handwheel.

C. Globe and Angle Valves: Valves shall be Class 125 or 150 and manufactured in accordance with MSS-SP80; body and bonnet are to be of bronze per ASTM B-62. Stems shall be of dezincification-resistant silicon bronze, ASTM B-371 or low-zinc alloy, B-99, non-asbestos packing, replaceable seat and TFE disc, and malleable or ductile iron handwheel.

D. Swing Check Valves: Valves shall be Y-pattern swing type manufactured in accordance with MSS-SP80, Class 125 or 150, bronze ASTM B-62 body with TFE seat disc.

E. Silent Check Valves: Bronze body, spring loaded, teflon ball or disc, screwed ends, 125 or 150 psi wp.

2.05 FUSION WELDED VALVES

A. Valves used in fusion welded piping systems shall constructed with fusion stainless steel threaded insert, flanged connections for flanged connections, or fusion welded valves with polypropylene connection.

B. Brass and Bronze construction valves shall not be used in corrosive areas.

2.06 FLANGE CONNECTED VALVES FOR GENERAL SERVICE

A. Butterfly Valves: Valves shall be lug body style, unless otherwise designated, manufactured in accordance with MSS-SP67, flanged or groove-type (where grooved piping is indicated), rated at least 200 psi non-shock cold water working pressure. Body shall be cast iron or ductile iron with 2" extended neck for insulating. Valve shall have aluminum bronze alloy disc

with replaceable resilient TFE or EPDM rubber seat and seals or EPDM rubber encapsulated disc with polymer-coated body, where indicated. Stem shall be 400 series stainless steel and stem to disc fasteners shall not be exposed to flow stream. Size 2 1/2" -5" shall be lever operated with 10-position throttling plate; size 6" and larger shall have weatherproof gear operators. Lug-style shall be capable for use as isolation valves and recommended by manufacturer for dead-end service with bubble-tight shutoff at full pressure without the need for downstream flanges. Where indicated provide units rated for 250 psi bubble-tight shutoff.

B. Gate, Globe/Angle Valves: Valves to be Class 125 or 250, manufactured in accordance with MSS-SP70 (gate) or MSS-SP85 (globe/angle), flanged, bolted bonnet, OS&Y, iron body, bronze mounted (IBBM), with body and bonnet conforming to ASTM A126 Class B cast iron. Packing and gasket shall be non-asbestos.

C. Swing Check Valves: Valves shall be swing-type manufactured in accordance with MSS-SP71, Class 125 or 250, flanged ASTM A126 Class B cast iron body with bronze trim, non-asbestos gasket.

D. Silent Check Valves (Spring-Loaded): Valves shall be wafer-style, rated for 125 or 250 psig, with stainless steel spring and pin, bronze disc plates, TFE seat, body of cast iron ASTM A126 B or A48 for use with Class 125/150 or 250 flanges.

E. Ball Valves: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, Class 125/150 flanges, 125 PSI SWP, 400 PSI W.O.G.

F. Gate valves 3"-48", flanged or mechanical joint, for domestic water and sewer applications shall meet AWWA C500 requirements and be rated for minimum 150 psig non-shock c.w.

G. Check valves 4" -12", flanged or mechanical joint, for domestic water or sewer applications shall be AWWA type, rated for minimum 150 psig non-shock c.w., and shall include outside lever and weight or spring for pumping applications and others indicated.

2.07 PLUG COCKS FOR WATER SERVICE

A. Iron body, brass plugs and washers, air tested, screwed ends. Rated for gas or water service as required.

B. Iron body and plug, pressure lubricated type, flanged ends. Rated for gas or water service as required.

C. Bronze body, bronze plug with square head, screwed ends. Rated for steam or water service as required.

D. Valves for gas service shall be in compliance with NFPA 54 and listed by UL, meet the requirements of AGA and the local fuel supplier.

2.08 DRAIN VALVES

A. Plumbing Systems: 3/4" Bronze compression stop with hose thread. Chrome plated for corrosive areas.

B. HVAC Systems: 3/4" bronze ball valve with hose adapter and cap.

2.09 VALVE OPERATORS

A. Provide suitable handwheels for gate, globe or angle and drain valves.

B. For butterfly valves, provide lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock nut and memory stop for throttling service, 5" and below.

Provide gear operator with indicating dial for larger valves or where chain operator is required.

C. Provide valves located more than 7 feet from floor in equipment room areas with chain operated sheaves. Extend chains to about 5 feet above floor and hook to clips arranged to clear walking aisles.

D. Provide one plug cock wrench for every ten plug cocks sized 2 inches and smaller, minimum of one. Provide each plug cock sized 2-1/2 inches and larger with a wrench, with set screw.

2.10 BYPASS VALVES

A. Provide on all high pressure steam valves, 2 1/2" and larger, and on other valves where indicated, a pair of tapped bosses or flanged bosses with a bypass globe valve of the same rating as the line valve, piped with stem parallel to main valve.

B. Sizes of bypass globe valves shall be the same as the recommended maximum tapped hole size set by MSS SP-45 for the particular line valve.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install valves with stems between upright and horizontal, not inverted or below horizontal.

B. Install gate valves or ball valves for shut-off and isolating service, to isolate equipment, parts of systems, or vertical risers.

C. Install globe or angle valves for throttling service and control device or meter by-pass.

D. Provide spring-loaded check valves on discharge of condensate pumps, condenser water, and water circulating or booster pumps.

E. Use plug cocks for gas service, AGA rated.

F. Use plug cocks in water or steam systems for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

G. Provide drain valves at main shut-off valves, and low points of piping and apparatus.

H. Provide brightly colored foam covers for the stems of all normally open O.S.&Y. valves below 7' AFF.

I. Provide isolation valves for all branch connections to the header.

END OF SECTION

SECTION 15180 - THERMAL INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide a complete system of insulation for the following:

1. HVAC condensate drain piping.
2. Low pressure air conditioning supply ducts.
3. Outside air intake ducts.
4. All mechanical equipment not factory insulated, or additional insulation as indicated.
5. Domestic cold water piping.
6. Domestic hot water piping, Tepid water piping.
7. Refrigerant lines.
8. Horizontal storm drain piping and roof drain bodies.

1.02 RELATED WORK

A. Referenced Section:

1. Section 15015: Sleeves and Penetrations.
2. Section 15090: Hangers, Supports and Anchors.
3. Section 15410: Plumbing Piping.
4. Section 15810: Ductwork.

1.03 QUALITY ASSURANCE

A. Identification of materials: All packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, shall have a manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material, including fire and smoke ratings.

1.04 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Product Data:

1. Include all insulation types to be used for each service in a schedule, including sizes, thicknesses, densities, and k or R values.
2. Include data on accessory materials such as mastic, sizing, taping, jacketing products and pipe inserts.
3. Include shop drawing of any field-fabricated housings for chilled water items requiring removable insulation.

C. Manufacturer's Installation Instructions.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fire and smoke hazard ratings.

1. All insulation shall have a permanent composite (insulation, jacket or facing, and adhesive) fire and smoke hazard rating as tested by procedure ASTM E84, NFPA 255 and UL 723, and not exceed:

a. Glass Fiber Insulation

1) Flame Spread: 25

2) Smoke Developed: 50

b. Unicellular Plastic Insulation (FR Type)

1) Flame Spread: 25

2) Smoke Developed: 100

2. Accessories, such as adhesives, mastics, cements, and cloth for fittings shall have the same component ratings as listed above.

3. Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer.

4. Adhesives shall be waterproof and no fire and smoke treatments shall be water soluble.

B. Manufacturers:

1. Manufacturer's listed are for establishment of quality and type. Alternate products may be approved per Section 15010.

C. In lieu of longitudinal lap seam specified, self-sealing lapped jacket shall be acceptable with no requirements for aluminum bands on concealed piping.

D. Jackets and Finishing (unless otherwise indicated)

1. All jacketing materials installed in exposed locations (mechanical equipment rooms, exposed in finished areas, etc.) shall be Owens-Corning ASJ or presized, neither requiring painting but suitable for direct application of finish without surface preparation. Jackets furnished for installation in concealed locations (in chases, above ceiling, etc may be ASJ. ASJ jackets shall have self-sealing joints. Fiberglass insulation for piping shall be provided with a vapor barrier having vapor permeability rating suitable for the service intended, and all joints shall be properly sealed.

2.02 HOT WATER LINES (Systems operating above 100 degrees F.)

A. One piece, fiberglass sectional insulation (K = 0.23 at 75 degrees F.) with factory applied white reinforced kraft/foil vapor barrier jacket. Longitudinal jacket laps and butt joints shall be self-sealing using 3" wide lap strips. Insulation shall be one of the following:

1. Johns-Manville "Flame Safe AP-T 500 degrees F.".

2. Owens/Corning "Fiberglass 25 ASJ/SSL".

3. Certainteed "Fiberglass 500 degree Snap-On".

B. Insulation thickness shall be as follows:

MAXIMUM FLUID TEMPERATURE DEGREES F	PIPE SIZES	
	1" AND LESS	1¼" TO 2"
100 – 200	3/4	1
201 – 250	1	1½

1. Exception for pipe sizes 1" and less not exceeding 200 degrees F.: Runouts not exceeding 12" in length to individual terminal units may be insulated with 1/2" thick insulation.

C. Finishing materials:

1. Acceptable manufacturers, insulating cement:

a. Johns-Manville No. 375.

b. 48 Insulations "Quik-Set".

c. Rockwood Mfg. Co. "Delta-Maid One Shot".

2. Acceptable manufacturers, breather mastic:

a. Benjamin Foster "Sealfas 30-36".

b. Insul-Coustic "Permsure IC-102".

c. Vimasco No. 713.

d. Childers "Chil-Seal CP-50".

e. Epolux "Cadalog 336".

3. Acceptable manufacturers, PVC premolded covers:

a. Johns-Manville "Zeston".

b. Ceel-Co.

2.03 COLD WATER LINES (Systems operating below 100 degrees F.)

A. One piece, fiberglass sectional insulation (K = 0.23 at 75 degrees F.) with factory applied white reinforced kraft/foil vapor barrier jacket. Longitudinal jacket laps and butt joints shall be self-sealing using 3" wide lap strips. Insulation shall be one of the following:

1. Johns-Manville "Flame Safe AP-T 500 degrees F.".

2. Owens/Corning "Fiberglass 25 ASJ/SSL".

3. Certainteed "Fiberglass 500 degree Snap-On".

4. Armstrong "Accotherm".

B. Insulation thickness for pipe sizes shall be as follows:

INSULATION THICKNESS	HVAC CONDENSATE	PLUMBING COLD WATER
½"	All Sizes	1" and Less
1"	----	1¼" to 4"
1½ "	----	5" and Greater

C. Finishing materials:

1. Acceptable manufacturers, insulating cement:

   a. Johns-Manville No. 375.

   b. 48 Insulations "Quik-Set".

   c. Rockwood Mfg. Co. "Delta-Maid One Shot".

2. Acceptable manufacturers, vapor barrier mastic:

   a. Benjamin Foster "Title Fit 30-35:.

   b. Vimasco No. 740.

   c. Insul-Coustic "FRVB IC-501".

   d. Childers "Chil-Perm CP-30".

   e. Epolux "Cadalar 650".

3. Acceptable manufacturers, PVC premolded covers:

   a. Johns-Manville "Zeston".

   b. Ceel-Co.

2.04 REFRIGERANT AND REFRIGERATION CONDENSATE LINES

A. Refrigerant Suction Lines: Suction lines operating above 0 degrees F saturated suction temperature (SST) shall be insulated with unicellular plastic tubing insulation with wall thickness of 3/4 or 1/2". Suction lines operating at a 0 degree F and lower shall be insulated with unicellular plastic tubing insulation of 3/4" wall thickness. Insulation shall be expanded, closed-cell, flexible elastomeric type (K-factor of .28 or less at 75 degrees F main temperature). Insulation shall be one of the following:

1. Armstrong "Standard Armaflex"

2. Johns-Manville "Aerotube" Splitting of joints of unicellular plastic insulation is not allowed unless approved by the Contracting Officer. Joints of unicellular plastic shall not be sealed until pressure tests and leak test are completed. Seal all seams and butt joints with Armstrong #520 or Johns-Manville #57 adhesive.

B. Refrigerant Liquid Lines: Liquid lines shall be insulated with unicellular plastic tubing with 1/2" wall thickness (see 2.04 A Above).

C. Refrigerant Hot Gas Lines: Hot gas lines from the compressor systems to heat recovery coils shall be insulated with 1" of fiberglass (see 2.02 above). Outlet lines leaving heat recovery coils do not require insulation. Insulation shall be installed after pressure and leak tests are completed.

2.05 EXTERIOR PIPE AND DUCTWORK

A. Expanded close cell, flexible elastomeric insulation (K = 0.28 at 75 degrees F.) available in 3/4" thick sheet or tube, see “DUCT AND VENTILATION EQUIPMENT INSULATION THICKNESS SCHEDULE” article for insulation thickness. Insulation shall be one of the following:

1. Armstrong "Standard Armaflex"

2. Johns-Manville "Aerotube"

B. Seal all seams and butt joints with Armstrong #520 or Johns-Manville #57 adhesive and finish with two (2) coats of Armaflex finish.

C. In general, exterior fiberglass insulation will not be allowed. When approved, for piping, it shall be provided with an additional 0.016" aluminum jacket with lock seam longitudinal joint and gasketed bands for butted joints as required for a water-tight insulation.

2.06 ROUND AND CONCEALED RECTANGULAR DUCTWORK

A. One pound density, 2" thick fiberglass blanket (K = 0.27 at 75 degrees F.) with FSK vapor barrier, overlapping edge. Insulation shall be one of the following.

1. Johns-Manville "Microlite FSK Faced Wrap".

2. Owens/Corning "Fiberglass All Service Wrap FRK 25", Series ED-100.

3. Certainteed "Ultralite Duct Wrap Type IV".

B. Acceptable manufacturers, fire retardant adhesive for securing insulation to ductwork and sealing circumferential joints:

1. Benjamin Foster No. 85-20.

2. Insul-Coustic "IC-255".

3. Vimasco No. 733.

4. Childers "CP-82".

5. Epolux "Cadoprene 400".

C. Acceptable manufacturers, white vapor barrier mastic for penetration and puncture sealing in insulation facing:

1. Benjamin Foster No. 30-35.

2. Insul-Coustic "IC-501".

3. Vimasco No. 740.

4. Childers "CP-30".

5. Epolux "Cadalar 650".

D. Acceptable manufacturers, 3" wide foil reinforced kraft tape:

1. Arno "C-430".

2. Fasson No. 0822.

3. Nashua "FSK".

2.07 EXPOSED RECTANGULAR DUCTWORK

A. Three pound density, 1" thick fiberglass insulation (K = 0.23 at 75 degrees F.) with FSK vapor barrier, overlapping edge. Insulation shall be one of the following:

1. Johns-Manville "814 Spin-Glass".

2. Owens/Corning "703" with FSK.

3. Certainteed "1B-300.

2.08 DUCT AND VENTILATION EQUIPMENT INSULATION THICKNESS SCHEDULE

Duct and Equipment	Insulation Thickness (in)
Exhaust Ducts within 10' of Exterior Walls or Openings or from Fan Discharge (whichever is least)	1
Outside Air Intake Ducts	1
Plenums (heating systems)	1
Plenums (systems with cooling coils)	1
Rectangular Supply Ducts (heating systems)	1
Rectangular Supply Ducts (systems with cooling coils)	1
Round Supply Ducts (heating systems)	1
Round Supply Ducts (systems with cooling coils)	1
Exterior Round and Rectangular Supply Ducts (Heating Systems)	2

PART 3 -EXECUTION

3.01 GENERAL

A. Install all insulation in strict accordance with the manufacturer's instructions.

B. No damaged or water soaked insulation shall be used.

C. Leave no "raw" ends on any insulation.

D. All insulation shall be continuous through sleeves, hangers, and walls where no sleeves are required. Refer to Section 15015.

E. All exposed insulation shall be finished smooth, ready for painting, where pre-sized coverings are not used.

F. Do not install covering before piping, ductwork, and equipment have been tested and approved.

G. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

H. Provide 16 gauge aluminum pipe protection on exposed insulated pipes in shop and shipping areas. Protection shall extend from floor to 7 ft. above floor.

I. Insulate hot water and waste piping under handicapped lavatories.

3.02 HOT AND COLD PIPE LINE INSULATION

A. Piping: Butt all joints firmly together and secure all "self-seal" jacket laps with lap adhesive. Seal all butt joints with joint strips furnished with insulation. Taper all pipe insulation ends and cover with insulating cement.

B. Fittings and valves:

1. Hot lines 2" and smaller: Valves, unions, and flanges shall not be insulated.

2. Hot and cold lines 2-1/2" and larger and cold lines 2" and smaller: Valves, unions, and flanges shall be insulated as follows, but insulation shall be removable to facilitate maintenance.

3. Insulate with molded fiberglass fitting segments of pipe covering, or with firmly compressed fiberglass blanket. Secure in place with 20 gauge galvanized steel wire and finish with a smooth coating of insulating cement. Pipe sizes under 4" may be insulated with hydraulic cement. All thicknesses shall be equal to that of adjoining pipe insulation.

4. Finish insulation with two (2) 1/16" thick coats of mastic, applied at not more than 15 sq. ft. per gallon and reinforced with white glass fabric embedded between the coats. (Use breather mastic on hot pipe lines and vapor barrier mastic on cold pipe lines.) Lap the glass fabric on itself and on adjoining pipe insulation.

5. Option: Factory pre-molded PVC fitting covers may be used. Pre-molded covers shall overlap the adjoining pipe insulation and jackets and shall be secured at all edges with vapor barrier adhesive on cold pipes. Secure ends of all covers with pressure sensitive vinyl tape which shall overlap both the jacket and the cover at least 1". On fittings where temperature exceeds 250 degrees F., two layers of insulation shall be applied with a few wrappings of twine on the first layer to eliminate any voids or hot spots.

C. Condensate drains: Insulation is not required in mechanical rooms where sweating will not cause water damage.

D. Insulation is not required for:

1. Expansion tank.

2. Water/air line from air separator to expansion tank.

3. Hot pipe air vents.

4. Exposed condensate return lines more than 8 ft. AFF.

3.03 CONCEALED DUCTWORK

A. Wrap insulation around ducts with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". Adhere insulation to ducts with 100% coverage of fire retardant adhesive.

B. For rectangular ducts over 24" wide, impale insulation on the bottom of the ducts on metal pins, on maximum 18" centers, welded to the duct and secured with speed washers.

C. Seal all circumferential joints with fire retardant adhesive and tape with 3" wide foil reinforced kraft tape. Staple all longitudinal seams approximately 6" on center, then seal with a foil vapor barrier tape or vapor barrier mastic.

D. Seal all breaks and punctures with vapor barrier tape and same type of fire retardant adhesive.

3.04 EXPOSED DUCTWORK

A. Apply insulation with all edges butted.

B. Impale insulation on pins welded to the duct and secure with speed washers, firmly embedded in the insulation, for rectangular duct.

C. Space fasteners at 12" to 18" on centers with a minimum of 2 rows per side of duct.

D. Seal all joints, breaks, and punctures with fire retardant vapor adhesive reinforced with 3" wide foil reinforced kraft tape.

3.05 EXTERIOR PIPES AND DUCTWORK

A. Apply insulation only when lines are clean, dry, and unheated.

B. Do not compress or stretch insulation.

C. Elastomeric Insulation shall be protected from UV with the manufactures sealant (coating) on all faces, or shall be protected with aluminum jacketing. Jacketing shall be supplied where noted herein or on the drawings.

D. Where fiberglass insulation is allowed to be installed in exterior applications, the insulation shall be sealing with aluminum jacket and joints installed on the bottom of ductwork/pipe to prevent water infiltration. The ends of the insulation shall sealed to prevent moisture infiltration. If insulation is installed on ductwork/pipe that extends to grade, the insulation within 12” of grade shall be elastomeric.

END OF SECTION

SECTION 15193 - ABOVEGROUND DIESEL STORAGE AND FUELING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Aboveground diesel fuel storage tank, tank accessories, piping, tank monitoring system, and related accessories. System shall be complete, and fully integrated.

B. Related Sections:

1. Electrical Work shall be provided in accordance with Division 16. Provide all labor and materials required to feed power to and install electrical systems required for fuel delivery. The design and methods of installation of the wiring materials, electrical equipment, and accessories shall conform to the National Electric Code and shall comply with applicable Federal, State and local requirements.

1.02 DEFINITIONS

A. Abbreviations:

1. MDEQ-STD – Michigan Department of Environmental Quality, Storage Tank Division.

2. AST – Aboveground Storage Tank.

1.03 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Size and weight of tanks, foundation loads, locations and sizes of all openings, emergency and normal vent sizing calculations, piping shop drawings, all electrical requirements, diagrams for wiring between field devices, and manufacturer's installation, operating and maintenance instructions.

2. Submit certified report for tank tightness testing from tank manufacturer.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of all applicable local, State and Federal codes, ordinances and regulations including:

1. Michigan State Police rules entitled "STORAGE AND HANDLING OF FLAMMABLE AND COMBUSTIBLE LIQUIDS."

2. National Fire Protection Association:

a. NFPA 30, Flammable and Combustible Liquids Code.

b. NFPA 30A, Automotive and Marine Service Station Code.

c. NFPA 31, Installation of Oil Burning Equipment.

d. NFPA 37, Installation and Use of Stationary Combustion Engines and Gas Turbines.

e. NFPA 395, Storage of Flammable and Combustible Liquids on Farms and Isolated Sites.

f. NFPA 70, National Electrical Code.

3. Michigan State Building Code.

4. UL Compliance: Comply with UL standards pertaining to equipment.

5. Steel Tank Institute (STI):

a. STI F941 – Standard for Thermally Insulated Aboveground Storage Tanks.

b. STI R94 – Fireguard Installation & Testing Instructions for Thermally Insulated, Lightweight, Double Wall Fireguard Aboveground Storage Tanks.

1.05 PERMITS, APPROVALS, LICENSES, AND INSPECTIONS

A. Owner shall apply for MDEQ plan review and permission to install Aboveground Storage Tank System. Contractor shall obtain all required building permits. Contractor shall be responsible for coordinating all required testing and inspections with the MDEQ, local Fire Marshal, local building officials, and Owner. Owner shall register Aboveground Storage Tank with MDEQ-STD.

B. Contractor shall obtain and pay fees for all permits, approvals, inspections and licenses required, including local fire and building officials, and MDEQ-STD inspections where required. Contractor shall submit three copies of all permits, approvals, licenses and inspection reports to Engineer. Contractor shall assign any licenses required to operate or maintain the systems to Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end caps on each length of pipe. Maintain end caps through shipping, storage and handling to prevent pipe end damage and entrance of dirt, debris, and moisture. Store pipes elevated above grade.

B. Protect fittings, valves, gauges, meters, and all electrical and electronic equipment indoors, away from moisture and dirt.

C. All tank openings shall be capped prior to shipping. Tank shall be stored upright on a firm, level pad at the Site.

1.07 WARRANTY

A. Special Warranty: Provide, in accordance with Section 01782, warranties covering the items included under this Section of the Contract. The special warranty shall repair or replace defective components that fail in materials or workmanship within special warranty period.

1. Aboveground diesel fuel storage tanks shall have a 30-year warranty by the manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Aboveground Storage Tank, “Fireguard” Tank:

    a. Clawson Tank.

    b. Hamilton Tank.

    c. Highland Tank.

    d. Modern Welding.

2. Aboveground Sub-Base Diesel Storage Tank:

    a. Tramont.

3. Tank Mounted Fill Station Spill Container:

    a. OPW/Pomeco.

    b. Clay and Bailey Mfg. Co.

4. Remote Fill Station:

    a. OPW/Pomeco.

    b. Clay and Bailey Mfg. Co.

5. Conservation Vent Cap:

    a. Morrison Bros. 548 or 748 series.

    b. OPW 523 Series.

6. Atmospheric Vent Cap:

    a. Morrison Brothers 354 Series.

    b. OPW 23 Series.

7. Aboveground Storage Tank Emergency Vent:

    a. Protectoseal, 7800 Series.

    b. Morrison Brothers, Model 244.

    c. OPW.

8. Aboveground Storage Tank Interstitial Emergency Vent:

    a. Morrison Brothers, Model 244.

    b. OPW.

9. Tank Fill Hose Connector:
    a. OPW 1611AN Series Kamvalok with 634B Series dust cap.
10. Ball Valves:
    a. Jamesbury Figure 6F-2236TT.
    b. Apollo, 89-140 Series.
    c. Jomar.
11. Emergency Shutoff Ball Valves:
    a. Jamesbury Figure 1075.
12. Check Valves:
    a. 2-1/2 inch and smaller: Crane Model No. 37.
    b. 3 to 4 inch: Crane Model No. 147.
13. Strainers:
    a. Mueller, 11M
14. Aboveground Storage Tank Overfill Prevention Valve:
    a. EBW Warden, AST 709-400-01.
    b. Morrison Brothers, Figure 9095A.
    c. OPW, 61fStop Series.
15. Foot Valves:
    a. 2 inch and smaller: Morrison Brothers Model 334.
16. Expansion Relief Valve:
    a. Morrison Brothers, Model 78.
17. Antisiphon Valve:
    a. EBW, Series 600.
18. Solenoid Valves:
    a. 2 inch and smaller:
        1) Asco 8210 Series.
        2) Morrison Brothers 710 Series.
    b. 3 to 4 inch: Magnatrol, Type A Full Port.

19. Flexible Connectors:

    a. Hose Master Inc.

    b. Fire-Shield Connector.

20. Diesel Fuel Filters:

    a. Cim-Tek.

21. Fuel Pump/Dispensers:

    a. Gasboy.

    b. Tokheim.

    c. Gilbarco.

    d. Wayne.

22. Dispenser Nozzles:

    a. OPW 7H.

23. Hose End Swivels:

    a. OPW 45.

24. Breakaway Connectors:

    a. OPW 66 series.

25. Dispenser Sumps:

    a. Total Containment.

26. Day Tank with Pumped Overflow Returns:

    a. Simplex, Inc. SST series.

    b. Pryco.

27. Pipe Labeling:

    a. Brady.

    b. Seton.

    c. Craftmark Identification Systems.

28. Tank Level and Interstitial Space Monitoring and Underground Piping Monitoring System:

    a. Simplex, Inc. Tank Commander.

    b. EBW, Auto Stick Jr.
    c. Pneumercator, LDE Series.

d. Veeder Root, TLS-300 Series.

2.02 ABOVEGROUND DIESEL STORAGE TANKS

A. Aboveground diesel storage tank shall have a UL 142 steel inner fuel storage tank and a steel containment tank with an intermediate layer consisting of lightweight thermal insulation. The assembly shall have a 2-hour fire rating. Tank shall be UL listed per UL 2085-INSULATED SECONDARY CONTAINMENT ABOVEGROUND TANKS FOR FLAMMABLE LIQUIDS. Tanks shall also meet the requirements of STI F941. The interstitial space between the inner tank and outer tank shall flow to a central low point for leak detection monitoring.

B. Tanks shall be of capacities listed on the Drawings and be of cylindrical design. All tank openings shall be located on the top of the tank, unless noted otherwise. Tank shall be complete with all required lifting lugs and support saddles for installation on a flat concrete pad. Tank saddle shall have provisions for electrically grounding and anchoring the tank to the concrete pad. Manufacturer shall size anchor bolts and furnish bolts for setting of anchor bolts by Contractor.

C. Tank shall have 1/4-inch strike plate beneath all openings. Strike plate shall extend 1 inch beyond openings and be 12-inch by 12-inch minimum. Tank shall be complete with all drop tubes and suction tubes. Tank shall include one spare 4-inch threaded opening with nipple and cap for future use.

D. Emergency and normal vents shall be sized by the tank manufacturer to comply with NFPA 30. Calculations sizing the emergency vent shall sealed by a professional engineer and submitted to Engineer.

E. Inner and outer tanks shall be labeled with manufacturer's name, all construction codes and standards, volume of tank, tank dimensions, and date of manufacture.

F. Tank shall be complete with OSHA-approved stairs and handrails, as shown on Drawings, for access to tank fill connection and other equipment on top of tank.

2.03 ABOVEGROUND SUB-BASE DIESEL STORAGE TANKS

A. Aboveground sub-base diesel storage tank shall have a UL 142 steel inner and secondary-containment fuel storage tank. The secondary containment shall be monitored for leak detection. A high/low level alarm shall also be provided.

B. The tank shall be of the size, shape and capacity as shown on the Drawings and be capable of mounting underneath the generator. Tank fittings shall be provided as shown on the Drawings.

C. Emergency and normal vents shall be sized, by the tank manufacturer, to comply with NFPA 30. Calculations sizing the emergency vent shall sealed by a professional engineer and submitted to Engineer.

D. Inner and outer tanks shall be labeled with manufacturer's name, all construction codes and standards, volume of tank, tank dimensions, and date of manufacture.

E. Sub-base diesel storage tank shall be provided with a leak detection switches for monitoring of the interstitial space and level switches for low, high, and critical fuel alarm levels. The output of the leak detection and fuel levels shall be indicated in the remote alarm fill panel and to SCADA via discrete connections. Remote fill alarm panel shall be capable of alarming the leak detection, and low, high and critical fuel alarm levels by audible horn and visible indication. A push to silence horn button shall be provided. Outdoor remote alarm fill panel shall be NEMA 4, stainless steel. Indoor remote alarm fill panel shall be NEMA 3R.

2.04 COMPONENTS

A. Day Tank with Pumped Overflow Return:

1. Day tank with pumped overflow return shall be a UL 142 labeled steel inner wall with rupture basin. Day tank shall be aboveground, rated for indoors installation, complete with built in overflow protection, supply and overflow return pumps, epoxy interior and exterior coatings, and UL 508 listed liquid level control systems. Day tank shall have a manual fill opening and remote vent connection.

2. The day tank volume shall be as noted on the Drawings.

3. Supply and return pumps shall be positive displacement, high vacuum suction pumps rated to transfer diesel fuel via suction lift or pressure at 20-foot water column. Pumps shall have mechanical shaft seals and be of non-corrosive, metal construction. Pumps shall be direct driven from close-coupled 1725 RPM, continuous duty, 40°C ambient rated, 120 VAC, 60 hertz, electric motors. Motors shall have class B insulation, integral overload protection, and be UL recognized.

   a. Supply pump shall be rated for 7.0 gpm.

   b. Overflow return pump shall be rated for 10.0 gpm.

4. Provide 5.0 gpm hand-operated supply pump in parallel with electric motor-driven supply pump.

5. The level control system shall include “auto-off-manual” supply pump control switch, “push-to-test” button for supply pump, “push-to-test” button for the overflow pump, automatic pump start-stop in “auto” mode based on tank level. The level control panel shall provide lamps to indicate the following: power on, supply pump switch not in “auto”, overflow pump controls energized, supply pump running, overflow pump running, day tank fuel level, day tank low level alarm, day tank high level alarm, and power available.

   a. The supply pump control shall automatically activate the supply pump when the liquid level in the day tank falls to a preset level, and stop the pump when the liquid level reaches a preset level.

   b. The overflow pump control shall automatically activate the overflow pump when the liquid level reaches a preset level and shall pump the tank down to an 85 percent level. The control circuits shall include dry contacts to open and close remote solenoid valves when the pumps start and stop, and to interlock the day tank pumps with the AST and pipe monitoring system.

6. Provide one-day start up service and one-day, eight (8) hours of training by a factory authorized service technician.

B. Tank Mounted Fill Station: Provide a 7-gallon minimum spill container designed for tank mounted filling of an AST. The container shall be spun steel construction with a hinged, lockable cover. The container shall be provided with a NPT threaded bottom connection for the fill riser, with size as shown on Drawings. Provide a pull-to-open brass drain valve for drainage of spilled product. Finish paint container with manufacturer's standard white epoxy paint after fabrication.

C. Remote Fill Station: Provide a 15-gallon minimum spill container designed for ground level filling of an AST. Container shall be constructed from 12-gauge steel with a non-sparking, lockable, hinged aluminum cover and Buna-N rubber boot coupling with stainless steel clamp. Provide slopped bottom with 1/2" lockable, drain ball valve and adjustable height legs. Finish

paint exterior and interior portions of container with manufacturer's standard white epoxy paint after fabrication.

D. Tank Fill Hose Connector:

1. Tank fill hose connector shall be sized as shown on the Drawings. Provide hard-coated aluminum or bronze, complete with matching pad-lockable cap.

2. Tank fill dry quick disconnect shall be sized as shown on the Drawings. Provide kamvalok system consisting of a dry quick disconnect coupler, kamvalok adapter and dust cap. Dry disconnect coupler shall have a built-in valve and spring-loaded poppet automatically close when disconnected, even if the lever is in the open position. Kamvalok adaptor shall contain a poppet assembly, spring loaded to hold the poppet disc closed until coupler is attached and the entire assembly is lever actuated. Dust cap shall be specifically designed to cap off kamvalok adaptor.

2.05 PIPING AND SPECIALTY VALVES

A. Aboveground diesel fuel and vent piping shall be Schedule 40 carbon steel, ASTM A53 or A120, with threaded 150 lb. class iron fittings. Joints shall be made with Teflon tape or pipe thread sealant compatible with gasoline and diesel fuels. Unions shall be ground joint with brass seat. Use of galvanized carbon steel and copper piping, valves and accessories in the diesel fuel and vent system are prohibited.

B. Conservation Normal Vent Caps: AST and day tank conservation normal vent caps shall be sized, by the tank manufacturer, per NFPA 30.

1. Conservation vent cap shall provide vacuum relief and normal venting. Connection shall be NPT. Body and internals shall be aluminum or brass.

2. Vacuum setting shall be 1/2 oz/in. Pressure setting shall be 25 percent minimum less than aboveground storage tank emergency vent setting.

3. Vents shall be at least as large as the filling or withdrawal connection, whichever is larger, but in no case less than 2-inch nominal inside diameter.

C. Normal Vent Caps: AST and day tank normal vent caps shall be sized, by the tank manufacturer, per NFPA 30.

1. Vent caps shall provide normal venting and direct vapors upward. Connection shall be NPT or slip-on with brass set screw. Body and internals shall be aluminum with 40-mesh brass screen.

2. Vent shall be at least as large as the filling or withdrawal connection, whichever is larger, but in no case less than 2-inch nominal inside diameter.

D. Emergency Vent Caps: AST emergency vent shall be sized, by the tank manufacturer, per NFPA 30.

1. Vent shall be constructed with aluminum body, cast iron cover, brass or viton O-ring seat, threaded or flanged connection to match tank.

2. Pressure relief setting shall be 8 ounce/square inch.

E. Emergency Vent Caps, Interstitial Space: AST interstitial emergency vent shall be sized, by the tank manufacturer, per NFPA 30.

1. Vent shall be constructed with aluminum body, cast iron cover, brass seat, threaded or flanged connection to match tank.

2. Pressure relief setting shall be 8 ounce/square inch.

F. Ball Valves:

1. Valves 2-inch and smaller shall have threaded connections.

2. Valves 2-1/2-inch and larger shall have flanged connections.

3. Valve bodies shall be carbon steel with 316 stainless steel trim. Ball seals shall be RPTFE or TFE with secondary metal sealing surface. Stem seal shall be RPTFE or TFE with a secondary graphite seal.

4. Valves shall comply with API standard 607. Valves shall have API standard 607 compliance indication on the handle or stamped on the body.

5. Valves shall have lever actuators with lockable handles, unless noted otherwise on Schedule or required by codes and regulations.

G. Emergency Shut-off Ball Valves:

1. Valves 2-inch and smaller shall have threaded connections.

2. Valves 2-1/2-inch and larger shall have flanged connections.

3. Valve bodies shall be carbon steel with 316 stainless steel trim. Ball seals shall be RPTFE or TFE with secondary metal sealing surface. Stem seal shall be RPTFE or TFE with a secondary graphite seal.

4. Valves shall comply with API standard 607 and be FM (Factory Mutual) approved for emergency shut-off. Valves shall have API standard 607 and FM compliance indication on the handle or stamped on the body.

5. Valves shall have lever actuators set for spring-to-close operation and 165 degree F fusible links unless noted otherwise on Schedule or required by codes and regulations. .

H. Check Valves:

1. Valves 2 inch and smaller, shall be screwed, Y-pattern B-62 bronze alloy body with integral seat. Disc and hinge pin shall be B-62 bronze alloy.

2. Valves 2-1/2 to 4 inch shall be flanged, cast steel, class 150, bolted cap. Body, cap and hinge shall be constructed of ASTM A216 grade WCB. Hinge pins shall be 410 stainless steel. Seat ring shall be hardfaced. Disc shall be 13 CR overlay.

I. Strainer Valves:

1. Valves 2 inch and smaller, shall be screwed, Y-pattern, carbon steel body. Provide 100-mesh screen.

J. Aboveground Storage Tank Overfill Prevention Valve:

1. Valve shall consist of aluminum (hard-coat anodized) adapter, anodized aluminum body, brass plunger and dashpot, stainless steel shaft, linkages and hardware, and epoxy coated steel piping.

2. Valve shall have an adjustable float to shut-off the flow of product when the liquid level reaches between 90 and 95 percent and have immediate and cushioned shut-off. After shut-off, the product shall be allowed to automatically drain from the highest point.

3. Mating connection to the storage tank shall be 4 inch NPT male. Fill connection shall be standard 2-inch male cam-and-groove fitting.

K. Foot valve shall be single poppet, screwed joint style with brass body, seat and poppet, and 20-mesh stainless steel screen.

L. Expansion relief valve shall be ductile iron or brass body with 1/2-inch screwed connections. Pressure relief setting shall be 25 psi.

M. Antisiphon valves shall automatically shut off product flow when lines are broken, preventing siphoning of storage tanks, and include an internal pressure relief valve. Valve shall be constructed of ductile iron and have an adjustable mechanism to set the head pressure for the size of the tanks installed. Valves shall meet NFPA 30 and API/RP requirements.

N. Solenoid valves shall be normally closed, energize to open, with 0 PSI minimum operating differential. Wetted parts shall be brass. Elastomeric parts shall be Viton. Connections shall be NPT. Solenoid shall be 120 VAC with watertight explosion-proof enclosure for use in a Class 1, Division 2 area.

O. Flexible connector shall have braided stainless steel outer jacket and flexible Teflon inner liner with threaded connections. Flexible connector shall be 150 PSI rated, minimum, and UL listed. Flexible connector shall be installed inside dispenser sump.

P. Diesel fuel filter shall be rated to remove water and solids down to 20 microns. Filter element shall be replaceable cartridge type.

1. Filter housing shall have a drain to remove water and collected sediments without removing element or disassembling the housing.

2. Filter shall be rated for 150 PSI working pressure and be rated for maximum flow capacity of dispenser, as noted on Drawings.

3. Provide six spare filters.

2.06 DISPENSING PRODUCTS

A. Fuel Pump/Dispenser shall be freestanding, base-mounted unit, UL listed, 15 gpm, with 12-foot-long, 1-inch-diameter hose(s). Hose(s) shall be UL listed for diesel and gasoline fuel dispensing. Number of hoses and products dispensed shall be as noted on drawings. Dispenser shall be rated for 50 PSI maximum working pressure, 115 VAC, 60 Hz.

1. Dispenser shall have transaction fuel volume display and non-resettable totalizer reading in U.S. gallons. Dispenser shall have internal fuel strainer and fuel meter.

2. Dispenser shall be complete with flow meters and other electronics required for use with fuel access system. Dispenser cabinet shall be carbon steel with baked enamel finish, or stainless steel with brushed finish. Dispenser shall have manufacturer's standard signage indicating type of fuel being dispensed.

B. Emergency shutoff valve at dispenser shall be UL listed per UL Standard 842 for diesel fuel. Valve shall be double-poppet design with internal thermal relief valve. Valve shall have a spring-closing actuator held open with a 165 degree F external fusible link. Valve body shall be designed to shear between the poppets when subjected to a 650 ft-lb. force.

C. Dispenser nozzles shall be UL-listed, heavy-duty, high-flow, automatic-closing type. Nozzle body shall be aluminum with 1-inch connection. Lever and lever guard shall be metal or heavy-duty plastic. Lever shall include 3-position, hold-open device. Nozzle packing shall be Teflon impregnated. Nozzle valve disc shall be Viton. Spout shall be 1-3/16 inches with external anchor spring. Nozzle shall have plastic hand insulator. Provide splashguard to prevent splashing of fuel from fuel tank.

D. Hose end swivel shall be installed between the breakaway connector and the nozzle. Swivel shall be UL listed and allow rotation in two planes. Swivel connections shall be 1-inch NPT. Swivel body shall be aluminum with elastomeric seals.

E. Breakaway connector shall be installed between dispenser hose and nozzle swivel. Connector shall automatically separate and stop the flow of fuel from the hose when subjected to a 300-pound pulling force. Connector shall require replacement after separation. Valve body shall be aluminum, with die-cast zinc coupling, Viton disc and seals. Breakaway connector shall be UL listed. Breakaway connector shall be 1-inch diameter to match hose and swivel. Install breakaway connector per manufacturer's recommendations.

F. Dispenser sump shall be made to fit dispenser. Dispenser sump shall contain any fuel leaks occurring inside the sump or dispenser. Dispenser sump shall be made of plastic compatible with diesel fuel, such as HDPE, 1/4-inch thick minimum. All piping and conduit penetrations into dispenser sump shall be made with liquid-tight bulkhead fittings.

1. Dispenser sump shall be installed in concrete fuel island per sump manufacturer's recommendations.

2.07 ACCESSORIES

A. Signage: Provide all safety warning signage required. Signage shall comply with MDEQ-STD requirements and all codes and ordinances.

B. Pipe labeling shall be labeled at the AST and in the Generator Room. Labels shall state either DIESEL FILL, DIESEL SUPPLY, or DIESEL RETURN, as appropriate and shall indicate the direction of flow with flow arrows. Labels shall be weather and sunlight resistant vinyl, coiled to match the pipe diameter or self adhesive. Lettering shall be black on a yellow background. Pipe labeling shall comply with ANSI Standard A13.1

C. Tank Level and Interstitial Space Monitoring and Underground Piping Monitoring System:

1. The tank level monitoring system shall automatically monitor the fuel and water levels in the tank and report them at a remote control panel. The level monitoring system shall compensate for fuel's specific gravity and temperature.

2. The system shall include at least three user programmable fuel level alarms, to be initially set at 95 percent full (high-high alarm), 90 percent full (high alarm) and 20 percent full (low alarm) and a programmable water level alarm initially set at 5 percent full.

3. The alarms shall light a lamp at the control panel. The high alarm shall light a flashing yellow lamp and sound an intermittent horn at a remote outdoor alarm panel near the unloading area. The high-high alarm shall light a flashing red light and sound a continuous horn. The horn shall be 80 dB minimum at 10 feet. The horn shall be silenceable from a reset button at the alarm panel. Silencing the horn at a high level alarm shall not prevent the horn from sounding a high-high level alarm. The tank level monitor shall utilize a magneto-resistive probe with fuel and water floats.

4. Interstitial monitoring system shall automatically monitor tank interstitial space for water and fuel. System shall alarm by lighting a lamp at the control panel.

5. The system shall be capable of generating the following reports:

    a. Fuel level in gallons,

    b. Fuel level in inches,

    c. Water level in gallons,

    d. Water level in inches, and

    e. Alarm and alarm responses.

6. Reports shall be printed at the system control panel. The control panel shall include RS-232 communications port and be capable of being monitored remotely. In addition, provide an Ethernet port and Ethernet TCP/IP communication to the SCADA system.

7. The tank monitoring system shall be UL listed, and powered by 120 VAC.

D. The interstitial space of underground double-contained fuel piping shall be sloped to a sump at the low point of the piping. The sump shall be automatically monitored for both water and hydrocarbons. The sensors shall be compatible with the tank interstitial monitoring system and by the same manufacturer. Sensing either water or hydrocarbon in the piping sump shall cause an alarm to be indicated at the tank level and interstitial monitoring system control panel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 ERECTION

A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operation condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer approved by Engineer.

3.03 PIPE TESTING

A. The fuel oil system shall be tested with air or an inert gas to a minimum of one and one-half times the system operating pressure, but not less than 50 psi. Test shall be conducted, in presence of Engineer and MDEQ-STD Field Inspector (if required), for a minimum of 15 minutes, or until approved by Engineer. Contractor shall notify Engineer and MDEQ-STD Field Inspector at least 48 hour prior to piping testing.

3.04 TANK TESTING

A. Aboveground storage tanks shall be tested in accordance with NFPA 30 as amended by Michigan State Fire Safety Board rules for Storage and Handling of Flammable and Combustible Liquids.

3.05 FUEL SUPPLY

A. Contractor shall supply fuel to completely fill fuel tanks provided under this project.

3.06 TRAINING

A. Provide a minimum of one (1) training sessions consisting of a minimum of eight (8) hours each for Owner's employees.

END OF SECTION

SECTION 15197 - NATURAL GAS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Distribution piping systems for natural gas extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified include:

1. Pipes, fittings, and specialties.

2. Special duty valves.

B. This Section does not apply to gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

C. Gas pressures for systems specified in this Section are limited to 5 psig.

1.02 DEFINITIONS

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

B. Gas Distribution Piping: A pipe which conveys gas from the point of delivery to the points of usage.

C. Gas Service Piping: The pipe from the gas main or other source of supply, including the meter, regulating valve, or service valve, to the gas distribution system.

D. Point of delivery is the outlet of the service meter assembly or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.03 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Product data for each gas piping specialty and special duty valve. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

2. Shop drawings detailing dimensions and required clearances for connection to gas meter.

3. Coordination drawings for gas distribution piping systems in accordance with Section 15050.

4. Welders' qualification certificates certifying that welders meet the quality requirements specified under "Quality Assurance" below.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

C. Test and Inspection Report: Submit a written report to Engineer documenting testing and/or inspection results. The report shall be prepared as noted under Section 01400.

1.04 QUALITY ASSURANCE

A. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."

B. Regulatory Requirements: Comply with the requirements of the following codes:

1. NFPA 54, National Fuel Gas Code, for gas piping materials and components, gas piping installations, and inspection, testing, and purging of gas piping systems.
2.

1.05 SEQUENCING AND SCHEDULING

A. Notification of Interruption of Service: Except in the case of an emergency, notify all affected users when the gas supply is to be turned off.

B. When interruptions in work occur while repairs or alterations are being made to an existing piping system, leave the system in safe condition.

C. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.06 EXTRA MATERIALS

A. Furnish to Owner, with receipt, two valve wrenches for each type of gas valve installed requiring same.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Pressure Regulators:

a. Fisher.

b. Honeywell.

c. Trerice.

B. Unless otherwise noted, materials shall conform to the following specifications.

1. Piping (Above Ground):

a. Pipe: Carbon steel pipe, Schedule 40, ASTM A 53 seamless or electric welded.
b. Joints: 2” NPS and under, Screwed; 2 ½” and larger, welded or flanged. Joints interior to the building and gas pressures above 5 PSI shall be welded regardless of size.
c. Fittings: 2” NPS and under, lack malleable iron, 150-pound class, screwed. ANSI standard B16.3.; 2-1/2” and larger, Carbon steel, standard weight, butt welding, ANSI Standard B16.9.
d. Nipples: 2” NPS and under, Carbon steel, extra strong, ASTM A 120 or A 53.
e. Unions: 2” NPS and under, Malleable iron, 250-pound class (500 WOG), railroad type with brass seats.

f. Flanges: 2-1/2" NPS, Carbon steel, 150-pound class, weld neck, standard raised face. ANSI standard B16.5. Gaskets, 1/16-inch Garlock Blue - Gard, Style 3200 (Style 3800 for natural gas), ring type.
g. Thread Sealant: Use paste rated for natural gas service. Use of Ribbon or Tape is not acceptable.

2. Piping (Buried):

a. Piping: High-density polyethylene, SDR-11, ASTM D 2513, PE 3408.
b. Joints: Fusion welded, ASTM D 2513 or socket.
c. Fittings: High-density polyethylene, SDR-11, socket fusion type, with diameters compatible with pipe for fusion joining.
d. Risers: Provide anodeless riser. Factory-assembled, certified to meet requirements of Category I of ASTM D 2513.
e. Riser Connections: Provide fusion welded or mechanical coupling as required by the Internalation Fuel Gas Code.
f. Gas Pipe Indenificaiton: Natural Gas Piping shall be identified with yellow color or stripe and shall contain the words "GAS" and "ASTM D 2513"
g. Accessories: All underground nonmetallic piping shall be installed with a Tracer wire which conforms to International Fuel Gas Code.

3. Valves: Either a. or b. below.

a. Plug Valves: Lubricated Plug valve
b. Ball Valves:
1) ½" to 2": Forged brass full port ball valve;
Connection: Threaded
Body: Brass, ASTM B283 alloy C37700
Seat and Packing: RPTFE
Ball: Brass ASTM B16, C36000 Chrome Plated
Approvals: UL, FM or CGA listed for Natural Gas service.
Manufacturer: Apollo 77F or equal
2) 2-1/2" to 4": Carbon Steel ASME Class 150 Flanged, Standard Port Ball Valve
Connection: Flanged, Class 150
Body: Carbon Steel, ASTM A216 WCB
Seat: RPTFE, Seals: PTFE
Ball and Stem: 316 Stainless Steel
Operator: Lever
Approvals: UL, FM or CGA listed for Natural Gas service.
Manufacturer: Apollo 88A-140 Series or Equal

2.02 PIPING SPECIALTIES

A. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape having the following properties:

1. Overall thickness: 20 mils.

2. Synthetic adhesive.

3. Water vapor transmission rate, gallons per 100-square-inch: 0.10 or less.

4. Water absorption, percent: 0.02 or less.

5. Prime pipe and fittings with a compatible primer prior to application of tape.

B. Anodeless Riser: Provide anodeless riser for all underground nonmetallic piping to above ground piping systems. Riser transition fitting shall be categorized as Category I in accordance with ASTM D 2513.

C. Tracer Wire: All nonmetallic piping shall be installed with Yellow insulated 18 AWG copper tracer wire with insulation type rated for direct burial.

2.03 SPECIAL DUTY VALVES

Gas Line Pressure Regulators shall be diaphragm-type, single-stage, steel jacketed, corrosion-resistant gas pressure regulators with atmospheric vent, and elevation compensator. Threaded ends for 2-inch and smaller, and flanged ends for 2-1/2-inch and larger, for inlet and outlet gas pressures, specific gravity and volume flow indicated in the Schedule.

PART 3 - EXECUTION

3.01 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "Field Quality Control" below to determine that all equipment is turned off in the piping section to be affected.

B. Conform with the requirements in NFPA 54 for the prevention of accidental ignition.

3.02 PIPING INSTALLATIONS

A. Conform to the requirements of NFPA 54, National Fuel Gas Code.

B. Concealed Locations: Except as specified below, install concealed gas piping in an air-tight conduit constructed of Schedule 40, seamless black steel with welded joints. Vent conduit to the outside and terminate with a screened vent cap.

1. Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves shall not be located in such spaces.

2. In Floors: Piping installed in floors shall have protective wrapping as specified in Part 2 above. Piping cast in concrete slabs shall be surrounded with a minimum of 1-1/2 inches of concrete and shall not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Piping shall not be embedded in concrete slabs containing quick-set additives or cinder aggregate.

3. Piping In Partitions: Concealed piping shall not be located in solid partitions. Tubing shall not be run inside hollow walls or partitions unless protected against physical damage. This does not apply to tubing passing through walls or partitions.

4. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter, or elevator shaft. This does not apply to accessible above-ceiling spaces specified above.

C. Underground Nonmetallic Piping: Install a yellow insulated copper tracer or other approved conductor shall be installed adjacent to underground nonmetallic piping. Access shall be provided to the tracer wire or the tracer wire shall terminate above ground at each end of the nonmetallic piping.

The tracer wire size shall not be less than 18 AWG and the insulation type shall be suitable for direct burial.

D. Install pipe sleeve and seals at foundation and basement wall penetrations, as specified in Section 15105.

E. Seal pipe penetrations through fire barriers using fire barrier penetration sealers specified in Section 07900.

F. Drips and Sediment Traps: Install a drip leg at points where condensate may collect, at the outlet of the gas meter, and in a location readily accessible to permit cleaning and emptying. Do not install drips where condensate is likely to freeze.

1. Construct drips and sediment traps using a tee fitting with the bottom outlet plugged or capped. Use a minimum of three pipe diameters in length for the drip leg. Use same size pipe for drip leg as the connected pipe.

G. Install gas piping at a uniform grade of 1/4-inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.

H. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

I. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.

J. Hanger, supports, and anchors are specified in Section 15060. Conform to the table below for maximum spacing of supports.

Steel pipe

Size (NPS)	Spacing in Feet	Min. Rod size Inches
1/2	5	3/8
3/4 to 1-1/4	6	3/8
1-1/2 to 3 (horizontal)	12	1/2
3-1/2 to 5		
All Sizes	every floor level (vertical)	

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

3.03 PIPE JOINT CONSTRUCTION

A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads.

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

3.04 VALVE INSTALLATIONS

A. Install valves in accessible locations protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install a gas cock upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.

C. Install pressure relief or pressure limiting devices so they can be readily operated to determine if the valve is free, so they can be tested to determine the pressure at which they will operate, and examined for leakage when in the closed position.

3.05 TERMINAL EQUIPMENT CONNECTIONS

A. Install gas cock upstream and within 6 feet of gas appliance. Install a union or flanged connection downstream from the gas cock to permit removal of controls.

B. Sediment Traps: Install a tee fitting with the bottom outlet plugged or capped as close to the inlet of the gas appliance as practical. Drip leg shall be a minimum of three pipe diameters in length.

3.06 PAINTING AND LABELING

A. All gas piping shall be painted. See specification 09961 for painting requirements.

B. Contractor shall label all gas piping at intervals not less than 20'. Labels shall have yellow background with black letters.

C. Piping systems that are called to be painted in 09961 shall be painted prior to installation in corrosive areas as defined in specification 15010. Pipe shall be completely painted as noted in the specifications and as shown on the drawings. Piping shall be painted behind all pipe hangers.

3.07 ELECTRICAL BONDING AND GROUNDING

A. Install above-ground portions of gas piping systems upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70, "National Electrical Code."

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70, "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.08 FIELD QUALITY CONTROL

A. Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

END OF SECTION

SECTION 15212 - COMPRESSED AIR SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of compressed air systems Work is indicated on Drawings and Schedules and by requirements of this Section. The standard accessories specified in this Section shall be included as a part of each single or duplex air supply system.

B. Refer to Division 16 Sections for work, which is not Work of this Section.

1. Power supply wiring from power source to power connection on compressed air equipment. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

2. Interlock wiring between electrically operated compressed air equipment units and between compressed air equipment and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this Section.

C. Provide the following electrical work as Work of this Section, complying with requirements of Division 16.

1. Control wiring between field-installed controls, indicating devices, and unit control panels.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Submit manufacturer's technical product data and installation instructions for compressed air systems materials and products.

2. Submit performance curves for each set of compressors furnished. The curves shall indicate compressor speed, air flow, and horsepower requirements versus discharge pressure. Compressor motor nameplate horsepower shall be sufficient for non-overloading operation at all points on the performance curve.

3. Submit manufacturer's electrical requirements for power supply wiring to compressed air equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

C. Test and Inspection Report: Submit a written report to Engineer documenting testing and/or inspection results. The report shall be prepared as noted under Section 01400.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of compressed air systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

B. After the equipment has been installed, performance tests shall be conducted. The purpose of these tests is to demonstrate that the units have been properly installed, will operate satisfactorily, and meet the specified conditions. These tests shall be conducted in the presence of Engineer with the cooperation of the manufacturer's representative. The equipment will not be accepted until a satisfactory test has been run.

C. Codes and Standards:

1. ASME Compliance: Fabricate and install compressed air piping system in accordance with ASME B31.9 "Building Services Piping."

2. CAGI Compliance: Provide compressed air auxiliary piping equipment in accordance with CAGI Standards (Compressed Air and Gas Institute).

3. ASME Compliance: Provide compressed air receivers, and compressed air safety valves in accordance with ASME "Boiler and Pressure Vessel Code"; provide ASME Code Symbol Stamp.

4. UL Compliance: Provide electrical components of compressed air system which have been listed and labeled by UL.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Traps:

a. Hankison, Trip-L-Trap.

b. The Trane Company.

2. Pressure Regulator and Filter Assemblies:

a. Gardner Denver Co., 65NC403QQ.

b. Wilkerson, B18-03-000.

3. Solenoid Valves:

a. Asco Red Hat II.

b. Double A.

c. Skinner.

4. Aftercooler, Water-cooled:

a. American Standard.

b. Thermal Transfer.

5. Aftercooler, Air-cooled:

a. Gardner-Denver.

b. Hankinson.

c. Quincy.

6. Moisture Separator:

a. Wright-Austin.

7. Pressure Switches:

a. Allen-Bradley.

b. Square D Co.

8. Air Coalescing Filter:

a. Deltech, 800 Series.

b. Finite Filter, Grade 6C.

c. Hankison, Aeroleser.

d. Pall Trinity Micro, Reverse Ultipor.

9. Cycling Refrigerated Dryer; no “or-equal” or substitutions will be permitted:

a. Zeks Air Drier Corporation.

10. Desiccant Dryer:

a. Deltech.

b. Hankison.

c. Zurn.

11. Particulate Filter:

a. Finite Filter, Grade 3PU.

b. Pall Trinity Micro, Epocel 3.

12. Air Regulator Station:

a. Curtis.

b. DeVilbiss.

c. Fisher.

d. Jordan.

13. Air-Cooled Reciprocating Air Compressor; no “or-equal” or substitutions will be permitted:

a. Champion, a Gardner-Denver Company.

b. Quincy.

c. Saylor-Beall.

14. Rotary Air Compressor Dual Control Switch:

a. Gardner-Denver Co.

b. Quincy.

c. Sullair Corp.

15. Water-Cooled Non-Lubricated Compressor:

a. Gardner-Denver Co.

b. Joy Manufacturing.

16. Oil-less Air Compressor/Receiver:

a. Bell and Gossett.

b. ITT Pneumotive.

c. Quincy.

d. Rego, Model D-L9722.

2.02 MATERIALS AND PRODUCTS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in compressed air systems. Where more than one type of materials or products are indicated, selection is installer's option.

B. High Temperature Air: Materials for the piping from the compressor discharge to the primary aftercooler shall conform to the following specifications. Refer to Section 15060, 15080 and 15100. Piping may be copper tubing or carbon steel pipe.

Item.	Location	Material
Piping	Non-Corrosive Areas	Copper Piping or Carbon Steel
Piping	Screen Area Truck Bay, Piping Gallery Grit Handling	PVC coated copper or Polypropylene Resin (PP-R) Fusion Welded
Ball Valves	Non-Corrosive Areas	Bronze or Stainless Steel – Full Port
Ball Valves	Screen Area Truck Bay, Piping Gallery Grit Handling	Stainless Steel or Polypropylene Resin (PP-R) Fusion Welded
Check Valves	Non-Corrosive	Bronze or Stainless Steel
Check Valves	Screen Area Truck Bay, Piping Gallery Grit Handling	Stainless Steel
Gate Valves	Non-Corrosive	Bronze or Stainless Steel
Gate Valves	Screen Area Truck Bay, Piping Gallery Grit Handling	Stainless Steel

1. Use 1/4-inch ball valves for gauge cocks.

C. Compressed Air Distribution: Unless otherwise noted, materials for the compressed air distribution system shall conform to the following specifications. Refer to Section 15060, 15080 and 15100 for piping valves listed below:

Item	Material
Piping	PVC Coated Copper or Fusion Welded Polypropelene (PP-R)
Valves	Stainless Steel.

1. Where piping is exposed in chemical, corrosive, or clean areas, or otherwise so specified on Drawings, materials shall be stainless steel, pvc coated copper or polypropelene fussion welded (PP-R). Valves shall be Stainless Steel.

2. Use 1/4-inch ball valve for gauge cocks.

D. Traps: Trap shall be provided at all filters, dryers, receivers, moisture separators, all low points, and when air headers enter or leave building. Traps shall include isolating shutoff valve.

E. Air Set Assembly: An air set assembly shall be furnished and installed at all locations where high-pressure air connects to equipment, valve and gate operators, instrumentation panels, and where shown on Drawings. The air set assembly shall consist of two, 2-way brass ball valves with 3/8-inch ports, 1/4 turn action and directional handle, and one combination pressure regulator and filter

assembly as specified below. Other instrumentation items shall be furnished with their own air set assembly under Division 16 and shall be installed under this Section.

1. Pressure Regulator and Filter Assembly: Regulator assembly shall be the diaphragm-operated type with integral filter, standard mount, 3/8-inch ports and furnished with a 2-inch pressure gauge, T-handle adjustable screw, and self-venting mechanism. Valve and filter body shall be die cast aluminum treated and finished with noncorrosive coating, diaphragm and inner valve shall be Buna-N, spring and adjusting screw shall be cadmium-plated steel. Maximum inlet pressure shall be 150 psi, operating inlet pressure shall be at least 80 psi, and reduced pressure range shall be from 0-125 psi as indicated on Drawings. Diaphragm head shall have a built-in relief valve which will open at a pressure 1 psi over the spring setting. Filter element shall be laminated phenolic resin. An automatic drain shall be provided in the bottom of the accumulator.

2.03 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with Section 15050, in accordance with the following listing:

1. Pipe escutcheons.

2. Dielectric unions.

3. Pipe sleeves.

4. Sleeve seals.

2.04 BASIC SUPPORTS AND ANCHORS

A. Provide supports and anchors complying with Section 15060.

2.05 PRESSURE GAUGES

A. Provide gauges complying with Section 15125, in accordance with the following listing:

1. Pressure gauges and fittings.

2.06 STANDARD ACCESSORIES

A. Provide the following accessory items for each air supply system: aftercoolers, moisture separator, particulate filter, coalescing filter, receiver, air dryer, air regulator station, traps, pressure relief valves, and air compressor controls. The size and capacity of each accessory item shall be sufficient to handle the total capacity of the compressor system specified.

B. Quick Disconnect: 200 PSIG working pressure zinc plated steel or brass body and Buna-N seal. Sleeve type, single shut off NPT inlet x 1/4” coupler unless noted otherwise. Provide 3/8” coupler where noted. Coupler design shall be compatible with ARO 210, Industrial Interchange and Tru-Flate plugs. MIL C-4109

C. Aftercooler, Air-cooled: The aftercooler shall be air-cooled, capable of cooling the discharge temperature of both air compressors to within 15 degrees Fahrenheit of room ambient temperature. The air-cooled aftercooler shall consist of finned triple-pass tubes mounted in an expanded metal housing which shall also serve as the belt guard for the compressor.

D. Moisture Separator: Following the aftercooler, shall be a moisture separator. The moisture separator shall consist of a separating chamber, collecting chamber, and a float actuated discharge valve. The separator shall be rated for 200 psig

E. The receiver shall be of the size specified on Schedule. It shall be ASME pressure rated at 200 psig working pressure. The following accessories shall be mounted on each receiver.

1. 200 psig pressure gauge (4-1/2-inch dial).

2. ASME safety relief valve.

3. Drain connection with valve.

4. Inlet and outlet connections.

5. Drain Trap, Mechanical Float Type (automatic).

6. Three adjustable pressure switches for compressor control and low pressure alarm. Switches shall be 120-volt 2-two pole and 1-one pole in NEMA 4 enclosure.

F. Air Coalescing Filter: The air filter capacities shall be equal to the capacity of the compressor specified or the combined capacity of both compressors in a duplex system and be rated for 200 PSIG. The filter shall deliver clean air, free of oil, condensed water or other entrained impurities. Provide internal auto drain on filter and a means to detect when elements require replacement. Housing shall be metal bowl construction. Provide one dozen spare filter elements. The coalescing filter shall pass a maximum solid particle of 0.3 micron and a maximum aerosol particle of 0.75 micron.

G. Air Dryer: Provide from one of the following air dryers as listed on Equipment Schedule.

1. The desiccant type dryer shall be capable of supplying air at minus 40 degrees Fahrenheit pressure dew point with a maximum inlet air temperature of 90 degrees Fahrenheit and sized to handle 110 percent of the rated flow. The dryer shall be ASME rated for 200 psig. Provide a moisture indication for the dryer. The desiccant capacity shall be six months at rated flow.

H. Particulate Filter: The air particulate filter capacity shall be equal to the capacity of the compressor specified or the combined capacity of both compressors in a duplex system. The particulate filter shall pass a maximum solid particle of three microns. Furnish a trap on filter and a means to detect when elements require replacement. Provide six (6) spare filter elements if replaceable filter type is furnished.

I. Air Regulator Stations: Air regulator station shall consist of a combination pressure-reducing valve and downstream pressure gauge. The capacity of the pressure-reducing valve shall be equal to the output of both compressors and shall be rated for maintaining a downstream pressure of 40 to 80 psi with air upstream pressure as supplied by the specified compressor.

J. A pressure relief valve shall be provided at the discharge of each compressor as a safety valve. The valve shall be ASME rated.

K. Air Compressor Controls: Each compressor system shall be furnished with a control panel pre-piped, prewired unit, or wall-mounted as indicated on Schedule. Provide unit mounted control panels with vibration isolation. The controls provided shall be TEST-OFF-AUTO (auto start) control, as noted on Schedule with 120 Vac control circuits. Motor thermal switches, oil level switch, magnetic unloaders, water and air temperature switches, alarms and aftercooler solenoid circuits shall be provided. The control panel shall be NEMA 4 construction unless otherwise noted on Schedule.

1. Under AUTO, the compressor shall start only when the air receiver pressure drops below a preset level. The control circuits will receive an input signal contact closure from an external source when the compressor is to start. The control circuit shall provide a contact closure rated at 3A, 120 Vac to operate a motor starter furnished by others and a secondary similar contact to operate the regenerative dryer, when specified. All time delays, thermal and oil interlocks, and other devices required to operate the compressor to the manufacturer's requirements shall be provided in this control panel.

2. For packaged unit, the control panel shall include magnetic motor starters, alternator, fusible disconnect switches, pressure switches and wiring as required for a complete operating system. The unit shall be wired to accept one electrical power feed by others.

2.07 AIR-COOLED RECIPROCATING AIR COMPRESSOR

A. This Work shall include the furnishing and erection on a concrete base of reciprocating (piston type) air compressor(s) in the number and type as shown on Equipment Schedule, complete with factory mounted accessories for each compressor as herein specified.

B. The compressor shall be a two-stage, pressure or splash oil lubricated as indicated in the Schedule, air-cooled, motor-driven compressor complete with controls. Compressor shall be provided with low oil level switch to shut down compressor at low oil level. Drive shall be V-belt type with means for easy adjustment of belt tension. Compressor and motor shall be mounted and aligned on a heavy-duty welded steel base. The compressor shall be complete with centrifugal, hydraulic or magnetic unloader, filter-silencer and dual control regulation for constant speed control or automatic start-stop. The unloader shall provide loadless starting and unload the compressor in the event of oil pressure failure.

C. For duplex, tank mounted systems, each compressor shall be capable of being isolated with valving while allowing the remaining compressor to continue operating based on pressure controls.

D. A moisture separator, with internal trap, shall be installed prior to the compressed air entering the receiver.

E. Valves shall be stainless steel, easily removed and inspected without special tools.

F. Spare Parts and Oil Supply: A minimum of three, or one year's supply, filter-silencer elements shall be provided for each unit as well as sufficient oil for two complete oil changes for each unit in addition to the initial filling prior to starting the compressor.

G. Refer to the Equipment Schedule and Section 16220 for motor specifications.

2.08 COMPRESSOR ACCESSORIES

A. Vibration Isolators: Provide sandwich type elastomer mounts, properly sized for weight loading. The mounts shall consist of a high-grade cork plate bonded between layers of oil resistant synthetic rubber. Mounts shall contain a steel load distributing plate (if required). The elastomer vibration isolators shall be located between the air receiver legs and the concrete pad.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which compressed air systems and equipment is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF COMPRESSED AIR PIPING

A. Install compressed air piping in accordance with Section 15060.

B. Install piping with 1/8-inch per foot (1 percent) downward slope in direction of air flow.

C. Install reducers where required.

D. Connect branch piping to mains from top of main. Provide drain leg and drain trap at end of each main, each branch, and each low point in piping system.

3.03 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Section 15080.

3.04 INSTALLATION OF SUPPORTS AND ANCHORS

A. Install supports and anchors in accordance with Section 15060.

B. Spacing: Do not exceed 10'-0" spacing between pipe hangers for any size pipe.

3.05 INSTALLATION OF VALVES

A. Install valves in accordance with Section 15100.

3.06 INSTALLATION OF GAUGES

A. Install gauges in accordance with Section 15080.

3.07 INSTALLATION OF AIR COMPRESSORS

A. Install air compressors in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install units on 4-inch-high reinforced concrete pad, 4 inches larger on each side than compressor base.

C. Mount units on vibration isolators which have been anchored to substrate, in accordance with manufacturer's instructions.

D. Electrical Wiring:

1. Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.

2. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.08 EQUIPMENT CONNECTIONS

A. Connect compressed air piping system to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.09 FIELD QUALITY CONTROL

A. Compressed Air Piping Leak Test: Prior to initial operation of piping system, air purge lines with oil-free dry air, and perform 24-hour standing pressure time-test. Charge line with compressed air to 150 psi; maintain test pressure for 24-hours with pressure loss no greater than 5 psi. During pressure test, test joints and fittings for leaks with soap bubble solution; while bubble testing, hammer joints with rubber or rawhide mallet to break hardened flux.

B. Repair or replace compressed air piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

C. Cap (seal) ends of piping where not connected to mechanical equipment.

3.10 ADJUSTING AND CLEANING

A. Clean, flush, and inspect compressed air systems in accordance with requirements of Section 15060.

B. Installation Check: The manufacturer shall provide the services of a factory-trained representative to check the installation of all equipment installed in this Section. The installation check shall include but not limited to the following: all guards installed and comply with OSHA regulaitons; Oil levels checked; all piping and drains installed per the manufacturer’s recommendations; Motor rotation confirmed with markings on the unit; Operational controls tested and verified; Alarms function; External equipment monitoring (where indicated) tested.

C. Supply new Oil Filter and replace oil after initial equipment start-up per the manufacturer’s recommendations.

3.11 START-UP AND TRAINING

A. Provide start-up of the air compressor following the manufacturer’s recommended start-up procedures. Test compressor under all load conditions. Provide owner with spare parts and consumables as indicated here-in or on the drawings. Provide owner with copy of the manufacturer’s startup list and field report indicating successful start-up of equipment.

B. Test the operation of the control devices and automatic drain systems.

C. Provide a minimum of two (2) training sessions consisting of a minimum of 2 hours each for owner’s employees. Training shall include but not limited to: standard operating procedure, routine maintenance activities, trouble shooting, set point adjustment and controls.

END OF SECTION

SECTION 15410 - PLUMBING PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide all plumbing piping systems as indicated on the plans and in the scope of work to include, but not limited to: Sanitary Drain, Waste and Vent piping, domestic hot and cold water piping, tepid water, service water (NPW), condensate drainage system for HVAC equipment, as indicated.

B. Work includes, but is not limited to, the following:

1. Connection to fixtures and equipment.

2. Connection to all floor and areaway drains.

3. Connection to site utility lines.

1.02 RELATED WORK

A. Section 15010 - General Mechanical Provisions.

B. Section 15015 - Sleeves and Penetrations.

C. Section 15060 - Pipe and Pipe Fittings - General.

D. Section 15090 - Hangers, Supports, and Anchors.

E. Section 15100 - Valves.

F. Section 15180 - Thermal Insulation.

G. Section 15430 - Plumbing Specialties.

H. Section 15440 - Plumbing Fixtures.

I. Section 15450 - Plumbing Equipment.

1.03 QUALITY ASSURANCE

A. Welding materials and labor shall conform to ASME Code and applicable state labor regulations.

B. Use welders fully qualified and licensed by state authorities.

C. Comply with Kentucky State Plumbing Law, Regulations and Code.

PART 2 - PRODUCTS

2.01 MATERIALS GENERAL

A. Materials installed corrosive environments shall be corrosion resistant to the space conditions. Refer to specification 15010 for corrosive environments.

2.01 PIPE

Service	**Material**
Sanitary and Industrial Waste drainage and vent below grade	PVC or ABS, schedule 40.
Sanitary and Industrial Waste drainage and vent above grade	PVC or ABS, schedule 40.
Storm drainage inside building	Schedule 40 PVC.
Storm mains not under traffic or structure	Reinforced concrete (ASTM C76), PVC (ASTM D2729) or Corrugated steel (AASHTO M36)
Storm mains under vehicle paving	Cast iron (ASTM A74) hub and spigot, or as an option, PVC or steel pipe listed above, completely imbedded in concrete
Domestic (Potable) water buried, and Non-Potable	Type K copper; 150 psi for sizes larger than 2 inch. HDPE
Domestic (Potable) water unburied and Non-Potable. Non Corrosive Areas only.	Type L hard copper
Including hot water and tepid water	
Equipment drains	PVC, schedule 40.
Domestic, Non-Potable, Tepid and Service Water – Corrosive Environments	Type L hard copper - polyethylene coated;
See specification 15010 for corrosive spaces.	Fusion Welded PP-R (polypropylene piping with faser layer) Auqatherm or equal.

2.02 FITTINGS

Service	Material	Joint
Sanitary drainage and vent below grade	PVC, ABS	Solvent weld
Sanitary drainage and vent above grade	PVC, ABS	Solvent weld
Sanitary drainage for acid waste	Polyethylene	Heat fusion
	Polypropylene	Comp. Coupling
Storm drainage inside building	PVC, ABS	Solvent weld
Domestic water	Wrought copper, bronze or cast brass	95-5 solder or flared
	PVC	Solvent weld
	Polybutylene	Socket heat-fusion or metal insert & compression ring
	Polypropylene with faser layer, PP-R	Heat-fusion or metal insert or flanged
Equipment drains	PVC	Solvent weld

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

3.02 ROUTES AND GRADES

A. Route piping in orderly manner and maintain proper grades. Install to conserve headroom and interfere as little as possible with use of space. Run exposed piping parallel to walls. Group piping wherever practical to common elevations. Install concealed pipes close at building structure to keep furring to a minimum.

B. Slope water piping 1" in 40 feet (1/480) and arrange to drain at low points.

C. On closed systems, equip low points with 3/4 inch drain valves and hose nipples. Provide, at high points, collecting chambers and high capacity float operated automatic air vents.

D. Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.

E. Grade horizontal drainage (other than sewer) and vent piping 1/4 inch per foot (1/48) minimum.

F. Install piping to allow for expansion and contraction without stressing pipe or equipment connected.

G. Provide clearance for installation of insulation and for access to valves, air vents, drains and unions.

H. Install same type piping material specified for inside building to 5 feet outside of building.

I. Slope drainage lines 1/8 inch per foot minimum (1/960).

J. Bury outside water and drainage pipe minimum 4 feet, unless otherwise shown.

K. Install connections from drain tile furnished under Division 2 to sanitary and storm drainage system including any cleanouts.

END OF SECTION

SECTION 15430 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Floor Drains (FD)

B. Cleanouts (CO, FCO, WCO, GCO)

C. Backflow Preventers (BFP)

D. Hose Bibbs (HB)

E. Wall Hydrants (WH)

F. Water Hammer Arrestors (WHA)

G. Thermostatic Mixing Valves (TMV or TMA)

H. Trench Drains

I. Pressure Control Valves

J. Yard Hydrants

K. Roof/Deck Drains

L. Backwater Valves

1.02 RELATED WORK

A. Section 15060 - Pipe and Pipe Fittings

B. Section 15090 - Hangers, Supports, and Anchors

C. Section 15095 - Expansion Compensation and Vibration Isolation

D. Section 15100 - Valves

E. Section 15180 - Thermal Insulation

F. Section 15410 - Plumbing Piping

F. Section 15440 - Plumbing Fixtures

G. Section 15450- Plumbing Equipment

1.03 REFERENCE STANDARDS

A. Kentucky State Plumbing Code, current edition.

B. ASME Boilers and Pressure Vessels Code, current edition.

PART 2 - PRODUCTS

2.01 FLOOR DRAINS

A. FD-1: Lacquered cast iron body with double drainage flange, weep holes, combined two piece body reversible clamping device and adjustable 7 inch diameter nickel-bronze strainer, as manufactured by Zurn, Model Z-415, 3", or as manufactured by Josam, Wade, or Smith.

   1. For Corrosive environment: Type 304 (CF8) stainless steel heavy-duty adjustable floor drain with integral anchor flange, adjustable top frame and deep flange grate with plain finish. Zurn Model Z1732, or equal as manufactured by Josam, Wade, or Smith.

B. FD-2: 12 inch diameter top heavy duty lacquered cast iron body with bottom outlet seepage pan and heavy duty cast iron anti-tilt slotted grate, manufactured by Zurn, Model Z-505, 4", or as manufactured by Josam, Wade, or Smith.

2.02 CLEANOUTS AND CLEANOUT ACCESS COVERS (CO)

A. Provide calked or threaded type extended to finished floor or wall surface. Provide bolted coverplate cleanouts on vertical rainwater leaders only. Ensure ample clearance at cleanout for rodding of drainage system.

B. Floor Cleanout Access Covers in Unfinished Areas: Countersunk type, round with nickel bronze scored frames and plates. Provide round access covers in finished areas with depressed center section to accommodate floor finish. Wall cleanouts to have chrome plated caps. Acceptable manufacturers are Zurn, Josam, Wade, and Smith.

C. For Corrosive environment: Type 304 (CF8) stainless steel cleanout body and plug with O-ring seal. Plug is scoriated with satin finish. Spanner wrench provided for each plug size. Zurn Model Z1745 or equal as manufactured by Josam, Wade, or Smith.

2.03 BACKFLOW PREVENTERS (BFP)

A. Provide reduced pressure principle (RPZ) backflow preventers at the locations and in the sizes as called for on the drawings.

B. Provide reduced pressure backflow preventers in the size shown size shown on the Drawings. Backflow preventers shall be rated for 175 psig and water temperatures up to 110 degrees F. Backflow preventers shall be tested and certified in accordance with ASSE 1013 and AWWA C506.

C. Backflow preventers shall have two (2) independent operating spring loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve installed between the check valves. Provide with FDA approved epoxy coated cast iron check valves, removable bronze seats, stainless steel internal parts, and FDA approved epoxy coated cast iron relief valve with stainless steel trim.

D. Provide isolation valves on the inlet and outlet of each backflow preventer. Valves shall be OS&Y gate valves. Backflow preventers 3-inch and larger shall have flanged connections (to match rating of pipe), and less than 3-inch shall have screwed connections.

E. The backflow preventers shall be complete with a strainer, as manufactured by Watts, Model Series 909 or equal. Optional manufacturers are Hersey, Wilkins, Beeco and Clayton.

2.04 WATER METER

A. Turbine Type with magnetic drive (3 to 4-inch):

B. All meters furnished shall be manufactured by a registered ISO 9001 quality standard facility. Acceptable meters shall have a minimum of fifteen (15) years of successful field use. All specifications meet or exceed the latest revision of AWWA C701.

C. Lead free and shall meet the Safe Drinking Water Act (SDWA) per NSF 372.

D. All meters shall be equipped with either direct reading hermetically sealed register or encoder remote registers per AWWA C707 and meet all AWWA C701 performance standards and per local authorities standards.

E. The main case and cover shall be cast from NSF/ANSI 61, certified lead free bronze alloy. The hermetically sealed register shall consist of naturally lubricated, molded gears. A positive magnetic drive shall couple the register with the measuring element.

F. Water meter shall be Trident Turbine, Neptune, or approved equal.

2.05 HOSE BIBBS (HB)

A. Bronze or red brass, hose thread spout, anti-siphon "wall hydrant" type, 3/4 inch size, integral vacuum breaker/backflow device, removable handle, and chrome plated as manufactured by Woodford, Model 24P, or as manufactured by Zurn, Josam, Wade or Smith.

2.06 WALL HYDRANT (WH) – FROST PROOF

A. Bronze casing and all bronze interior parts, flush encased "anti-siphon" wall hydrant, non-freeze type with integral backflow preventer, chrome plated, hose thread connection, recessed box with hinged cover complete with operating key lock, 3/4 inch size as manufactured by Zurn, Model Z-1300 or as manufactured by Josam, Wade or Smith.

2.07 WATER HAMMER ARRESTORS (WHA)

A. Install stainless steel bellows type water hammer arrestors on water lines connected to flush valves, and to fixture or group of fixtures, complete with accessible isolation valve, Zurn, Model Series Z-1700, PDI size as indicated, or as manufactured by Amtrol, Wade, or Ancon.

2.08 THERMOSTATIC MIXING VALVES (TMV, TMA)

A. Provide pressure compensating, thermostatic mixing valve, Lawler Model 911, Bradley, Leonard, Symmons, Powers or approved equal, capacity 37 gpm at 10 psi differential. May be factory fixed at 80 deg.F or field-adjustable.

B. Provide strainer, stop/check valves on inlets.

C. Provide lockable wall cabinet of 16 gage prime coated steel or mount above lay-in ceiling as shown.

D. Provide with volume control shut-off valve and stem type thermometer on outlet for adjustable units.

F. TMV used for emergency fixtures shall comply with ANSI Z358.1

2.09 PRESSURE CONTROL VALVES (PCV)

A. PCV-1

1. Function: The Pressure Reducing Valve shall maintain a constant downstream pressure regardless of changing flow rate and/or inlet pressure.

2. The valve shall be hydraulically operated, single diaphragm-actuated, globe or angle pattern. The valve shall consist of three major components: the body, with seat installed; the cover, with bearings installed; and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the

following minimum weights and thicknesses, unless otherwise indicated.

3. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert.

4. The diaphragm assembly containing a non-magnetic 303 stainless steel stem with sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

5. Valve shall be epoxy coated.

6. Provide inlet and outlet pressure indicating gauges

7. Valve shall be Cla-Val Model 90-01 or equal.

B. PCV-2,3,4,5,6,7

1. Provide water Pressure Reducing Valve with integral strainer. s. Approved valve shall be listed to ASSE 1003 and IAPMO and certified to CSA B356. Valve shall be a Watts Series LF25AUB-Z3 or equal. Refer to the drawings for flow rate and pressure requirements.

2. Provide reducers as required to installation of the valve in the piping system.

2.10 TRENCH DRAINS

A. Trench Drain (TD-1-1)

1. Channels shall be, 12" wide and have a 9-1/8" throat. Modular channel sections shall be made of 12ga. Fabricated Stainless Steel conforming to ASTM A-240 (type 304). Channels shall have a bolted, flanged connection between channel sections that will not separate during the installation, gaskets available. Channels shall weigh less than 4.15 lbs. per linear foot, have a smooth, 1-1/2" radiused self-cleaning bottom with a Manning's coefficient of .009 and 1.04% or neutral 0% built in slope. Channels shall have feet for patty pour or leveling studs standard to secure trench in its final location. All welds must be performed by a certified welder per ASTM standard AWS D1.6. Channels shall be produced in the U.S.A.

2. Grating: Reinforced Slotted Stainless Steel (type 304) Grate - Class C

3. Drain Connection: Center, 6" bottom

4. Manufacturers: Trench drain shall be ZURN Model Z895 or equal.

B. Trench Drain (TD-1-2, -3)

1. Provide 16 ga. fabricated Stainless Steel channel conforming to ASTM A-240 (type 304). Channels have a bolted, flanged connection between channel sections that will not separate during the installation, gaskets available. Channels shall have a smooth, 1-1/2 radiused self cleaning bottom with a Manning's coefficient of .009 and 1.04% or neutral 0% built in slope. Channels have feet for patty pour or leveling studs standard to secure trench in its final location. All welds must be performed by a certified welder per ASTM standard AWS D1.6. Channels shall be produced in the U.S.A.

2. Grating: Provide fiberglass grating, CLASS A rating

3. Nominal exposed trench width: 7” and minimum inside width of 4”

4. Drain Connection: End, 3”

5. Manufacturers: Trench drain shall be ZURN Model Z890 or equal.

2.11 YARD HYDRANTS – BACKFLOW PROTECTED

A. Provide Sanitary Yard Hydrant that is backflow protected with automatic draining and freezeless design. The unit shall employ a reservoir below the frost line to contain the drainage water. The hydrant shall be completely sealed to prevent surface and ground water from entering the reservoir or service line. The valve shall employ a venture design to remove water from reservoir when the valve is opened. The unit shall be with a hose connection backflow preventer with two check valves compliant with ASSE 1052.

B. Bury Depth: Provide unit with bury depth to comply with Frost Depth of 24” (Lexington, KY frost depth).

C. Hydrant shall be lead-free compliance with NSF/ANSI 372: Drinking Water System Components – Lead Content.

C. Manufacturer: Woodford Model S3, Jay R. Smith MFG Co. Model 5904 non-freeze sanitary post/yard hydrant, Simmons MFG Co Model 6800LF Series Sanitary Frost-Proof Yard Hydrant

2.12 ROOF/DECK DRAINS

A. Provide 304 stainless steel deck drain with medium duty flat grate with plain finish. The grate opening area shall be a minimum of 17 square inched. The drain size shall be as noted on the plans. Drain shall be Zurn Z1719 or equal.

2.13 BACKWATER VALVE

A. Provide Dura-Coated cast iron body, hub inlet and offset spigot outlet, bronze threaded cover, automatic PVC flapper type backwater valve with O-ring. Provide extension and length to extend flush with floor and provide flush cover. Valve shall be Zurn Z1095 or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.

B. Install backflow preventers of type, size, and capacity indicated, at each water-supply connection to mechanical equipment and systems, and to other equipment and water systems as indicated. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment. Install air-gap fitting on preventers with drain/relief port and pipe outlet drain to nearest floor drain. Do not install bypass around backflow preventer.

C. Install line strainers on supply side of each control valve, pressure regulator, and solenoid valve, and where indicated. See Section 15080.

D. Install hose bibb faucets and wall hydrants with integral or field-installed vacuum breaker.

E. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:

1. Size same as drainage piping up to . Use for larger drainage piping unless larger cleanout is indicated.

2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of . for piping and smaller and for larger piping.

4. Locate at base of each vertical soil and waste stack.

F. Install floor cleanout deck plates of types indicated, for piping below floors. Use secure fasteners where indicated. Install wall cleanout access covers of types indicated, with frame and cover flush with finished wall, for piping concealed in walls. Use secure fasteners where indicated.

G. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

H. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

I. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor or as indicated. Size outlets as indicated.

J. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

1. Radius, or Less: Equivalent to 1 percent slope, but not less than total depression.

K. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

L. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

M. Position floor drains for easy access and maintenance.

N. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

O. Secure supplies to supports or substrate.

P. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated.

Q. Install water-supply stop valves in accessible locations.

R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

S. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping connections between plumbing specialties and piping specified in other Division 15 Sections.

2. Install piping connections indicated between appliances and equipment specified in other Sections; connect directly to plumbing piping systems.

3. Install piping connections indicated as indirect wastes from appliances and equipment specified in other Sections, to spill over receptors connected to plumbing piping systems.

B. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power is specified in Division 16 Sections.

C. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction.

D. Drainage Runouts to Plumbing Specialties: Install drainage and vent piping, with approved trap, of sizes indicated, but not smaller than required by authorities having jurisdiction.

E. Ground electric-powered plumbing specialties.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power, wiring, and disconnect switches are specified in Division 16 Sections.

3.03 TRENCH DRAINS

A. Install trench drains per manufacturer’s requirements. Connect sections as required.

B. Provide supports and anchors for complete installation. Slope floors to the trench drains. Coordinate with structural plans for installation.

C. Slope drain to discharge connection. Connect trench drain to plumbing as shown on the plans.

C. Install trench grating per manufacturer’s requirements.

3.04 PRESSURE CONTROL VALVES

A. Install the pressure control valve level and plumb. Install with inlet and outlet pressure gauges. Install isolation valves on inlet and outlet of the valve and install bypass line with globe valve. Provide wye-strainer upstream of the valve with blowdown valve.

B. Adjust the pressure of the device as shown on the schedule.

3.05 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work. Place plugs in ends of uncompleted piping at end of each day or when work stops.

B. Lubricate cleanout plugs with mixture of graphite and linseed oil. Prior to building turnover, remove cleanout plugs, re-lubricate and re-install using only enough force to ensure permanent leakproof joint.

C. Provide vacuum breakers or backflow preventers on all plumbing lines where contamination of domestic water may occur, and on boiler make-up lines, hose bibbs, and flush valves.

END OF SECTION

SECTION 15440 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provide complete and operating fixtures with necessary accessories and trim, as scheduled and indicated on drawings.

1.02 RELATED WORK

A. Section 15100 - Valves

B. Section 15410 - Plumbing Piping

C. Section 15430 - Plumbing Specialties

D. Section 15450 - Plumbing Equipment

1.03 REFERENCES

A. ANSI A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

B. ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.

C. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.

D. ANSI A112.19.5 - Trim for Water Closet Bowls, Tanks, and Urinals.

1.04 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for all products specified in this Section, including fixtures, trim, carriers, supplies, drainage specialties.

B. Submit spare parts list with exploded views for flush valves, faucets, and other items with separate parts.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include American Standard, Kohler, Crane, Eljer, Elkay, Just, Guardian, Speakman, Western, Haws, Bradley, Sloan, Delaney, Josam, J.R. Smith, Wade, Zurn, Church, Beemis, Beneke, Sperzel, Fiat, Halsey-Taylor, Oasis, Chicago, T&S Brass, Moen, Delta and Olsonite. Only one manufacturer and model number will be used as a standard for each of the following fixtures. Provide standard item specified or its equivalent successor in the base manufacturer's product line. Consult with the Engineer if there is a question.

2.02 GENERAL

A. Provide new fixtures, free from flaws and blemishes with finished surfaces clear, smooth and bright.

B. Provide approved plumbing fittings. All exposed metal parts and parts within cabinetwork shall be heavily chrome plated, including traps, tubing drains to walls, escutcheons, supplies and valves.

C. Fixtures of the same type shall be produced by one manufacturer.

D. Fittings of the same type shall be the product of one manufacturer.

E. Protect fixtures against use and damage during construction.

F. Color of fixtures shall be white unless otherwise indicated.

2.03 FIXTURES

A. Fixtures provided in this Division.

1. WC-1-1 Water Closet (floor mounted, residential type)

   a. American Standard #2109.405 "Elongated Cadet" floor mounted water closet with elongated siphon jet action bowl and close coupled tank with water-saving trim.

   b. Olsonite #44 white, plastic, closed front elongated seat with stainless steel posts, top mount hinges and cover.

   c. Brass Craft No. SR-1712-DL, toilet tank supply with 3/8" angle valve with 1/2" male pipe thread inlet and loose key stop, 3/8" X 1/2" flexible riser with 3/8" X 1/2" female coupling nut, 1/2" X 3" long c.p. wall nipple and cast brass wall escutcheon with set screw.

2. SK-1-1 Service Sink (wall mounted)

   a. American Standard # 7692.049 "Lakewell" service sink, 22 x 18 x 12 inch deep, stain resisting, porcelain enamelled inside only, cast iron roll-rim sink with 12 inch high back, concealed hanger, stainless steel rim guard, faucet holes on 8" centers. Fixtures dimensions per ANSI Standard A112.19.1M.

   b. American Standard #8341.075 backmount service sink faucet with vacuum breaker and stops in shanks, rough chrome finish, bucket hook, lever handles, 3/4" hose connection, 1/2" inlet connections, 8" centers.

   c. American Standard # 7798.176, 3" finished cast iron trap standard with grid drain, cleanout plug, pedestal with flange.

3. LAV-1-1 Lavatory (wall mounted)

   a. American Standard # 0356.012 "LUCERNE" wall hung lavatory, 20-inch by 18-inch vitreous china lavatory, with 14-1/2-inch by 10-1/4-inch rectangular basin, splash lip, front overflow, fabricated for concealed arm supports, and having two soap depressions. Drill lavatories for 4-inch center faucets. Provide concealed arm carriers.

   b. Faucet: American Standard #8186.211. Polished chrome-plated cast brass, 4-inch center set, 4-inch spout with chrome-plated constant flow aerator, single-wing handles indexed "HOT" and "COLD," and 1-1/4-inch chrome-plated pop-up waste..

4. EEW-1-1 Emergency Eye/Face Wash

   a.. Provide an Emergency Eye/Face Wash compliant with ANSI Z358.1. Unit shall be pedestal mount style. The eye/face wash includes an integral 5.1 GPM (19.2 L) flow control, providing water at a safe velocity while maintaining its effectiveness (exceeds minimum water flow of 3.0 GPM at 30 PSI). Eye/face wash is protected by a full bowl dust cover that activates the unit when it is opened. Safe, steady water flow under

varying water supply conditions from 30–90 PSI shall be assured by integral flow control in the sprayhead assembly. Sprayheads shall be construction from durable 304/316 stainless steel with electro-polished finish. Valve and piping shall be constructed of stainless steel.

1. Accessories:
   a. stainless steel dust cover
   b. Identification sign

b. Manufacturer: Bradley Model S19214SC or equal.

5. Miscellaneous Equipment

   a. Provide rough-in and final connections only for all indicated owner-furnished plumbing fixtures, and miscellaneous items furnished under other divisions. Coordinate locations, pipe sizes and work phasing with other divisions.

   b. Provide tailpieces, traps, supplies and other trim as required for complete installation. All equipment shall have water supply stops or valves.

PART 3 - EXECUTION

3.01 INSPECTION

A. Check millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Obtain approximately centerline rough-in dimensions between partitions or walls from drawings. Verify dimension in field before making rough-ins. Work shall be roughed-in so that all exposed piping will be straight and true without bends or off-sets.

3.02 INSTALLATION

A. Provide all fixtures complete with trim required and connect in a manner conforming to State Plumbing Code.

B. Install each fixture with trap, easily removable for servicing and cleaning, unless intergral type. At completion, thoroughly clean plumbing fixtures and equipment. Place traps as near to fixture as possible, and always within limits permitted by Code.

C. Water supplied shall connect through walls and not to floor as far as possible, with screwdriver stops, reducers and chrome plated escutcheons with set screws. All exposed pipe and fittings shall be chrome plated red brass. Where fixtures are without supporting legs or carriers (lavatories, urinals, etc.) secure wall hangers to bolts welded to 3/16" steel plates, mounted against walls within chases, or use commercial back-up plates.

D. Install wall mounted lavatories, urinals, and water closets with approved wall carriers, model to suit installation.

E. All fixtures shall be roughed-in in strict accordance with prevailing codes and regulatory agencies having jurisdiction. Mount fixtures at the following heights above finished floor in absence of specific instructions or dimensions in architectural drawings:

Water Closet:	Standard	15 inches to top of bowl rim
	Handicapped	18 inches to top of seat

F. Set all floor mounted closet bowls with Dap Bowl-Setting Compound or equivalent. Set all strainers on sinks with Dap Bowl-Setting Compound or equivalent. Thoroughly clean excess compound from fixtures. Caulk all wall mounted fixtures. Wherever backs or other portions of fixtures join wainscotting or tile, maximum allowable gap between fixture and wall surface shall be 1/8". If this dimension is exceeded, fixture shall be removed and ground to obtain a smooth flush mounting surface, or wall shall be altered. Gap between fixture and wall surface shall then be neatly filled with DAP, Thiokol, or approved equivalent, white silicone sealant.

G. Install hose end faucets and hose connections with vacuum breakers.

3.04 EMERGENCY FIXTURES

A. Install fixtures per manufacturer's requirements. Install plumbing to provide clear access to the unit.

B. Install drain line from the unit to the nearest drain as shown on the plans.

C. Test the unit for flow as indicated by the manufacturer's recommendations.

END OF SECTION

SECTION 15450 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Diaphragm expansion tanks

B. Instantaneous gas water heaters

1.02 REFERENCES

A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

B. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

1.03 SUBMITTALS

A. Submit under provisions of Section 15010.

B. Shop Drawings:

1. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

C. Product Data:

1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Indicate pump type, capacity, power requirements, and affected adjacent construction.

D. Manufacturer's Installation Instructions.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with the Kentucky Plumbing Code and the Kentucky Building Code.

B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).

2. American Society of Mechanical Engineers (ASME).

3. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).

4. National Electrical Manufacturers' Association (NEMA).

5. Underwriters Laboratories (UL).

6. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation.

1.06 REGULATORY REQUIREMENTS

A. Conform to Kentucky Boiler Inspection Division requirements for water heaters.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 15010.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

A. Provide warranty under provisions of Section 15010.

PART 2 - PRODUCTS

2.01 DIAPHRAGM-TYPE EXPANSION (COMPRESSION) TANKS

A. Manufacturer:

1. Amtrol Therm-X-trol AST or approved equal

2. Other acceptable manufacturers - Bell and Gossett, Armstrong, Wood, Taco.

B. Construction: Welded steel, tested and stamped in accordance with Section 8D of ASME Code; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles. Construction shall be approved for use with hot potable water systems

C. Accessories: Pressure gauge and air-charging fitting, tank drain.

D. Size: As indicated on plans

2.02 INSTANTANEOUS ELECTRIC WATER HEATERS

A. Manufacturers: Design basis is RHEEM Model RTGH series. Similar units by Bosch, orRinnai will be considered under provisions of Section 15010.

B. Tankless water heater shall be natural gas fired with a maximum input as shown on the schedule. Heater shall be have flow controls to activate at a minimum flow of 0.5 GPM. The heater shall have a minimum firing rate of 12,000 BTU.

The system shall be rated for capacities listed in the schedule.

C. Construction shall be copper piping or tubing complying with NSF 372 barrier materials for potable water, without storage capacity, 150 psig maximum working pressure, ASME B1.20.1 pipe thread connections.

D. Aluminum or steel jacket with enameled finish or plastic, resistance heating element system with high-temperature-limit cutoff device, flow-control fitting temperature control, and bracket for wall mounting.

E. Unit shall operate on 120 volt, 60 hertz, single phase power,

F. Provide with the following accessories:
   1. Wall thimble and concentric wall vent termination kit.
   2. Neutralization kit for water heater exhaust drain.
   3. Temperature gauge on unit outlet
   4. Temperature and Pressure relief Valve

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions.

B. Coordinate with plumbing piping and related work to achieve operating system.

3.02 EXPANSION TANK INSTALLATION

A. Install according to manufacturer's instructions.

B. Measure cold water line static pressure and precharge tank to same pressure.

END OF SECTION

SECTION 15478 - HEAT TRACING FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SUMMARY:

A. Section includes plumbing piping heat tracing for freeze prevention and domestic hot-water-temperature maintenance with the following electric heating cables:

1. Self-regulating, parallel resistance.

1.02 ACTION SUBMITTALS:

A. Product Data: For each type of product.

B. Shop Drawings: For electric heating cable.

1.03 INFORMATIONAL SUBMITTALS:

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.04 CLOSEOUT SUBMITTALS:

A. Operation and maintenance data.

1.05 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Ten (10) years' experience in design, Engineering, manufacture and support of specified system and components.

1.06 WARRANTY:

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES:

A. Comply with IEEE 515.1.

B. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, stranded copper bus wires embedded in cross-linked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads

with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

D. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.

E. Maximum Operating Temperature (Power On): 150 deg F.

F. Maximum Exposure Temperature (Power Off): 185 deg F.

G. 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.

H. Capacities and Characteristics:

1. Maximum Heat Output: 8 W/ft.
2. Piping Diameter: As indicated on drawings.
3. Electrical Characteristics for Single-Circuit Connection: 120 volts, single phase, 60 Hz.

2.02 CONTROLS:

A. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from 40 to 100 deg F.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

2.03 ACCESSORIES:

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

Warning Labels: Refer to Section 15075 – Identification for Plumbing Piping and Equipment

B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Section 15080 – Mechanical Insulation.
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

C. Electric Heating-Cable Installation for Temperature Maintenance for Domestic Hot Water:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install insulation over piping with electric heating cables according to Section 15080 – Mechanical Insulation.
3. Install warning tape on piping insulation where piping is equipped with electric heating cables.

D. Set field-adjustable switches and circuit-breaker trip ranges.

E. Ground equipment according to Section 16060 – Grounding.

F. Connect wiring according to Section 16120 – Wires and Cables (1000 Volt Maximum).

3.02 FIELD QUALITY CONTROL:

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
2. Test cables for electrical continuity and insulation integrity before energizing.
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Remove and replace damaged heat-tracing cables with new.

END OF SECTION

SECTION 15480 - WATER HEATERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Water heater Work indicated on Drawings and Schedules and by requirements of this Section.

B. Provide factory-mounted and factory-wired controls and electrical devices as specified in this Section.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section.

1. Submit manufacturer's technical product data including rated capacities and efficiencies of selected model clearly indicated, operating weights, furnished specialties and accessories, and installation and start-up instructions.

2. Submit manufacturer's assembly type shop drawings indicating dimensions, required clearances, and methods of assembly of components, in accordance with Division 1.

3. Submit manufacturer's electrical requirements for electrical power supply wiring to water heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory-installed and portions that are to be field-installed.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 001780, operation and maintenance manuals for items included under this Section.

1.03 QUALITY ASSURANCE

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

B. Codes and Standards:

1. UL Compliance: Provide water heater components which are UL-listed and labeled. Construct water heaters in accordance with the following UL standards:

a. UL 174, "Household Electric Storage-Tank Water Heaters."

b. UL 732, "Oil-Fired Water Heaters."

c. UL 1261, "Electric Water Heaters for Pools and Tubs."

d. UL 1453, "Electric Booster and Commercial Storage Tank Water Heaters."

2. NEC Compliance: Install electric water heaters in accordance with requirements of NFPA 70, "National Electrical Code."

3. NFPA Compliance: Install gas-fired water heaters in accordance with requirements of NFPA 54, "National Fuel Gas Code."

4. NFPA Compliance: Install oil-fired water heaters in accordance with requirements of NFPA 31, "Installation of Oil Burning Equipment."

5. AGA and NSF Labels: Provide water heaters which are listed and labeled by American Gas Association and National Sanitation Foundation.

6. ASME Code Symbol Stamps: Provide water heaters and safety relief valves which comply with ASME Boiler and Pressure Vessel Code, and are stamped with appropriate code symbols.

7. ASHRAE Compliance: Provide water heaters with Performance Efficiencies not less than prescribed in ASHRAE 90A, "Energy Conservation in New Building Design."

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle water heaters and components carefully to prevent damage, breaking, denting, and scoring. Do not install damaged water heaters or components; remove from Site and replace with new.

B. Store water heaters and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading water heaters and moving units to final location for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Instaneous Gas Water Heaters:

a. Bosch ModeC1210ESC.

b. RHEEM RTG-95 with Manifold for two (2) water heaters.

c. Rinnai RUR98i with Manifold for two (2) water heaters

2.02 INSTANTANEOUS GAS WATER HEATER (WH-2, WH-3)

A. Power Vented tankless water heater: Water heater shall be direct vented for both exhaust and combustion air. Supply with manufacturer concentric Wall or Roof termination kit. Units shall be design and operate with a minimum of 94% ANSI Z-21 efficiency. Recovery rate of the 300 gallons per hour at 75°F temperature rise.

B. Heat Exchanger: Water heater shall be gas fi red, condensing tankless design with a modulating power burner and negative pressure gas valve. Burner shall be capable of 9:1 turndown of fi ring, without loss of combustion effi ciency. Primary heat exchanger/combustion chamber shall incorporate a multi pass copper tube and fi n design with internal turbulators. Secondary condensing heat exchanger shall incorporate a multi-pass aluminum heat exchanger of fi n tube design with copper water path to prevent galvanic corrosion. Heat exchangers shall be rated for maximum working pressure not less than 150 psig. Exhaust outlet connector shall be of corrosion resistant metal, with a 3” diameter flue connection.

C. Water Flow: The water heaters must provide a minimum of 7.4 GPM at 45^0 F rise (per unit) and 14.8 GPM at 45^0 F rise for the system.

D. Control: The control system shall contain: embedded control board incorporating LCD display to read temperature, and tactile buttons for output power, temperature, and programming control; CPU board which houses all control functions; power transformer; ignition spark module; and unique connections for each sensor or component. The control board shall be fi eld replaceable. The combustion safeguard/fl ame monitoring system shall utilize spark ignition and a rectifi cation type flame sensor.

E. Accessories: Provide the unit with the following accessories:
   1. Temperature and Pressure Relief Valve
   2. Neuteralization kit with spare element for unit condensate drain.
   3. Concentric Wall Kit and termination

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which water heaters are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 INSTALLATION OF WATER HEATERS

A. Install water heaters in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Place units level and plumb, orient so controls and devices needing service and maintenance have adequate access.

C. Piping: Connect hot and cold water piping to units with shutoff valves and unions. Connect recirculating water line to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain, or as indicated.

D. Gas-Fired Water Heaters: Connect gas supply to gas line with drip leg, tee, gas cock, and union, full size of unit inlet connection. Locate piping so as not to interfere with service of unit.

   1. Flue: Connect flue to draft hood with gas-tight connection. Provide flue of minimum size as flue outlet on heater. Comply with gas utility requirements.

3.03 FIELD QUALITY CONTROL

A. Start-up, test, and adjust gas-fired water heaters in accordance with manufacturer's start-up instructions, and utility company's requirements. Check and calibrate controls, adjust burner for maximum efficiency.

B. Start-up, test, and adjust electric water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.

END OF SECTION

SECTION 15535-REFRIGERATION PIPING AND SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Piping

B. Refrigerant

C. Moisture and liquid indicators

D. Valves

1.02 RELATED WORK

A. Section 15010 - General Mechanical Provisions

B. Section 15015 - Sleeves and Penetrations

C. Section 15180 - Thermal Insulation

1.03 REFERENCES

A. ANSI/ARI 495 - Refrigerant Liquid Receivers.

B. ANSI/ARI 710 - Liquid Line Dryers.

C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

D. ANSI/ASHRAE 34 - Number Designation of Refrigerants.

E. ANSI/ASME B31.5 - Refrigeration Piping.

F. ARI 750 - Thermostatic Refrigerant Expansion Valves.

G. ARI 760 - Solenoid Valves for Use With Volatile Refrigerants.

H. MIL-I-631C - (Construction at Solenoid Valve Coils)

I. MIL-V-23450C - Valves, Expansion, Thermostatic, Refrigerant 12 and Refrigerant 22.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 15010, indicating schematic layout of system, including equipment, critical dimensions, and sizes (Follow manufacturer's instructions), general assembly of specialties, including manufacturer's catalogue information.

B. Submit manufacturer's installation instructions under provisions of Section 15010.

C. Submit welders certification of compliance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

D. Submit data indicating pipe sizing, where not indicated on plans, and calculations for sizes.

1.05 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9.

B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME SEC 9 or ANSI/AWS D1.1.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site, store and protect from damage under provisions of Section 15010.

B. Deliver and store piping and specialties in shipping containers with labelling in place.

C. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation. Tubing delivered to the job site or found on the job site without capped ends will be marked and rejected from installation on this project.

PART 2 - PRODUCTS

2.01 GENERAL

A. The refrigeration piping system shall consist of all HVAC, product and heat reclaim piping systems handling fluorocarbon refrigerants. Refrigeration piping shall be circuited as shown on the drawings.

B. Refrigeration piping lines shall be sized as shown on drawings

C. Refrigerant piping, valves, fittings, and accessories shall conform to the requirements of ANSI/ASHRAE 15-1978 and ANSI B31.5 unless otherwise specified.

2.02 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn Type L, dehydrated, capped, sealed and marked.

1. Fittings: ANSI/ASME B16.22 wrought copper or forge brass (cast brass sweat fittings not allowed). All ells shall be of long radius type.

2. Joints: ANSI/AWS A5.8 BCUP silver braze. Copper joints shall be brazed with AWS BCUP-5 (14.5-15.5% Silver) Silver Braze and copper to brass or steel shall be brazed with AWS BAG-4 (40% Silver).

B. Copper Tubing to 7/8 inch OD: ANSI/ASTM B88, Type K, annealed.

1. Fittings: ANSI/ASME B16.26 cast copper.

2. Joints: Flared.

2.03 REFRIGERANT

A. Refrigerant: ANSI/ASHRAE 34; HCFC-123 (Trane), HFC-134a (McQuay, Carrier, York) etc., HFC-407c, HFC-410a, HCFC-123.

2.04 MOISTURE AND LIQUID INDICATORS

A. Indicators: Double port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum working pressure of 430 psi and maximum temperature of 200 degrees F.

2.05 STOP VALVES

A. Refrigerant shut-off valves shall be designed for use with the refrigerant used and shall have pressure ratings compatible with system pressures encountered. Gate valves will not be acceptable. Valves shall be all brass, handwheel-operated, diaphragm packless-type, globe or angle valves in sizes up to and including 5/8". For valves 5/8" and larger, ball valves designed specifically for refrigerant service shall be used.

B. Diaphragm Packless Valves: UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Packed Angle Valves: Forged brass, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

D. Packed Ball Valves: Two piece forged brass Body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Follow procedures and techniques indicated in Section 15060 - Pipe and Pipe Fittings.

C. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

F. Provide non-conducting dielectric connections when joining dissimilar metals.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Pipes, strainers, and valves shall be cleaned free of scale and thoroughly flushed of all foreign matter. All strainers and valves shall be thoroughly cleaned.

J. Insulate piping and specialties; refer to Section 15180.

K. Fully charge completed system with refrigerant after testing.

3.04 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ANSI/ASME B31.5.

END OF SECTION

SECTION 15540 - FUEL-FIRED HEATERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Fuel-fired heater Work required as indicated on Drawings and by requirements of this Section.

B. Types of fuel-fired heaters specified in this Section include:

1. Gas-fired unit heaters.

C. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, apply to Work of this Section.

D. Interlock wiring specified as factory installed is Work of this Section.

E. Refer to Division 16 Sections for the following; not Work of this Section.

1. Power supply wiring from power source to power connection on fuel-fired heaters. Include starters, disconnects, and required electrical devices, except where specified as furnished or factory installed by manufacturer.

2. Interlock wiring between fuel-fired heaters and field-installed control devices.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties, and accessories, and installation and start-up instructions.

2. Submit manufacturer's assembly-type Shop Drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

3. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for fuel-fired heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

1.03 QUALITY ASSURANCE

A. Corrosive Area Requirements: Heaters and appurtenances installed in the chemical handling areas and where noted on Drawings shall be made of a corrosion-resistant material or be coated with a coating resistant to the air contaminant present in the room. Provide written documentation from the manufacturer stating the coating’s resistance to the air contaminant.

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fuel-fired heaters, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

C. Codes and Standards:

1. ANSI Compliance: Construct and install gas-fired unit heaters in accordance with ANSI Z83.8, "Gas Unit Heaters."

2. NFPA Compliance: Install fuel gas piping and gas-fired heaters in accordance with NFPA 54, "National Fuel Gas Code."

3. AGA Labels: Provide gas-fired unit heaters and duct heaters which are listed and labeled by the "American Gas Association."

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle fuel-fired heaters and components carefully to prevent damage, breaking, denting, and scoring. Do not install damaged fuel-fired heaters or components; replace with new.

B. Store fuel-fired heaters and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading fuel-fired heaters and moving them to final location.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Separated Combustion Gas-Fired Unit Heaters:

a. Modine Manufacturing Co.

b. Reznor.

c. The Trane Co.

2.02 SEPARATED COMBUSTION GAS-FIRED UNIT HEATERS

A. Provide gas-fired unit heaters as indicated, of type and minimum capacity as scheduled and as specified herein.

Provide 82% high-efficiency, separated-combustion, power vented, gas-fired unit heaters manufactured as Reznor® brand units. The unit shall be designed for use in a building with negative pressures up to 0.15 " w.c. and for use in building where a non-explosive atmosphere exist that is dust laden and/or contains mildly corrosive fumes.

B. Cabinet: The cabinet shall be low profile with a pre-coat or powdercoat paint finish. Finish shall be a minimum 80 gloss on G30 galvanized steel. All units shall be manufactured with a tooled drawn supply air orifice on the rear panel to reduce fan inlet noise. The unit shall be designed for ceiling suspension featuring 3/8"-16 female threads or hanger kits for 1" pipe at both 2-point and 4-point locations with no additional adapter kits. The cabinet shall be equipped painted, roll-formed horizontal louvers. Louvers shall be spring held and adjustable for directing airflow. Vertical louvers shall be available. The cabinet shall be equipped with a full safety fan guard with no more than ½ inch grill spacing. The unit shall be designed with a full opening service access panel complete with screw closure attachment and lifting handle for removal. Service panel shall be fully gasketed and

equipped with a safety interlock switch. All components in the gas train, all standard electrical controls, and the power venter shall be within the sealed service compartment

C. Fan: The enclosed motor and fan assembly shall be resiliently mounted to the cabinet to reduce vibration and noise. Construct fan of aluminum, direct drive type, and factory balance.

D. Heat Exchanger: The heater shall be equipped with a multi-cell, 4 pass serpentine style steel heat exchanger. Heat exchanger tubes shall be press fabricated of 316 stainless steel. All heat exchangers shall be fabricated with no welding or brazing, only tool pressed mechanical joints. All heat exchanger cells shall be designed with an aerodynamic cross section to provide maximum airflow.

E. Burner: The units shall incorporate a single, one piece burner assembly with a single orifice. The burner shall have a continuous wound close pressed stainless steel ribbon separating the flame from the burner interior. All units shall have a single venturi tube and orifice supplying fuel to a one-piece burner housing. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control.

F. Controls: Controls shall include a two-stage gas valve; direct spark multi-try ignition with electronic flame supervision with timed lockout integrally controlled via a printed circuit control board. The control board shall also incorporate diagnostic lights, DIP switches for fan overrun settings, and a relay for fan only operation. All units shall be equipped with a safety limit switch.

   All controls shall be enclosed in the sealed control compartment to protect them from accidental damage, dust, and atmospheric corrosion.

G. Combustion Air and Venting: The unit shall have a factory-installed power venter device to draw combustion air from outside of the building. The outside air shall enter the unit through a factory-installed round inlet air terminal on the rear of the heater. The control compartment shall be sealed and the access door shall be gasketed to prevent dirt, lint, dust, or other contaminants present in the heated space from entering the unit. The control compartment door shall be equipped with a safety interlock switch to prevent operation when the door is open. The combustion air supply pipe and flue exhaust pipe shall be run in parallel from the heater to a factory supplied concentric adapter assembly, which allows for a single wall or roof penetration, to the horizontal or vertical (see plans) air inlet and vent terminal. The combustion air/venting system shall include a vibration isolated power venter motor and wheel assembly and a combustion air pressure switch.

H. Provide the following controls, factory piped and pre-wired to electrical junction box mounted on unit:

   1. 115 volt or 24 volt automatic gas valve.

   2. Safety pilot with 100 percent shutoff (intermittent operation).

   3. Pressure regulator with leak-limiting device.

   4. Manual main and adjustable pilot valves.

   5. High limit switch.

I. Provide the following accessories, factory mounted and pre-wired to electrical junction box:

   1. Electric spark ignition.

J. Provide temperature controls consisting of line or low voltage room thermostat with locking cover and thermostat guard. Provide 2 stage thermostats for two stage unit heaters..

2.03 RADIANT HEATERS:

A. Provide capacity as scheduled. Unit shall have AGA certification. Provide unit with fan, burner, emitter tube, reflectors, controls, and flexible gas connection.

B. Control Casing: Steel with enamel finish.

C. Combustion Chamber/Emitter Tube: 16 gauge aluminized steel.

D. Controls: Provide hot surface ignition system and safety differential pressure switch. Controls shall shut off the gas flow to main burner if there is a loss of gas supply or electric power. Controls shall provide pre-purge prior to initiating burner operation.

E. Reflectors: Polished aluminum with end caps.

F. Asseccories:
   1. Provide reflector shields as noted on the plans.
   2. Provide Manufacture's vent termination and air intake kit
   3. Remote mounted thermostat.

G. Electrical: 120 volts, single phase.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which fuel-fired heaters are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF GAS-FIRED HEATERS

A. Install gas-fired unit heaters as indicated and in accordance with manufacturer's published installation instructions.

B. Hang units from substrate using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.

C. Extend breeching from flue to unit heater; make gas-tight connection. Install vents as recommended by heater manufacturer's installation instructions.

3.03 START-UP

A. Start-up, test, and adjust fuel-fired heaters in accordance with manufacturer's published start-up instructions. Adjust air diffusion louvers for proper airflow. Verify proper line and manifold gas pressure. Check and calibrate controls; adjust burner for maximum efficiency.

3.04 OPERATION AND MAINTENANCE TRAINING

A. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of equipment. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance.

1. Manufacturer's representative shall provide 1 day, 8 hours, on-Site training.
2. Review operating and maintenance data contained in the operating and maintenance manuals.
3. Schedule training with Owner, provide at least 7-day prior written notice to Engineer.

END OF SECTION

SECTION 15548 - FUEL FIRED MAKE-UP AIR HEATERS

PART 1: GENERAL

1.01 SUMMARY

A. Section Includes: Provide units with gas-fired heating and ventilating sections, specifically designed and manufactured for indoor or outdoor installation. Units shall be packaged air handlers which include casing, modulating burner, non-overloading fan, mixing chamber, positive position modulating return air dampers, hot water coil, and automated DDC-based controls for temperature control, pressure control and system monitoring.

B. Types of fuel-fired heaters specified in this Section include:

1. HV-1-1, Truck Load Bay: Direct gas-fired heater with 100 percent outside air.

2. HV-1-2, Screening and Grit Handling: Room: Direct gas-fired heaters with 100 percent outside air.

C. Refer to Division 16 Sections for the following; not Work of this Section:

1. Power supply wiring from power source to power connection on fuel-fired heaters. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

2. Interlock wiring between fuel-fired heaters and field-installed control devices.

3. Interlock wiring specified as factory-installed is Work of this Section.

1.02 SUBMITTALS

A. SHOP DRAWINGS

Submit in accordance with Division 1 covering the items included under this Section. Shop Drawing submittals shall include:

1. Manufacturer's technical product data, including rated capacities of selected model clearly indicated, motor data, furnished specialties and accessories; and installation and start-up instructions.

2. Manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

3. Manufacturer's electrical requirements for power supply wiring for fuel-fired heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

4. Manufacturer’s burner data including burner maximum and minimum firing rate, and gas pressure requirements

B. RECORD DRAWINGS

At Project closeout, submit record drawings of installed products, in accordance with requirements of Division 1.

C. TEST AND INSPECTION REPORT

A written report shall be submitted to the Engineer documenting testing and/or inspection results.

D. OPERATION AND MAINTENANCE MANUALS

Submit in accordance with requirements of Division 1.

E. WARRANTY

Submit in accordance with requirements of Division 1, warranties covering the items included under this Section.

1.03 QUALITY ASSURANCE:

A. MANUFACTURER'S QUALIFICATIONS

Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

B. CODES AND STANDARDS

1. American National Standards Institute (ANSI):

   a. Standard Z83.8

2. American Society for Testing Materials (ASTM):

   a. Standard A526; Steel Sheet Metal - Zinc Coated by Hot Dip Process; G-90.

   b. Standard A1016/A1016M Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes.

3. ETL Testing Laboratories, Inc. (ETL):

   a. Requirements applicable to product labeling and listing in the Directory of ETL Listed Products.

4. Factory Mutual Insurance (FM)

5. National Electrical Manufacturers Association:

   a. Standard 250 (1985); Enclosures for Electrical Equipment (1000V Maximum)

6. National Fire Protection Association (NFPA):

   a. Article 54; National Fuel Gas Code.

   b. Article 70; National Electric Code.

   c. Article 90A; Installation of Air Conditioning and Ventilating Systems.

7. Occupational Safety and Health Administration (OSHA).

8. Underwriters Laboratories, Inc. (UL):

   a. Standard UL916 Energy Management Equipment.

   b. Standard UL873 Temperature Indicating & Regulating Equipment.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle fuel-fired heaters and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged fuel-fired heaters or components; replace with new.

B. Store fuel-fired heaters and components in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading fuel-fired heaters, and moving them to final location.

1.05 MAINTENANCE

A. Extra Materials: Provide to Owner, with receipt, the following spare parts for each direct gas-fired heating unit:

1. One set of matched fan belts for each belt-driven fan.

2. One set of filters.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Direct Gas-Fired Heaters:

a. Reznor (Basis of Design)

b. Areovent

c. Trane

2.02 DIRECT GAS-FIRED HEATERS

A. GENERAL:

Provide a direct gas-fired horizontal unit built in conformance to NFPA-54 and ANSI Z-83.4, Z83.18 and Z223.1 standards. In addition, units shall be ETL, UL or AGA listed. Provide self-contained, packaged heaters which include: casing, modulating burner, non-overloading fan, motor, automatic controls, filter box, weather hood intake, discharge plenum, and base for pad mount or curb for roof mounted. Unit shall be mounted outside in weather tight enclosure.

1. HV-1-1 and HV-1-2 shall be rated to serve a Class 1, Division 2 rated space. The unit shall be located outside of the rated space in an unclassified space and supply 100% outside air to the space. Components exposed to air stream shall be explosion proof with non-spark construction fan and static free belts.

B. UNIT CASINGS:

Provide casings which shall be 18-gauge paintable galvanized steel minimum, welded to structural steel framing and 22 gauge liner for fan and burner section. All exterior casing seams are to be 100 percent weathertight and welded.

1. Clean all exterior surfaces of oil and grease, then treat with an iron-phosphate surface coating, followed by passivating rinse. Paint shall consist of a high-quality prime coat and a finish coat of two coats of epoxy with rust inhibitors.

    a. Color shall be selected by the Owner.

2. All interior surfaces will be lined with 1-inch, 1-1/2-pound density, coated fiberglass. The fiberglass shall comply with UL Standard 181 for erosion and NFPA 90A for fire resistivity. All exposed edges will be coated to eliminate erosion.

3. The interior of unit shall be line with 22 gauge galvannealed steel (all units). The liner shall sandwich the insulation and insure 100% coverage throughout the casings of the unit. Both the floor and roof casings are to be double wall insulated. The internal liners shall be carefully sealed with a silicone caulk.

4. Access Doors: Neoprene-gasketed doors shall be provided to allow easy service of all critical components, controls and fan.

5. Lighting: Provide a marine light in the control panel, coil, discharge and fan/burner sections with timer. The light in HV-1-1 and HV-1-2 shall have an explosion proof light,

C. BURNERS:

Provide a stainless steel gas burner and profile plates. The burner shall have a 25 to 1 turndown ratio and be designed for 93 percent thermal efficiency for the life of the equipment. The burner shall be sized to provide a minimum BTU output of not greater than 15% of the scheduled burner output. Data shall be supplied to show the maximum and minimum burner output.

1. Burner shall be stainless steel construction. HV-1-1, and HV-1-2 shall have no air from the indoor space shall be allowed to recirculate across the burner at any time. The burner assembly and fuel piping arrangement shall include automatic ignition controls, UV scanner flame failure system, pressure regulator, fully modulating gas control valve, primary and secondary automatic shutoff valves and manual shutoff cock. Pilot gas controls shall include a pilot regulator, normally-closed solenoid shutoff valve, needle valve, and manual shutoff cock. Gas train shall be sized to provide full unit capacity at specified inlet pressure to the gas train. Provide and install a supplementary pressure regulator at each unit as necessary to maintain unit inlet pressure at less than the maximum allowable pressure rating of the gas train components.

2. Combustion efficiency must limit the products of combustion to a maximum of 5 ppm carbon monoxide and 0.5 ppm nitrogen dioxide.

3. Provide a heat treated glass observation port to provide a full view of the flame. Provide hinged access door(s) to provide ease of maintenance to burner, ignitor, and flame sensor.

4. Provide high and low gas-pressure switches as per manufactures requirements. The high gas-pressure switch, to be located on the burner end of the manifold, shall turn the burner off when the gas pressure is too high. The low gas pressure switch, to be located on the inlet end of the manifold, shall turn the burner off when the gas pressure is too low.

5. Provide gas pressure gauge upstream of the unit's control valve and pressure regulator.

D. FANS:

The fan section and motor assembly shall be constructed in accordance with the requirements of the Air Moving and Conditioning Association (AMCA). The blower wheel(s) shall be single width

single inlet, aluminum backward inclined multi-blade type with wheel statically and dynamically balanced. The fan(s) and motor shall be mounted on a welded unitary base..

1. Fan shall be AMAC Type B spark resistant construction.

2. The motor, pulleys and belts shall be located outside of the airstream. The blower discharge collars shall be isolated from the casing with flexible neoprene coated canvass.

3. Units that shall have the motors located out of the air stream and shall be premium efficiency totally enclosed fan cooled with a safety factor of 1.15. A motor and drive-belt safety enclosure shall be provided. Belts shall be static free.

4. The motors and HV-1-1 and HV-1-2 shall be TEFC / Explosion Proof premium efficient construction.

5. Fans shall be wired for the Scheduled voltage, 1,750 rpm, and standard NEMA frame. Fan discharge velocity shall not exceed 2,000 FPM.

6. Blower, motor, and drive shall be factory-tested to guarantee the specified air delivery (according to ANSI standards) at the selected static pressure.

7. Fan shaft shall be connected to the motor by a multi-V-belt drive, designed for 50 percent over the motor nameplate capacity. Belts shall be non-static type.

8. Fan shaft shall be of a turned, ground, and polished shafting. A coat of all-purpose paint (asphalt base) shall be applied to the shaft to minimize oxidation. Fan wheel and bearings shall be supported from a reinforced structural steel framework. Bearings supported from only the fan or heater housing is not acceptable.

9. Bearings shall be ball bearings with locking collar and shall be rated L10 for 100,000 hours or better. Bearings shall have copper extended-lube lines which shall terminate at the heater outer skin so that all lubrication can be performed at a common point, without shutting down the system.

10. Sound power shall not exceed 72 DbA at a distance of 10 feet from a discharge opening at full airflow, 0 inches ESP.

E. FILTER SECTION

1. Filters shall be 2” multipleat MERV 8 30% efficient throw away type. The filter rack shall be flat bank type and not to exceed 500 fpm velocity. Filter access shall be through a latched and gasketed access doors located on both sides of the unit.

2. Access doors are to feature trim seal neoprene gasket and Romtech roller industrial door handles.

F. DAMPERS:

1. Intake and return air dampers: Damper shall be low leak type with aluminum airfoil parallel blades and extruded EPDM seals. Frame shall be extruded aluminum with extruded silicone seals. Dampers are to be coupled and complete with jackshaft to ensure smooth operation with a direct drive actuator. Actuator will be complete with an end switch to prove open prior to energizing the blower circuit. The damper actuator shall mount inside an explosion proof housing.

G. CONTROL PANELS

Provide an incandescent light in the control panel and fan/burner section with timer. Provide network control software and hardware for remote operation.

H. CONTROLS

1. Unit Sequence of Operation: The manufacturer provides contacts to interlock fans and dampers as noted on Drawings.

2. Control Panel shall be completely isolated from the airstream. Any penetration to the air stream shall be sealed to prevent gas transfer to the control section. Each unit shall be provided with a control enclosure similar to NEMA 250 Type 3R and contain all standard NEMA rated electrical components, such as fused disconnect switch, motor starter, 120 volt and 24-volt transformers, control circuit fusing, flame relay, 120V ground fault circuit with incandescent light. Control panel has a have strip heater to maintain minimum temperature within the control panel.

3. For HV-1-1 and HV-1-2, Control devices in the air stream or not isolated from the air stream shall be rated for Class 1, Division 2 environment.

4. Each unit shall be provided with direct digital controls of the same manufacturer as the unit. This controller shall provide the following functions:

a. Visual Display and Verification of Control Sequence. Display:

1) Fan status.

2) Operational mode.

3) Burner status.

4) Temperature set point and actual space temperature.

5) Outdoor temperature.

6) Filter Clog Status.

7) Burner Status

b. Air flow switch status.

c. High gas pressure switch status.

d. Low gas pressure switch status.

e. High temperature limit status.

f. Pilot valve status.

g. Flame safeguard (pilot status).

h. Control Panel shall have contact for the following errors.

1) Low temperature shutdown.

2) Fan failure.

3) High temperature.

4) Flame safe guard failure.

5. The control panel shall have a burner flame relay to lock out the flame in abnormal conditions. A remote reset command shall allow personnel to reset the burner at the remote monitoring station. Complete control and safety system, burner and gas manifold shall be factory tested to assure proper operation and to simplify field commissioning.

6. Discharge Air Temperature Control: The solid-state temperature control system, located in the main control panel, shall have a temperature sensor in the unit. The controller shall maintain discharge air temperature in the occupied and unoccupied mode. An additional sensor mounted in the heater discharge controls the maximum and minimum discharge air temperature in response to burner modulation. Provide discharge air temperature adjustment on the control panel for operator adjustment.

7. Provide Room Temperature Override thermostat in the space. Provide thermostat rated for Class 1, Group D, Division 2 environment. Thermostat that adjust the discharge air temperature to preset value when temperature falls below setpoint.

8. Low-Temperature Limit Switch: This switch turns the fan motor off when cold air is being discharged from the heater. The minimum discharge temperature may be selected from 30°F to 50°F. Provide 15 minute delay before shutting down the unit and initiating an alarm.

9. High-Temperature Limit Switch: This switch turns the burner off when the discharge air temperature exceeds 150° F. The switch must then be manually reset at the unit control panel.

10. Provide controls for Discharge Air Damper and limit switch. Coordinate control voltage with damper manufacturer. Basis of design is 120V actuator. Refer to schedule for additional data on damper.

11. Provide additional contacts as required to satisfy the interlocks listed in the sequence of operation.

I. REMOTE OPERATOR INTERFACE PANEL

1. Provide with remote operator interface panel located where indicated on the drawings. Panel shall provide the following controls.
    a. Unit ON/OFF
    b. Fan Status
    c. Burner Status
    d. Discharge Temperature setpoint adjustment
    e. Room temperature override temperature adjustment
    f. Unit alarm
    g. Dry Contacts for Fan running
    h. Dirty Filter Status
    i. Dry contacts for Dirty Filter

J. ACCESSORIES

1. Provide supply air smoke detector, ionization type. Duct smoke detector shall be field installed and wired to the HV unit. The detector shall shutdown the supply fan and have spare contacts for monitoring by SCADA.

2.03 SOURCE QUALITY CONTROL

A. FACTORY TESTING

Each unit shall be factory-tested. Testing shall consist of checking all circuits for continuity, verifying operability of all valves, control motors, fan speed, linkages, switches and burner. Each fan and drive combination shall be dynamically balanced during testing at the factory to .1" per second or less equivalent displacement. Each air handler shall be test-fired for minimum and high fire conditions.

PART 3: EXECUTION

3.01 ACCEPTABLE INSTALLERS

A. INSTALLER'S QUALIFICATIONS

Firms specializing and experienced in systems installations for not less than five years.

3.02 EXAMINATION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.03 INSTALLATION OF GAS-FIRED HEATERS

A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operation condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer approved by Engineer.

B. Connect ductwork to unit inlet and outlet duct collars, using transitions no greater than 15 degrees in any direction for exact fit to collars.

C. Connect Smoke Detector, Discharge Air Damper, Remote Indicating Light/Horn, Fire Alarm connections, Remote Thermostat and other remote devices to the unit.

3.04 CONTROL INSTALLATION

A. Refer to Specification 15010 "General Mechanical Provisions" for installation of controls for the fans and related accessories.

B. Test the operation of the equipment to confirm equipment operates as indicated in the sequence of operation shown on the drawings.

3.05 EQUIPMENT INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit Site of Work a minimum of 2 times, once prior to installation to review installation procedures with Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to Engineer.

1. Verify all remote devices are connected.

2. Bump motor to valid the fan is rotating the correct direction.

3. Startup unit following the manufacturer’s startup procedure.

4. Test the functions of the remote indicator.

5. Perform an operational test of the sequence of operation shown on the drawings.

6. Adjust fan speed to achieve the airflow indicated on the drawing.

7. The burner shall be adjusted for high fire and low fire to satisfy schedule requirements

B. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

C. Each equipment supplier's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment:

1. Has been properly installed and lubricated;
2. Is in accurate alignment;
3. Is free from any undue stress imposed by connecting piping or anchor bolts;
4. Has been operated under full load condition and that it operated satisfactorily to Engineer;
5. That OWNER's Representative has been instructed in the proper maintenance and operation of the equipment; and
6. Furnish OWNER a copy of all test data recorded during the installation check including noise level and vibration readings.

3.06 OPERATION AND MAINTENANCE TRAINING

A. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of equipment. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance.

1. Manufacturer’s representative shall provide one (1) day, eight (8) person hours per day for a total of eight (8) person hours of on-Site training.
2. Review operating and maintenance data contained in the operating and maintenance manuals.
3. Schedule training with Owner, provide at least 7-day prior written notice to Engineer.

3.07 FIELD QUALITY CONTROL

A. SITE PERFORMANCE TESTS

After the equipment has been installed, performance tests shall be conducted. The purpose of these tests is to demonstrate that the units have been properly installed, will operate satisfactorily, and meet the specified conditions.

1. For the purpose of these tests, Owner will furnish the electricity, and natural gas.

2. The performance tests shall be conducted under the supervision of Engineer with the cooperation of the manufacturer's factory representative.

3. The equipment will not be accepted until a satisfactory test has been run. Acceptance of the equipment shall be compliant with Section 01770 – Project Closeout.

B. INSPECTION REPORT

A written report of the installation check shall be submitted to Engineer.

END OF SECTION

SECTION 15620 - DIRECT HEATERS

PART 1- GENERAL

1.01 SECTION INCLUDES

A. Electric unit heaters – provide as shown on the drawings.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. ANSI/NEMA MG 1 - Motors and Generators.

C. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

D. ANSI/NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

E. NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

1.03 SUBMITTALS

A. Submit shop drawings, product data and operation and maintenance data under provisions of Section 15010.

B. Submit product data indicating typical catalog of information including arrangements, capacities, weights, and accessories.

C. Indicate mechanical and electrical service locations and requirements, specifically indicating deviations from indicated products.

D. Submit manufacturer's installation instructions under provisions of Section 15010. Indicate rigging, assembly and testing instructions.

PART 2 - PRODUCTS

2.01 PROPELLER UNIT HEATERS (EXPLOSION PROOF)

A. General: Except as otherwise indicated, provide manufacturer's standard explosion-proof electric propeller unit heater materials and components as indicated by published product information, designed and constructed as recommended by manufacturer and applicable national and local codes for use in hazardous classified locations and shall be UL listed for Class I, Group D, Divisions 1 and 2, and Class II, Groups E, F, and G, Division 1 and 2, and as required for a complete installation.

B. Heating Elements: Except as otherwise indicated, provide manufacturer's standard heating elements of types, sizes, capacities and ratings for duty indicated; consisting of heat exchanger double walled, liquid filled with low watt density immersion type copper sheathed elements hermetically sealed into the core made of steel with aluminum fins. Heat transfer fluid of ethylene-glycol solution protected to -49°F.

C. Heating Capacity: Size element for indicated fan speed, CFM, room heating load (BTUH), air temperature rise, and electric inputs (watts, voltage, phase).

D. Casings: Provide casings braced and reinforced to provide required stiffness, and with adjustable heating element supports and brackets. Provide rounded corners. Include fan

orifice (venturi) in casing, as well as threaded hanger connections (weld nuts). Fabricate from 14-gage cold rolled steel, epoxy coated.

1. Unit construction for corrosive areas (Grit and Screen Handling) shall have 316 stainless steel heat exchanger, headers and tubes with aluminum fins; stainless steel cabinet; corrosive resistance hardware; epoxy-coated motor.

E. Air Deflectors: Provide manufacturer's standard air deflectors of the following types.

1. Individually adjusted louvers, epoxy coated.

F. Motors: Provide permanent-split capacitor explosion-proof motors, Class “B” insulation, resiliently mounted, tap wound with built-in thermal overload protection, and permanently lubricated ball bearings. Select motors with the following ratings: 460-volts, 60 Hz, three phase, or as specified on the plans.

G. Motor Controls: Provide built-in and pre-wired unit mounted motor control switch with “OFF-HEAT-FAN” positions and pilot light. Control box shall be explosion-proof.

H. Internal Electrical Wiring: Provide units with high temperature, heat-resistant electrical wiring enclosed in explosion-proof metal conduit extending from terminal junction box to electrical devices. Provide fusing for motor and control circuit wiring.

I. Devices: Provide the following devices:

1 Thermally activated fan switch to keep fan motor operating until residual heat is dissipated.

2. Disconnect switch with enclosure interlock.

3. Automatic reset, high limit cut-out switch located in discharge air stream.

4. Magnetic contactor.

5. Factory installed pressure relief valve on heat exchanger.

6. Transformer.

7. Built-in explosion-proof hydraulic thermostat.

J. Fans: Provide aluminum propeller fans which are balanced statically and dynamically of indicated capacity. Provide fans suitable for spark proof application.

K. Propeller Unit Heaters shall be manufactured by Heatrex Model 233, The Trane Co., Chromalox Div./Emerson Electric Co., Markel, Berko, Ruffneck, or equal.

2.02 ELECTRIC WASHDOWN UNIT HEATER

A. The electric unit heater shall be rated for wash-down application and shall include all built-in controls. Heaters shall be U.L. listed assemblies containing all limits and controls as required by U.L. specifications. Control shall be housed in a NEMA 4X non-metallic control enclosure fixed to the bottom of the unit heater. The control enclosure shall open from the bottom for ease of installation and service. The control enclosure shall include contactors, 24-volt transformer, fusing, pilot light, thermostat, and three position switch.

B. The heater scroll shall be 16 gauge 304 stainless steel with 304 stainless steel outlet louvers. The inlet grills shall be chrome plated.

C. The motor shall be totally enclosed, permanently lubricated, designed to resist moisture and corrosion, and be factory wired to a NEMA 4X enclosure. The heater shall be configured for a single point wiring connection.

D. The heating elements shall be factory wired and sealed for wash-down applications.

E. Each heater shall be furnished with an electric disconnect switch and stainless steel wall/ceiling bracket.

F. The heater shall be Heatrex, Indeeco Triad, Trane UHRA, Markel 5500, Chromalox Type HDH, Ruffneck CR1, or equal.

2.03 PROPELLER UNIT HEATERS - STANDARD

A. Provide unit heaters that can be mounted horizontally or vertically as indicated on Drawings.

B. Heating Elements: Provide resistance elements in steel sheath with extended fins, or with spiral finned sheath.

C. Casings: Phosphatize and paint casings inside and out with single coat of baked-on enamel; and zinc plate hardware. Include threaded hanger connections (weld nuts). Fabricate casings from 18-gauge galvanized steel.

D. Air Deflectors: Provide adjustable horizontal louver air deflectors on horizontal units.

E. Motors: Provide totally enclosed, fan-cooled premium efficiency motors.

F. Fans: Provide aluminum propeller fans which are balanced statically and dynamically.

G. Mounting Bracket: On horizontal units provide swivel mounting bracket for wall mounting.

H. Internal Electrical Wiring: Provide units with high temperature, heat-resistant electrical wiring enclosed in flexible metal conduit extending from terminal junction box to electrical devices. Provide fusing for motor and control circuit wiring.

I. Controls: Controls shall include automatic reset over-temperature cutout, controlling contactors, disconnect switch, thermally activated fan switch to keep fan motor operating until residual heat is dissipated, and a control transformer.

J. Accessories: Unit-mounted thermostat.
   1. If indicated on Drawings, provide thermostat for remote wall mounting.
   2. Summer fan switch for remote wall mounting.

2.04 DUCT HEATING COILS

A. Provide electric duct heating coils with automatic reset thermal cutouts for primary over-temperature protection and with load-carrying manual reset thermal cutouts, factory wired in series with each heater stage for secondary protection. The thermal cutouts shall be the bulb and capillary type with the remote sensing bulb located completely within the air stream. Include overcurrent cutouts and sub-circuit fusing for the assembly. Select coils with the following additional construction features:
   1. Finned Tubular Electric Coils: Construct coils with resistance wire of 80 percent nickel/20 percent chromium, installed in copper-plated steel tubing and surrounded by compacted magnesium-oxide powder. Provide spiral-wound copper-plated steel fins brazed continuously to tubes.

B. All factory wiring shall be glass-Teflon insulated with nickel-plated copper conductors rated for 250 degrees C. Wiring from each element on the bank shall be brought to clearly marked terminals.

C. Controls: Heater shall have SCR Control

D. Accessories:

1. Coil Layout: Vertical (air flow horizontal).
2. Rows: Provide 4-row coils.
3. Casing Assembly: Flanged type.
4. Casing Material: Galvanized steel coil casing.
5. Staging Contactors: 100,000-cycle rated to disconnect all ungrounded conductors of each heating stage. Contactor holding coils are to be connected in series with the external temperature controller and built-in automatic reset thermal cutout.
6. Safety Conductors: 100,000-cycle rated to disconnect all ungrounded line voltage conductors of each internal circuit. Contactor holding coils are to be connected in series with the built-in manual reset thermal cutouts.
7. Overcurrent Protective Fuses: To open all ungrounded line voltage conductors of each internal circuit and/or control voltage transformer upon sensing overcurrent condition.
8. Terminal Blocks: Terminal blocks shall be provided with optional built-in controls and sized for copper conductors. A 480-volt, 3-phase power source shall be provided to unit under Electrical Work. Any required transformers shall be supplied by equipment manufacturer.

2.05 AIR FILTERS

A. Contractor shall provide the filter boxes with odor removal pleated filters. The filters shall have the dimensions required to fit into the filter rack.
B. Media: Media shall be carbon loaded non-woven media consisting of 100% synthetic fibers that do not support microbial growth. Media shall contain chemically enhanced coconut shell activated carbon loaded to 300 grams per square meter.
C. Frame: Frame shall be heavy duty, high strength, moisture resistant paperboard with cross member design that increases filter rigidity and prevents breaching.
D. Performance: Minimum MERV 8 (per ASHRAE Standard 52.2-2007)
E. Odor effectiveness: Filter shall demonstrate effectiveness against Hydrogen Sulfide when tested as recommended in ASHRAE 145.2 Test Standard.
F. Pressure Drop: Filter initial pressure drop shall not exceed 0.66”w.g. when tested at the rated air flow. Filters shall be capable of a final resistance of 1.25”w.g.
G. Temperature: Filters shall be design to operate at a continuous operating temperature of at least 150 F.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work and opening dimensions are as indicated on shop drawings and as instructed by the manufacturer.

B. Verify that required utilities are available, in proper location, and ready for use.

C. Beginning of installation means that installer accepts existing surfaces as sufficient for work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install to NFPA 90A and ANSI/NFPA 90B.

C. Install unit heaters with vibration isolation. Refer to Section 15095.

D. Hang unit heaters from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom or at height scheduled.

E. Protect units with appropriate covers during balance of construction.

F. Furnish copy of manufacturer's wiring diagram submittal. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 sections.

3.03 CLEANING

A. Clean work under provisions of 15010.

B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer, per 15010.

END OF SECTION

SECTION 15732 - ROOFTOP HEATING AND COOLING UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Package rooftop heating and cooling units.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:
   1. Shop Drawings detailing manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling units. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
   2. Shop Drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.
   3. Manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, fan curves, furnished specialties and accessories, and installation and start-up instructions.
   4. Factory Test Data sheet for controls testing per the sequence of operation listed on the drawings and control system defined in this section.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

1.03 QUALITY ASSURANCE

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

B. Codes and Standards:

   1. Gas-fired furnace section construction shall be in accordance with AGA Safety Standards. Furnace section shall bear the AGA label.
   2. Testing and rating of rooftop units of 135,000 Btu per hour capacity or over shall be in accordance with ARI 360, "Standard for Commercial and Industrial Unitary Air Conditioning Equipment."
   3. Testing and rating of rooftop units under 135,000 Btu per hour capacity shall be in accordance with ARI 210, "Standard for Unitary Air Conditioning Equipment," and shall provide Certified Rating Seal. Sound testing and rating of units shall be in accordance with ARI 270, "Standard for Sound Rating of Outdoor Unitary Equipment." Units shall bear Certified Rating Seal.
   4. Refrigerating system construction of rooftop units shall be in accordance with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
   5. Rooftop units shall be designed, manufactured, and tested in accordance with UL requirements.

C. Factory Testing: Unit shall be factory tested with control system defined below for compliance to the sequence of operation defined on the drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle rooftop units and components carefully to prevent damage. Replace damaged rooftop units or components with new.

B. Store rooftop units and components in clean, dry place, off the ground, and protect from weather, water, and physical damage.

C. Rig rooftop units to comply with manufacturer's rigging and installation instructions for unloading rooftop units, and for moving them to final location.

1.05 SCHEDULING AND SEQUENCING

A. Coordinate installation of roof mounting curb with roof structure.

B. Coordinate roof opening locations for mechanical and electrical connections.

1.06 SPECIAL WARRANTY

A. Warranty on Compressor and Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and heat exchangers with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required, provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only and does not include labor for removal and reinstallation.
   1. Warranty Period: 5 years from date of Substantial Completion.

1.07 MAINTENANCE

A. Extra Materials: Furnish to OWNER, with receipt, the following spare parts for each rooftop heating and cooling unit.
   1. One set of matched fan belts for each belt-driven fan.
   2. One set of filters for each unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:
   1. Rooftop Units –HV1-3:
      a. AAON
      b. The Trane Co., Div. of American Standard, Inc.
      c. Daikin McQuay
      d. Seasons 4

2.02 ROOFTOP UNITS – HV-1-3

A. Units shall be factory assembled and tested, designed for roof or slab installation, and shall consist of compressors, condensers, evaporator coils, condenser, reheat coils and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities are scheduled on Drawings.

B. Casing: Manufacturer's standard casing construction having corrosion protection coating and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1/2-inch-thick thermal insulation, knockouts for electrical and piping connections, and an exterior condensate drain connection and lifting lugs.

C. Roof Curbs: Manufacturer's standard construction, insulated and having corrosion protective coating, complete with factory installed wood nailer and drain nipple. Construction shall be in accordance with NRCA Standards.

D. Evaporator Fans: Forward curved, centrifugal, belt-driven fans with adjustable sheaves or direct-driven fans, and permanently lubricated motor bearings.

E. Condenser Fans: Propeller type, direct-driven fans with permanently lubricated bearings.

F. Coils:
   1. Aluminum plate fin and seamless copper tube type. Fins shall have collars drawn, belled, and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.
   2. Coil Coatings: coils (evaporator and condenser) shall be coated with an “ElectroFin E-Coat” by LUVATA (www.luvata.com) or approved equal E-Coat process for corrosion resistance
   3. Refrigerant Cooling Coils have an equalizing-type vertical distributor to ensure each coil circuit receives the same amount of refrigerant. Coils shall be proof (450 psig) and leak (200 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of nitrogen.
   4. Provide Hot Gas Reheat Coils.

G. Compressors: Serviceable, semi-hermetic or fully hermetic compressors, complete with integral vibration isolators and crankcase heaters.
   1. Compressors shall be modulating or multiple stage for temperature control
   2. Provide modulating or multiple stage hot gas reheat control

H. Safety Controls: Manual reset type for:
   1. Low-pressure cutout.
   2. High-pressure cutout.
   3. Compressor motor overload protection.

I. Heat Exchangers: Manufacturer's standard construction for gas-fired heat exchangers and burners.

J. Controls: Unit shall be provided with manufacturer’s control panel. The control panel shall incorporate all the functions specified here-in and shown on the plans. The sequence of operation on the drawings shall be incorporated. The following system shall be controlled:

   1. Modulating or Multi-Stage heating control valve with minimum 5 to 1 turn down
   2. Redundant gas valve.
   3. Intermittent pilot ignition.
   4. Electronic spark ignition system.
   5. High limit cutout.
   6. Forced draft proving switch.
   7. Provide Motor Starter to control Exhaust fan as shown on the sequence of operation.
   8. Provide motor starter/control for the relief air damper as shown in the sequence of operation.
   9. Gas reheat control.

K. Economizer Control: Return and outside air dampers, outside air filter, fully modulating electric control system with differential enthalpy control, and adjustable mixed-air thermostat. System shall have 100 percent outside air capability. Provide automatic changeover through adjustable enthalpy control device.

L. Accessories: Units shall include the following accessories as indicated or scheduled:

M. Remote Potentiometer: For minimum position setting of economizer.

1. Thermostat: Assembly shall provide for staged heating and cooling with manual or automatic changeover on standard subbase.
2. Insulation Kit: To prevent high humidity condensation from forming on bottom of unit when mounted on a down-flow curb.

2.03 UNIT ACCESSORIES:

A. Provide units with pre-filter/screen on the condenser coil to prevent building of debris on coil. Material shall be equal to Air Solution Company's "Dual Ply Filters". Filter shall have heavy duty, fiber reinforced outer binding with combination of industrial and fine mesh media. Provide twist lock fasteners for attaching the media to the unit. Provide the required mounting hardware.

B. Provide with side outlet curb adapter.
1. The curb shall be designed to provide air tight seal between the supply air and return air plenums. The plenum boxes shall be sealed on the bottom to prevent air leakage between the curb and mounting pad. The Plenums shall be insulated. The curb shall have a top plate installed and opening installed for the supply and return air duct on the air handler unit. The unit ductwork attachment shall provide air tight seal to the plenum openings.

2.04 AIR FILTERS:

A. Contractor shall provide the HVAC unit with odor removal pleated filters. The filters shall have the dimensions required to fit into the HVAC unit's standard filter rack. These filters are non-standard for many HVAC unit manufacturers and contractor shall coordinate the filters with the HVAC unit supplier.

B. Media: Media shall be carbon loaded non-woven media consisting of 100% synthetic fibers that do not support microbial growth. Media shall contain chemically enhanced coconut shell activated carbon loaded to 300 grams per square meter.

C. Frame: Frame shall be heavy duty, high strength, moisture resistant paperboard with cross member design that increases filter rigidity and prevents breaching.

D. Performance: Minimum MERV 8 (per ASHRAE Standard 52.2-2007)

E. Odor effectiveness: Filter shall demonstrate effectiveness against Hydrogen Sulfide when tested as recommended in ASHRAE 145.2 Test Standard.

F. Pressure Drop: Filter initial pressure drop shall not exceed 0.66"w.g. when tested at the rated air flow. Filters shall be capable of a final resistance of 1.25"w.g.

G. Temperature: Filters shall be design to operate at a continuous operating temperature of at least 150 F.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations and Shop Drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.

C. Electrical Connections: Refer to Division 16 for final connections to equipment and installation of loose-shipped electrical components.

D. Install condenser pre-filter/screen with twist lock fasteners per the manufacturer's recommendations.

E. Provide gasket/sealant to provide an air tight seal between the Supply and Return Plenums in the manufacturer's provided side discharge curb unit. The supply and return ductwork on the air handling unit shall be sealed to the curb.

3.03 EQUIPMENT INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit Site of Work a minimum of 2 times, once prior to installation to review installation procedures with Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to Engineer.

1. Verify all remote devices are connected.

2. Bump motor to valid the fan is rotating the correct direction.

3. Startup unit following the manufacturer's startup procedure.

4. Test the functions of the remote indicator.

5. Perform an operational test of the sequence of operation shown on the drawings.

6. Adjust fan speed to achieve the airflow indicated on the drawing.

7. The burner shall be adjusted for high fire and low fire to satisfy schedule requirements

B. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

C. Each equipment supplier's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment:

1. Has been properly installed and lubricated;
2. Is in accurate alignment;
3. Is free from any undue stress imposed by connecting piping or anchor bolts;
4. Has been operated under full load condition and that it operated satisfactorily to Engineer;
5. That OWNER's Representative has been instructed in the proper maintenance and operation of the equipment; and
6. Furnish OWNER a copy of all test data recorded during the installation check including noise level and vibration readings.

3.04 OPERATION AND MAINTENANCE TRAINING

A. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of equipment. Training shall include start-up and shutdown, servicing and

preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance.

1. Manufacturer’s representative shall provide 2 day, 8 person hours per day for a total of 16 person hours of on-Site training.
2. Review operating and maintenance data contained in the operating and maintenance manuals.
3. Schedule training with Owner, provide at least 7-day prior written notice to Engineer.

3.05 FIELD QUALITY CONTROL

A. SITE PERFORMANCE TESTS

After the equipment has been installed, performance tests shall be conducted. The purpose of these tests is to demonstrate that the units have been properly installed, will operate satisfactorily, and meet the specified conditions.

1. For the purpose of these tests, Owner will furnish the electricity, and natural gas.

2. The performance tests shall be conducted under the supervision of Engineer with the cooperation of the manufacturer's factory representative.

B. INSPECTION REPORT

A written report of the installation check shall be submitted to Engineer.

END OF SECTION

SECTION 15782 - UNITARY AIR CONDITIONERS AND HEAT PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Outdoor Air-cooled Condensing Unit.

B. Indoor Blower/Coil Unit, matched to A. above

C. Refrigerant Lines connecting the units.

D. Factory controls, unless specifically referenced in Section 15910 as provided by Automatic Temperature Controls subcontractor.

E. Maintenance service.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 15910 – HVAC Controls and Instrumentation: Installation of thermostats and other controls components which are not specified within this section as being factory provided.

1.03 RELATED WORK

A. Section 15535 - Refrigeration Piping and Specialties

B. Section 15810 - Ductwork

C. Section 15815 - Ductwork Accessories

D. Section 15910 - HVAC Controls and Instrumentation

E. Section 15961 - Testing, Adjusting, and Balancing – Air Systems

F. Division 16 - Equipment Wiring Systems, Electrical supply to units.

1.04 REFERENCES

A. Associated Air Balance Council (AABC) Publication:

1. National Standards for Field Measurement and Instrumentation (Form Number 81266), Volume One

B. Air-Movement and Control Association Standards:

1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Errata

2. AMCA 500 - Test Method for Louvers, Dampers and Shutters

C. Air-Conditioning and Refrigeration Inst. Standards:

1. ARI 240 - Air-Source Unitary Heat Pump Equipment

2. ARI 270 - Sound Rating of Outdoor Unitary Equipment

3. ARI 340 - Commercial and Industrial Unitary Heat Pump Equipment

4. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils

6. ARI 495 - Refrigerant Liquid Receivers

7. ARI 520 - Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units

8. ARI 710 - Liquid-Line Driers

9. ARI 720 - Refrigerant Access Valves and Hose Connectors

10. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers

11. ARI 750 - Thermostatic Refrigerant Expansion Valves

12. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants

D. American Society of Heating, Refrigerating and Air- Conditioning Engineers, Inc. Standards:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

2. ASHRAE 20 - Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.

3. ASHRAE 37 - Methods of Testing for Rating Unitary Air-Conditioning and Heat Pump Equipment.

4. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

5. ASHRAE 90.1 - Energy Efficient Design of New Buildings except Low-Rise Residential Buildings. Energy-Efficiency Ratio: Equal to or greater than prescribed by the latest standard adopted by local code in force.

E. American Society of Mechanical Engineers (ASME) Publication:

1. Boiler and Pressure Vessel Code

2. Section VIII Pressure Vessels, Division 1

F. American Society for Testing and Materials (ASTM) Standards:

1. A 527 - Steel Sheet Zinc Coating (Galvanized) by the Hot-Dip Process, Lock-Forming Quality

2. B 117 - Salt Spray (Fog) Testing

G. Federal Specifications (Fed. Spec.):

1. F-F-310B - Filter, Air Conditioning: Viscous Impingement and Dry Media, Replaceable

2. BB-F-1421B - Fluorocarbon Refrigerants

3. CC-M-1807A - Motors, Alternating Current, Fractional and Integral Horsepower (500 Hp and Smaller)

4. HH-I-545B - Insulation, Thermal and Acoustical (Mineral Fiber, Duct Lining Material)

H. Military Specifications (Mil. Spec.):

1. DOD-P-21035A - Paint, High Zinc Dust Content, Galvanizing Repair

2. MIL-H-22547B - Heat Pumps, Heating and Cooling (Unitary), (8400 to 300,000 BTUh)

I. National Electrical Manufacturers Association (NEMA) Standard:

1. ICS 6-1983 Enclosures for Industrial Controls and Systems

J. National Fire Protection Association Standards:

1. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

K. Sheet Metal and Air Conditioning Contractors National Association, Inc., (SMACNA) Publications:

1. HVAC Systems - Testing, Adjusting and Balancing (1st Ed., Dec 1982)

L. Underwriters' Laboratories, Inc., (UL) Standards:

1. UL 181 - Factory-Made Air Ducts and Connectors (latest ed. with revisions)

2. UL 900 - Test Performance of Air Filter Units (latest edition)

3. UL 1096 - Electric Central Air Heating Equipment (latest edition)

1.05 SUBMITTALS

A. Submit shop drawings and product data for manufactured products and assemblies required for this project under provisions of Section 15010. Indicate electrical service and duct connections.

B. Submit manufacturer's installation instructions under provisions of Section 15010.

C. Submit operation and maintenance data under provisions of Section 15010. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and protect products under provisions of Section 15010.

1.07 WARRANTY

A. Provide five year manufacturer's warranty under provisions of Section 15010 for refrigeration compressor. Other components shall be warranted for one year both parts and labor.

1.08 MAINTENANCE SERVICE

A. Furnish complete service and maintenance of packaged cooling system for one year from Date of Substantial Completion.

B. Provide maintenance service with a one month interval as maximum time period between calls during first cooling season of operation and two months otherwise. Provide 24-hour emergency service on breakdowns and malfunctions.

C. Include maintenance items as outlined in manufacturer's operating and maintenance data, include minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibrations.

D. Submit copy of service call work order or report to owner, and include description of work performed.

1.09 EXTRA MATERIALS

A. Provide one extra complete set of filters under provisions of Section 15010.

PART 2 - PRODUCTS

2.01 MANUFACTURERS (HVAC-1-1)

A. Design basis: Lennox CBX40UHV-024

B. Equivalent products may be furnished by: Amana, Carrier, Trane, York, or McQuay

C. Substitutions: Under provisions of Section 15010

2.02 DESCRIPTION

A. Provide split-system as scheduled and noted. Units shall be self-contained, factory assembled, prepiped and prewired, of the following type:

B. A matched set consisting of outdoor air-cooled condensing unit and an indoor blower/coil unit. Connecting lines: Refrigerant piping connecting indoor and outdoor units shall meet the manufacturer's requirements as well as those of Section 15535 and shall contain indicated specialties. Line sets may be furnished by the manufacturer or field fabricated.

C. Units shall be regularly cataloged equipment tested and rated in accordance with ARI 240, 270, or 340, and shall produce a SEER as indicated. Cooling capacity of each unit shall meet the sensible and total heat requirements. Allowances shall be made for the effective sensible heat factor to satisfy the required sensible cooling capacity.

D. Sound Rating: Outdoor section of split package unit shall Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."

2.03 FANS

A. General: Fan wheel shafts shall be supported by maintenance accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans shall be selected to produce the CFM required at the fan total pressure. Fan motors shall be totally enclosed (TEFC) or explosion proof depending on the hazard classification of the area where equipment is located. Motor starters shall be magnetic across-the-line type with a weather-resistant enclosure on outdoor units. Thermal overload protection shall be of the manual or automatic reset type. All fan wheels or propellers shall be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings shall be of galvanized steel, and both centrifugal and propeller fan casings shall be constructed of aluminum or galvanized steel. All steel elements of fans, except fan shafts, shall be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill galvanized steel surfaces and edges damaged or cut during fabrication shall be recoated with an approved zinc-rich compound. Fan wheels or propellers shall be dynamically balanced after fabrication and the application of any specified protective coatings.

B. Evaporator Fans shall be double-width, double inlet, forward curved, backward inclined, or airfoil blade, centrifugal scroll type, and shall be provided in each air-discharge opening of the fan section. Fans shall be directly connected to the motor shaft or by means of a V-belt drive. Direct-drive fan motors shall be of the multiple speed variety. Belt-driven fans shall have adjustable sheaves to provide not less than 20 percent fan-speed adjustment. The sheave

size shall be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity.

C. Condenser Fans shall be manufacturer's standard for unit specified and may be either propeller or centrifugal scroll types.

D. Centrifugal Scroll Type Fans shall be provided with streamlined orifice inlet and V-belt or direct drive. Each drive will be independent of any other drive. Each coil or circuit within the condensing unit shall be furnished with its own condensing fan(s).

E. Propeller Type Fans shall be direct-drive or V-belt type, dynamically balanced, with adjustable or fixed pitch blades. Each drive will be independent of any other drive. Outdoor drive bearings shall be protected with water slingers or shields. Each coil or circuit within the condensing unit shall be furnished with its own condensing fan. V-belt drives shall be fitted with guards, and fixed pitch sheaves.

2.04 EVAPORATOR AND CONDENSER COILS

A. Units shall have nonferrous tubes of 3/8-inch minimum diameter with copper or aluminum fins that are mechanically bonded or soldered to the tubes. Casing shall be galvanized steel or aluminum. Coils shall be tested in accordance with ASHRAE 15 at the factory and shall be suitable for the working pressure of the installed system.

B. Each coil shall be dehydrated and sealed after testing and prior to evacuation and charging. Each unit shall be provided with a factory operating charge of refrigerant and oil or a holding charge. Units shipped with a holding charge shall be field charged.

C. Separate expansion devices shall be provided for each compressor circuit, and a filter-drier shall be installed in each liquid refrigerant line circuit.

D. Evaporator and condenser coils shall be coated with one of the flowing:
   1. HERESITE P-413, 3mil DFT minimum multi step baked phenolic coating system.
   2. “ElectroFin E-Coat” by LUVATA (www.luvata.com).
   3. Or approved equal coating to protect the coils from Hydrogen Sulfide corrosions.

2.05 CASINGS AND CABINETS

A. General: Basic sheet metal construction shall be galvanized steel or aluminum with structural members of the same materials. Minimum thickness of single wall exterior surfaces shall be 18-gage galvanized steel or .071-inch thick aluminum. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness shall be 20 gage. Provisions to permit replacement of major unit components shall be incorporated. Penetrations of cabinet surfaces, including floor, shall be sealed. Units shall be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan shall be fabricated from Type 300 stainless steel, galvanized steel with a protective coating as required, or approved plastic material. Pans under indoor coils shall be insulated. Pan insulation shall be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces shall prevent, within limits of specified insulation, heat transfer between unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on unit surfaces. Insulation shall conform to Fed. Spec. HH-I-545.

B. Outdoor Cabinet Materials and Construction shall be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure Cabinets constructed for indoor service which have been modified for outdoor service are not acceptable. Cabinet surfaces shall be additionally protected with a multiple-coat weather-resistant protective coating which will be certified as passing a minimum 500 hour salt spray fog test in conformance with ASTM B 117. Condenser casing shall be provided with epoxy or polyester corrosion resistant coating on entire unit cabinet inside and out and fan blades.

C. Indoor Cabinet Materials and Construction shall be suitable for specified service.

2.06 INTERNAL CONTROLS

A. Units shall be internally prewired with a 24 or 120 volt control circuit powered by an internal transformer. A terminal block shall be provided for power wiring and external control wiring. Unit shall have cutoffs for high and low pressure and low oil pressure. Head pressure controls shall sustain unit operation with an ambient temperature of 0 degrees F. Adjustable-cycle timers shall prevent short-cycling and multiple compressors shall be staged by means of a time delay. Unit shall be internally protected by fuses or a circuit breaker. Unit controls located outside the unit cabinets shall be as specified in Section 15910. Provide step capacity control by hot gas by-pass, cycling compressors, cycling unloading, cycling multi-speed compressors.

2.07 AIR FILTERS

A. Contractor shall provide the HVAC unit with odor removal pleated filters. The filters shall have the dimensions required to fit into the HVAC unit's standard filter rack. These filters are non-standard for many HVAC unit manufacturers and contractor shall coordinate the filters with the HVAC unit supplier.

B. Media: Media shall be carbon loaded non-woven media consisting of 100% synthetic fibers that do not support microbial growth. Media shall contain chemically enhanced coconut shell activated carbon loaded to 300 grams per square meter.

C. Frame: Frame shall be heavy duty, high strength, moisture resistant paperboard with cross member design that increases filter rigidity and prevents breaching.

D. Performance: Minimum MERV 8 (per ASHRAE Standard 52.2-2007)

E. Odor effectiveness: Filter shall demonstrate effectiveness against Hydrogen Sulfide when tested as recommended in ASHRAE 145.2 Test Standard.

F. Pressure Drop: Filter initial pressure drop shall not exceed 0.66"w.g. when tested at the rated air flow. Filters shall be capable of a final resistance of 1.25"w.g.

G. Temperature: Filters shall be design to operate at a continuous operating temperature of at least 150 F.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that concrete equipment pads and mechanical spaces are ready to receive work and opening dimensions have been coordinated with other trades and sufficient clearance is allowed.

B. Verify that proper power supply is adequate for approved equipment requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up, including routine servicing and check-out during first year of operation.

B. Provide training to the owner's employees. Training shall be a minimum or 2 site visits and shall be a minimum of 2 hours for each session. Training shall include but not limited to: basic

operation of the unit, routine maintenance, trouble shooting, set point adjustment, and programming of thermostat.

END OF SECTION

SECTION 15783 - COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Floor-mounted computer-room air conditioners, 6 tons (21 kW) and larger.

1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Computer-room air conditioners shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.06 QUALITY ASSURANCE

A. 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.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 FLOOR-MOUNTED UNITS 6 TONS (21 kW) AND LARGER

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Corporation; a United Technologies company.
2. Compu-Aire, Inc.
3. Data Aire Inc.
4. Liebert Corporation.

B. Description: Packaged, factory assembled, prewired, and prepiped; consisting of cabinet, fans, filters, humidifier, and controls.

C. Cabinet and Frame: Welded steel, braced for rigidity, and supporting compressors and other mechanical equipment and fittings.

1. Doors and Access Panels: Galvanized steel with polyurethane gaskets, hinges, and concealed fastening devices.
2. Insulation: Thermally and acoustically insulate cabinet interior with 1-inch- (25-mm-) thick duct liner.
3. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
4. Finish of Exterior Surfaces: Baked-on, textured vinyl enamel; color to match computer equipment.
5. Floor Stand: Welded tubular steel, <Insert required height> high, with adjustable legs and vibration isolation pads.

D. Supply-Air Fan(s):

1. Double-inlet, forward-curved centrifugal fan(s); statically and dynamically balanced.
2. Drive: V-belt, with steel shaft with self-aligning ball bearings and cast-iron or steel sheaves, variable- and adjustable-pitch motor sheave, minimum of two matched belts, with drive rated at a minimum of two times the nameplate rating of motor.

E. Refrigeration System:

1. Compressors: Hermetic scroll; with oil strainer, internal motor overload protection, resilient suspension system, crankcase heater, manual-reset high-pressure switch, and pump-down low-pressure switch.
2. Refrigeration Circuits: Two; each with hot-gas mufflers, thermal-expansion valve with external equalizer, liquid-line solenoid valve, liquid-line filter-dryer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
3. Refrigerant: R-410A.
4. Refrigerant Evaporator Coil: Alternate-row or split-face-circuit, direct-expansion coil of seamless copper tubes expanded into aluminum fins.

    a. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1.

5. Remote Air-Cooled Refrigerant Condenser: Corrosion-resistant cabinet, copper-tube aluminum-fin coils arranged for two circuits, multiple direct-drive propeller fans with permanently lubricated ball bearings, and single-phase motors with internal overload protection and integral electric control panel and disconnect switch. Control capacity by cycling fans. The unit shall have the following corrosion-resistant construction:
    a. Unit Protective Coating: The unit shall be supplied with corrosion resistant, high build polyamide epoxy coating and two part UV resistant aliphatic urethane top coat to the exterior casing of the unit and interior components.
    b. Evaporator Coil: The evaporator coil shall have a phenolic coating applied for protection in harsh environments. Silver solder braze joints are provided on unit coil and refrigeration piping.

F. Extended-Surface, Disposable, Panel Filter: Pleated, lofted, nonwoven, reinforced cotton fabric with carbon media; supported and bonded to welded-wire grid; enclosed in cardboard frame with 2-inch- (50-mm-) thick, disposable, glass-fiber prefilter.

1. Thickness: 2 inches (50 mm).
2. Initial Resistance: As shown on drawings.
3. Recommended Final Resistance: As shown on drawings.
4. Media: Media shall be carbon loaded non-woven media consisting of 100% synthetic fibers that do not support microbial growth. Media shall contain chemically enhanced coconut shell activated carbon loaded to 300 grams per square meter.
5. Odor effectiveness: Filter shall demonstrate effectiveness against Hydrogen Sulfide when tested as recommended in ASHRAE 145.2 Test Standard.
6. Arrestance (ASHRAE 52.1): 90 percent.
7. Merv (ASHRAE 52.2): 7.

G. Integral Electrical Controls: Unit-mounted electrical enclosure with piano-hinged door, grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control-circuit transformer.

H. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

I. Electronic-Control System: Solid state, with start button, stop button, temporary loss of power indicator, manual-reset circuit breakers, temperature control, humidity control, and monitor panel.

1. Monitor Panel: Backlighted, with no visible indicator lights until operating function is activated; indicators include cooling, humidification, loss of airflow, change filters, high temperature, low temperature, high humidity, low humidity, high head pressure (each compressor), and low suction pressure (each compressor).
2. Temperature- and Humidity-Control Modules: Solid state, plug-in; with adjustable set point, push-to-test calibration check button, and built-in visual indicators to show mode of operation.
3. Location: Behind hinged door in front of unit; isolated from conditioned airstream to allow service while system is operating.

2.02 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.03 CAPACITIES AND CHARACTERISTICS

A. Unit Configuration:

1. Upflow.

B. See Equipment Schedule for performance requirements

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

B. Computer-Room Air-Conditioner Mounting: Install using elastomeric mounts. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1 inch (25 mm).

C. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric mounts.

1. Minimum Deflection: 1 inch (25 mm).

D. Install conduit, wire, cabling, between the air handling equipment and field installed components, sensors, devices, and remote thermostats.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Provide shutoff valves and piping.

3.03 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

D. After startup service and performance test, change filters and flush humidifier.

3.04 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.05 FACTORY REPRESENTATIVE SERVICES

A. Manufacturer’s representative shall provide start-up service. The manufacturer’s start-up checklist shall be completed. All functions of the equipment shall be function tested. The sequence of operation shown on the contract documents shall be verified and documented in the manufacturer’s startup report.

B. Training: Manufacturer’s representative shall two (2) separate training sessions for the owner’s operators. The training sessions shall be less than 2 hours each. The training shall include the

normal operation of the unit, routine maintenance, trouble shooting the equipment, set point adjustments, and units standard control system.

END OF SECTION

SECTION 15810 - DUCTWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Low pressure ducts

B. Fasteners

C. Sealants

D. Duct cleaning

1.02 RELATED WORK

A. Section 15090 - Hangers, Supports, and Anchors

B. Section 15180 - Thermal Insulation

C. Section 15815 - Ductwork Accessories

D. Section 15830 - Air Outlets and Inlets

E. Section 15960 - Testing, Adjusting and Balancing

1.03 REFERENCES

A. ASHRAE - Handbook Fundamentals current edition; Chapter regarding - Duct Design.

B. ASHRAE - Handbook Equipment current edition; Chapter regarding- Duct Construction.

C. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

D. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

E. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

F. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

G. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

H. SMACNA - HVAC Duct Construction Standards, current edition.

I. UL 181 - Factory-Made Air Ducts and Connectors.

1.04 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure (SMACNA Duct Standard): Construct all duct to 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.

1.05 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and NFPA 90B standards.

B. Comply with SMACNA Low Pressure Duct Construction Standard.

1.06 SUBMITTALS

A. Submit shop drawings under provisions of Section 15010.

B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for low pressure duct systems.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect materials per Section 15010.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pre-fabricated sheet metal components: Ductmate, Kirk & Blum, United McGill, Semco, Master Fit.

B. Flex Duct: Wiremold.

2.02 MATERIALS

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A90.

C. Stainless Steel: ASTM A 480/A 480M, Type 304, and having a number 2D finish for concealed ducts and exposed ducts in unfinished areas and a number 4 finish for exposed ducts in finished areas as indicated on the Contract Drawings, and of adequate strength and rigidity to meet the conditions of the service and installation requirements.

D. Fiberglass Ductwork. See article below.

E. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction rated to 2 inches WG positive and 1.5 inches WG negative for low pressure ducts or fabric supported by helically wound steel wire or flat steel strips and insulated.

F. Fasteners: Rivets, bolts, or sheet metal screws.

G. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

H. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

I. Hangers: See Section 15090.

2.03 FIBERGLASS-REINFORCED DUCT FABRICATION:

A. FIBERGLASS-REINFORCED DUCT: Where indicated, provide vinylester fiberglass-reinforced ductwork. The fiberglass duct shall be Class 1 rated flame retardant additive not to excees 3-5% by weight added to the resin. Or duct shall be Class 1 rated using AOC K022-AC or Dow Derakan 510-B resins. The duct shall be manufactured in accordance with requirements of SMACNA Thermoset FRP Duct Construction Manual and NBS PS15-69. Flame spread shall be 25 or less in accordance with ASTM E 84.
   1. The duct shall be designed for a minimum of 8 inches of w.c. pressure and 8 inches w.c. of vacuum at 180 degrees Fahrenheit temperature.
   2. Duct stiffness shall have a minimum rated stiffness in accordance with ASTM D 2412. Maximum deflection of rectangular ducts under deadload and operating conditions shall not exceed one percent of the width of the longest side.
   3. Ductwork/Piping shall be designed with 10:1 safety factor for pressure and 5:1 safety factory for vacuum.
   4. Ductwork shall use resins that are resistant to the gasses being handled as noted on Drawings.
   5. Corrosion Liner: Inner surface shall contain a 20 mil thick minimum surface veil saturated with polyester resin consisting of approximately 90 percent resin and 10 percent glass content by weight.
   6. Structual Layer: Structural layer shall consist of a filament wound of Type A premium grade polyester resin and glass as required for the specific working pressure, bedding conditions, and design conditions.
   7. Exterior Layer: The exterior layer shall be of chemically resistant construction suitable for the service and provide the additional strength to meet tensile and flexural requirements. The exterior surface shall be relatively smooth free of exposed glass fibers or sharp projections.
   8. Exterior Gel Coat: The gel coat shall consist of polyester resin, a pigment for color and an ultra-violet light inhibitor. Submit manufacturer's standard color charts for color selection.

B. FITTINGS:
   1. Provide fittings as shown on drawings or specified herein, fabricated from the same materials and thickness as connecting ductwork. Centerline radius for fittings shall be 1.5 times diameter. Provide conical-type branch connections when main to branch size allows room for the conical connection.
   2. Bends shall be formed over a removable mold up thru 30 inch diameter, and fabricated from straight duct for larger sizes with the following mitre segments:
      Bends up to 30 degree: 1 mitre/2 gore
      31 degree to 60 degree bend: 2 mitre/3 gore
      61 degree to 90 degree bend: 4 mitre/5 gore
      Corrosion resistance and working pressure equal to that of connecting duct.

C. DUCT JOINTS: Same material as the duct and shall meet or exceed the hoop tensile strength and axial strength requirements of the duct.
   1. Duct joints shall be butt and wrap.
   2. Fittings shall be plain end for butt and wrap.
   3. Adhesive material for field joints shall be suitable for minimum 250 degree Fahrenheit continuous service.
   4. Flanges:
      a. Flanges shall be hand lay-up in accordance with ASME-RTP1 or NBS PS 15-69 and furnished undrilled. Minimum flange thickness shall be 3/4 inch.
      b. Bolts, nuts and washers shall be Type 316 stainless steel.
      c. Flange gasket shall be suitable for 250 degrees Fahrenheit continuous service and constructed of neoprene rubber.

D. SUPPORTS AND HANGERS: Ductwork shall be supported at intervals no greater than 10-foot centers.
   1. Hangers shall be band type contacting 180 degrees of duct surface.

2. Supports shall be saddle type with hold down ring, or as indicated on Drawings.

2.04 DUCTWORK APPLICATION SCHEDULE

Air System	Material
Low pressure supply (heating systems)	Stainless Steel, Type 304
Low pressure supply (system with cooling coils)	Stainless Steel, Type 304
Return and relief	Stainless Steel, Type 304
General exhaust	Stainless Steel, Type 304
Outside air intake	Stainless Steel, Type 304
Ductwork Within the Screening Building, and Truck Loading Bay	Fiberglass Ductwork
Ductwork – Odor Control	Fiberglass Ductwork
Ductwork – Pipe Gallery and Grit Handling	Fiberglass or Stainless Steel, Type 304

2.05 LOW PRESSURE DUCT GAGES

A. Rectangular Ducts

Maximum Width (in)	Minimum USS Gage
Up to 12	24
13 to 30	22
31 to 54	20

B. Round Ducts

Duct Diameter (in)	Minimum USS Gage
Up to 13	24
14 to 22	22
23 to 36	20

PART 3 - EXECUTION

3.01 GENERAL

A. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

B. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum length or as shown of flexible duct. Hold in place with strap or clamp.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Fabricate and support in accordance with SMACNA Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

E. Size round ducts installed in place of rectangular ducts or vice versa in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by arrangement with the Engineer.

F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees, or as detailed.

H. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

I. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws or with drawbands on sheet metal collars.

J. Use crimp joints with or without bead for joining round duct sizes 10 inch and smaller with crimp in direction of air flow.

K. Use double nuts and lock washers on threaded rod supports.

3.02 INSTALLATION OF FIBERGLASS REINFORCED DUCTWORK:

A. Install fiberglass reinforced ductwork in accordance with SMACNA Thermoset FRP Duct Construction Manual.

B. JOINTS: All field cut edges shall be coated with resin so that no glass fibers are exposed and all voids are filled. Finished joints shall be built up in successive layers and have structural characteristics equal to or greater than the ductwork. The joint shall be made over the centerline of the joint with first layer being a minimum of 2 inches. Successive layers shall build up the joint to provide the manufacturer’s required width. Crevices between joints shall be filled with resin or thixotropic resin paste, leaving a smooth interior surface.

C. FLANGED JOINTS: Provide flanged joints at equipment and dampers connections, and where indicated on Drawings.
   1. Bolt holes shall straddle the centerline. Number of bolt holes and bolt sizes shall be in accordance with manufacturer’s written instructions.

3.03 ADJUSTING AND CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

SECTION 15815 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Volume control dampers

B. Backdraft dampers

C. Air turning devices

D. Flexible duct connections

E. Duct test holes

1.02 RELATED WORK

A. Section 15095 - Expansion Compensation and Vibration Isolation

B. Section 15810 - Ductwork

C. Section 15830 - Air Outlets and Inlets

D. Section 15960 - Testing, Adjusting and Balancing

1.03 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. SMACNA - Low Pressure Duct Construction Standards.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 15010.

B. Provide shop drawings for shop fabricated assemblies, including volume control dampers, duct access doors, and duct test holes. Provide product data for hardware used.

C. Submit manufacturer's installation instructions under provisions of Section 15010.

PART 2 - PRODUCTS

2.01 DAMPERS

A. Manual Dampers: Provide dampers as shown on Drawings and where required to properly balance the duct system as described by the Associated Air Balance Council.

B. Rectangular Ducts: Provide multiple opposed-blade type dampers. Provide 9-inch maximum blades made from 16-gauge galvanized steel or aluminum. Provide neoprene edging and stops, channel iron frames painted with two coats of rust-resistant paint and locking quadrants.

C. Round ducts: Provide butterfly-type damper with a minimum 4-inch-long 20-gauge galvanized steel frame, and a minimum 22-gauge steel blade. Provide steel axle with steel sleeve or nylon bearing that penetrates both sides of frame. Provide locking quadrants.

D. Stainless Steel Dampers for Round Ducts: Dampers shall be provided where shown on Drawings. Dampers shall be of the butterfly-type consisting of circular blade, mounted to a shaft within a flanged frame. The damper shall meet the following requirements:

1.	Velocity Rating:	7,000 FPM minimum.
2.	Pressure Rating:	15-inch w.g. differential minimum.
3.	Leakage:	Maximum 0.03 cfm per inch of blade circumference for a 48-inch diameter size at 10 inches w.g.
4.	Frame:	304 stainless steel channel flanged with bolt holes.
5.	Shaft:	304 extending 6 inches minimum beyond bearings on one side, stainless steel continuous through damper diameter and
6.	Nuts and bolts:	Stainless steel.
7.	Bearing:	Grease-lubricated ball bearings mounted outboard of frame with adjustable packing gland shaft seals.
8.	Blade:	304 stainless steel.
9.	Seal:	Adjustable, full-circumference neoprene blade seal with bolted retainer ring.
10.	Manual Operation:	Locking hand quadrant up to 24 inches, worm gear drive for 24 inches and above. Provide chain operator on dampers 7 feet or more above the floor.

E. Aluminum Control Damper, Insulated and Thermally Broken: Dampers shall be provided where shown on Drawings. Dampers shall be Opposed Blade or Parallel blade as shown in the drawings and schedule. The damper shall meet the following requirements:

1.	Velocity Rating:	4,000 FPM minimum.
2.	Pressure Rating:	10-inch w.g. differential minimum.
3.	Leakage:	Dampers shall have a maximum leakage of Class 1 @ 4 in. wgas defined by AMCA (Leakage class 1 is defined as 8 cfm/ sq. ft. @ 4 in. wg. at -40°F). Tested in accordance with AMCA standard 500-D.
4.	Frame:	Frame shall be aluminum formed into structural hat channel or single flange as required. Frame shall be 4-piece construction with 1 ½" (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.
5.	Blade:	Damper blades shall be heavy gauge extruded aluminum airfoil shape with metal blade to blade overlap. Polyurethane foam fills the airfoil blade cavity giving the blade its thermal transfer properties. Ends of blade have a thermal break to isolate the transfer of heat/cold through the aluminum material from one side of the blade to the other.
6.	Blade Stop:	Each blade stop (top and bottom of damper frame) shall occupy no more than ½" of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.
7.	Shaft:	304 extending 6 inches minimum beyond bearings on one side, stainless steel continuous through damper diameter
8.	Linkage:	Concealed in frame, out of air stream.
9.	Bearing:	Dual bearing with acetal inner sleeve, flanged outer bearing resulting in no metal-to-metal or metal-to-plastic contact.
10.	Seal:	Silicone blade seals mechanically fastened to each blade.
11.	Operator:	Motorized Damper actuator, see schedule of Voltage and 2 position.
12.	Mounting:	Provide with Internal Mounting
13.	Accessories:	Provide with limit switch to indicate open position.

F. Control Damper: Stainless Steel Dampers for Rectangular Ducts: Dampers shall be provided where shown on Drawings. Dampers shall be of the opposed blade with maximum blade of

8.5", mounted to a shaft within a flanged frame. The damper shall meet the following requirements:

1. Velocity Rating: 3,000 FPM minimum.
2. Pressure Rating: 5-inch w.g. differential minimum.
3. Leakage: Class 1A @ 1in.wg, Class 1 @ 4in. wg.
4. Frame: 16 ga 316 stainless steel.
5. Axle: 316 stainless steel square and positively locked to blade.
6. Linkage: 316 stainless steel, with blade to blade linkage concealed in jamb.
7. Nuts and bolts: Stainless steel.
8. Bearing: Corrosion resistant, permanently lubricated, 316 Stainless Steel sleeve type.
9. Blade: Refer to schedule for Paralle or Opposed Blade. 16 ga equilivent 316 stainless steel 3V type.
10. Seal: TPE blade seal and 316 stainless steel jamb seals.
11. Automatic Operation: Provide NEMA 4X automatic actuator as noted on the drawings. Provide NEMA 7 automatic actuators for hazaroud environments where noted on the drawings.

G. Gravity/Motorized Back Draft Dampers for Exhaust Fans: Dampers shall be provided where noted on Drawings. Dampers shall be of the parallel blade type mounted to a shaft within a flanged frame. The damper shall meet the following requirements:

1. Velocity Rating: 2,500 FPM minimum.
2. Pressure Rating: 2-inch w.g. differential minimum.
3. Frame: Aluminum.
4. Blade: Parallel Blade, Aluminum.
5. Axle: 304 stainless steel.
6. Seal: Vinyl blade seals.
7. Operation: Gravity backdraft.
8. Coatings: Industrial Epoxy.
9. Actuation: Gravity or Motorized, see schedule

H. Fiberglass Balancing Dampers for Round Ducts: Provide where shown on Drawings. Dampers shall be butterfly-type meeting the following requirements:

1. Housing: FRP with flanged connections. Dampers shall be fabricated from same materials and specification as ductwork. Structural layer to be filament wound. Minimum liner thickness shall be 100-mil.
2. Shaft: 304 stainless steel or fiberglass with shaft seals.
3. Shaft Bearing: Teflon with double Viton O-rings.
4. Pressure Rating: Pressure differential of 10 inches w.g. minimum.
5. Blade: FRP, one or two piece molded with full circumference blade stop or seals, offset in closed position.
6. Leakage rates: Less than 2 percent of max flow at 1 in w.g. pressure differential
7. Nuts, bolts, and washers: Type 316 stainless steel or nylon.
8. Manual Operation: Type 316 stainless steel or FRP handle and locking quadrant.

I. Fiberglass Control/Isolation Dampers for Round Ducts: Dampers shall be provided where shown on Drawings. Dampers shall be of the butterfly-type meeting the following requirements:

1. Housing: FRP with flange connections. Dampers shall be fabricated with same materials and specification as ductwork. Structural layer to be filament wound. Minimum liner thickness shall be 100-mil.
2. Shaft: 304 stainless steel or fiberglass with shaft seals.
3. Shaft Bearing: Teflon with double Viton O-rings.
4. Pressure Rating: Pressure differential of 10 inches w.g. minimum.

5. Blade: FRP, one or two piece molded with full circumference blade stop or seals, offset in closed position. A resilient machined Viton seat shall be permanently formed into the duct wall.
6. Leakage rates: Less than 0.5 percent of max flow at 1 in w.g. pressure differential
7. Nuts, bolts, and washers: Type 316 stainless steel or nylon.
8. Automatic Operation: Electric or pneumatic operated as indicated in Schedule on Drawings. Recommended by manufacturer for use with motor operator.
9. Manual Operation: Type 316 stainless steel or FRP handle and locking quadrant.

J. Fiberglass Dampers for Rectangular Ducts: Dampers shall be provided where shown on Drawings. Provide multiple opposed-blade type dampers meeting the following requirements:
1. Frame: Dampers shall be fabricated from same materials and specification as ductwork. FRP pultruded construction, 8-inch by 2-3/16-inch by 1/4-inch minimum channel, with flanged connections.
2. Axles: Fiberglass rod, 3/4-inch.
3. Bearings: Molded PTFE.
4. Pressure Rating: Pressure differential of 10 inches w.g. minimum.
5. Blade: FRP airfoil design. 7-1/2-inch width, 5/32-inch thickness, minimum, full-length pultruded axle pocket.
6. Blade Seals: EPDM, mechanically attached to blade.
7. Leakage rates: Less than 0.5 percent of max flow at 1in. w.g. pressure differential
8. Nuts, bolts, and washers: Type 316 stainless steel or nylon.
9. Automatic Operation: Electric or pneumatic operated as indicated in Schedule on Drawings. Recommended by manufacturer for use with motor operator.
10. Manual Operation: Type 316 stainless steel or FRP handle and locking quadrant.

K. Counterbalanced Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at indicated static pressure. Construct blades of extruded aluminum, provide 1/2-inch-diameter ball bearings, 1/2-inch-diameter steel axles spaced on 9-inch centers maximum. Construct frame of 2-inch by 1/2-inch by 16-gauge steel channel minimum. Provide galvanized steel finish on frame with aluminum touch-up.

2.02 AIR TURNING DEVICES

A. Manufacturers: United, Master-Fit, Carnes, Hart and Cooley, Titus or approved equal per Section 15010.

B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction with push-pull operator strap.

C. Duct mounted airfoil blades secured at ends with prefab runners per SMACNA detail.

2.03 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers: Flexmaster, Genflex, Ventfabrics, or approved equal per Section 15010.

B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

C. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 36 oz. per sq. yd., approximately 6 inches wide, crimped into metal edging.

2.04 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.

C. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

E. Provide duct test holes where indicated and required for testing and balancing purposes.

3.02 DAMPER SCHEDULE

A. Dampers in FRP Ductwork: Materials: FRP, Stainless Steel, or Aluminum

B. Wall Dampers: Wall Dampers greater than 24” x 24”: Insulated Aluminum

C. General: unless otherwise noted, damper materials shall be the same construction as the ductwork.

D. Provide balancing dampers at points on low pressure supply, return, and exhaust systems

END OF SECTION

SECTION 15830 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Diffusers

B. Register/grilles

C. Door grilles

1.02 RELATED WORK

A. Division 6 - Carpentry work

B. Division 7 - Joint Sealers

C. Division 8 - Doors and Frames

D. Division 9 - Coatings

E. Section 10210 – Metal Wall Louvers

F. Section 15810 - Ductwork

G. Section 15815 - Ductwork Accessories

H. Section 15960 - Testing, Adjusting, and Balancing – Air Systems

1.03 REFERENCES

A. ARI 650 - Air Outlets and Inlets

B. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

1.04 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ASHRAE 70.

B. Test and rate performance of louvers in accordance with AMCA 500.

1.05 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.06 SUBMITTALS

A. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

B. Submit product and performance data under provisions of Section 15010.

C. Submit schedule of outlets and inlets indicating type, size, location, application, noise level, pressure drops at rated cfm, manufacturer and model number.

PART 2 - PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

A. Materials in corrosive environment (Truck Loading Bay, Screening Area) shall be aluminum or stainless steel construction.

2.02 CEILING DIFFUSERS

A. Hart & Cooley, Titus or equal per Section 15010.

B. Round Ceiling Diffusers: Round, adjustable pattern, stamped or spun, multicore type diffuser to discharge air in 360 degree pattern. Provide finished assembly suitable for direct mounting to rectangular or round duct. Fabricate of type 304 stainless steel finish. Provide radial opposed blade or combination splitter damper with damper adjustable from diffuser face.

2.03 CEILING GRILLES

A. Hart & Cooley, Titus or equal per Section 15010.

B. Streamlined and non-adjustable straight blades, single deflection, set at 0°. Fabricate 1-1/4 inch margin frame with countersunk screw mounting and gasket. Fabricate of type 304 stainless steel finish.

2.04 WALL GRILLES

A. Same as 2.02 except provide wall mounting frames with curved hemmed edge blades for return grilles.

2.05 LOUVERS

A. Louvers are specified under Section 10210. They are scheduled in mechanical division for standards of quality and performance only.

B. Louver shall have performance as scheduled in mechanical drawings.

2.06 DOOR LOUVERS

A. Door louvers are provided under Division 8, and scheduled with doors.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to Section 09961.

C. Connect diffusers to ductwork with air tight connection.

D. Provide balancing manual dampers on duct take-off to diffusers, and grilles and registers where shown regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09961.

F. Beginning of installation means acceptance of existing conditions.

G. Install air devices level and plumb.

H. Clean all surfaces and components.

END OF SECTION

SECTION 15868 - CARBON BASED ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, and equipment necessary for fabrication, production, installation, and erection of the items specified in this Section as shown on Drawings or listed on Schedule.

B. Section includes the following:

1. Activated carbon canister odor control system.

C. Products Furnished But Not Installed Under This Section:

1. Anchor bolts shall be installed under Division 3, in accordance with certified prints furnished by the equipment manufacturer.

1.02 SYSTEM DESCRIPTION

A. Each Odor Control System shall include:

1. Activated carbon vessel.

2. Media.

3. Fan and motor assembly with sound enclosure.

4. Mating connectors.

5. Pre-filter.

6. System Accessories.

7. Control Panels with VFD

8. Manufacturer's services.

B. The vessel, fan, and carbon canisters function as a system and shall be the end products of the odor control system supplier to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services.

C. The odor control system shall meet the performance requirements listed on Schedule at the end of this Section.

1.03 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01300, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Shop Drawings and/or catalog cuts of supplied items.

a. Vessel Drawings with valves and interconnecting piping
   1) load and anchoring requirements
b. Prefilter: Detailed drawing showing wall construction, pad construction details, end connections and access configuration.

c. Dimensional and weight information. Include empty weight and operating weight with carbon.

2. Documentation to demonstrate that the reaction system is the standard product of the supplier.

   a. Provide structural calculations, including material property test data.
   b. Vessel fabrication details and materials of the components shall be included in shop drawings, and submitted for approval before fabrication.
   c. Vessel design calculations stamped by a professional engineer.
   d. Resin manufacturer's certificate listing the nomenclature, composition, and characteristics of the resin shall be furnished for all major components including the vessel, dampers and ductwork. This should include a letter from the resin manufacturer stating recommended corrosion liner for service outlined in this specification.
   e. Vessel fabricator's certificate of compliance with fabrication requirements.
   f. Copy of fabricator's quality assurance (QA) program.
   g. Detailed information on the internal media retention system to include free area calculations, construction data, baffling system and compaction compensation calculations. Calculations shall be supported by detailed CFD modeling.
   h. Pre-filter: Installation instructions and O&M Data, Detailed pressure drop calculations for the pre-filter.
   i. Media:
      1) Furnish with 60 days after contract execution, a certificate from the media manufacturer certifying that the proposed media will meet the specifications.
      2) Statement of origin and manufacturers test data noting lot numbers. Submitted lot numbers shall be confirmed with actual material delivered. Media shall not be private-labeled by the system supplier.
      3) Media manufacturer's certificate to include statement of origin and test results.

   j. A list of ten recent installations where similar radial flow equipment by the manufacturer is currently in service; include contact name, telephone number, mailing address, and the names of the engineer, owner, and installation contractor.
   k. A list of ten units of equal or larger size that have been in operation under the system manufacturers name for over ten years – complete with contact numbers. All references to be checked and confirmed to be radial flow configuration.

3. Documentation to demonstrate that the manufacturer has been regularly engaged in fabricating odor control systems for at least 5 years.

4. Certified fan Drawings.

B. Record Drawings: At Project closeout, submit Record Drawings of installed products, in accordance with requirements of Section 01770 and Section 01785.

C. Test and Inspection Report: A written report shall be submitted to Engineer documenting testing and/or inspection results. The report shall be prepared as noted under this Section.

D. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01780, operation and maintenance manuals for items included under this Section.

E. Warranty: Submit in accordance with requirements of Section 01782, warranties covering the items included under this Section.

1.04 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Activated Carbon Odor Control System:

   a. ECS Environmental Solutions, Inc. – (Basis of Design).

   b. Continental Carbon Group.

   Refer to specification 00410 regarding non basis of design vendors

2. Fan and Motor Assembly:

   a. New York Blower Co.

   b. Hartzell Fan.

   c. Greenheck.

2.02 ABSORBER VESSEL AND DUCTWORK

A. Vessel Design: Radial Flow.

B. The FRP absorber vessels shall be filament-wound, manufactured in accordance with ASTM D3299. The visual defects, per ASTM D2563, shall not exceed Level II on the vessel interior and Level III on the vessel exterior. The resin used shall be Dow 510, AOC K022, or approved equal suitable for continuous exposure to saturated water vapor, hydrogen sulfide gas, and their associated acidic products. The resin system should provide a class 1 flame spread rating. Antimony, Nyacol or any other additives are not allowed. A permanent wax containing resin coating, formulated according to the resin manufacturer's most recent recommendations (or other Engineer-approved method) shall be used for surface protection and to prevent air inhibition of resin curing. Contact molded accessories shall be manufactured in accordance with NBS PS15. The completed vessel shall be translucent until it is gel coated. The final gel coat color shall be selected by the owner or engineer. A certificate from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin shall be furnished with the vessel. Acceptable manufacturers for the FRP vessel are ECS, Diamond Fiberglass, Ershigs, Belco, without exception.

   1. An inner corrosion barrier shall be provided consisting of no less than three laminated layers. The inner corrosion layer shall be resin rich, not to exceed 20 percent plus or minus 5 percent glass by weight, and a minimum thickness of 10 to 15 mils. The inner corrosion layer shall be followed by at least two layers of chopped-strand mat or two passes of chopped roving to a total of 3 ounces per foot. Should the chopped roving technique be employed, the chopped fibers shall be 1/2 inch to 2 inches in length. The total corrosion barrier shall total 100 mils minimum and be 27 percent plus or minus 5 percent glass by weight.

2. The structural aspects of the vessel shall be sufficient to meet recommended requirements, including seismic requirements for all conditions during the design life. Manufacturer shall include with the shop drawings, detailed calculations illustrating the seismic characteristics of the proposed vessels. Calculations shall be signed and stamped by a registered mechanical engineer.

3. In addition to the above requirements, the adsorber vessel shall have an average glass content of 55 percent plus or minus 5 percent by weight per ASTM D2584.

4. Tie down lugs and lifting lugs shall be 316 stainless steel. Quantity and design shall be determined in the PE stamped vessel calculations.

5. The absorber vessel shall be complete with integral carbon screen support structure, access manways, air inlet connection, air outlet, no-loss discharge stack, pressure differential assembly, a fill connection, a drain connection, sample port nozzles, 316 stainless grounding rod and all necessary accessories as shown on the Drawings and/or specified within. All exhaust air shall leave the vessel at the top. Provide sufficient access manway so that all internal parts can be easily removed from the vessel. All metal parts shall be Type 316 stainless steel with no metallic parts contacting the carbon except for grounding purposes. No pultruded components shall be used on the interior of the vessel unless they are completely coated with the specified 100-mil corrosion barrier and manufactured using the specified resin systems.

6. Access manway covers shall be airtight at the pressure equal to or higher than the corresponding fan static pressure. Poly manways are not acceptable. The fabrication details and materials of the components shall be included in shop drawings, and submitted for approval before fabrication.

7. Vessel shall have an internal slope bottom. Bottom shall be sloped to a drain nozzle at 1/8” per foot in diameter. Low point of the slope shall be raised to ensure full drainage.

8. Vessels shall have a flanged top section to facilitate complete removal of all internal components. Flange shall be design for 12” positive pressure and full hydrostatic loading.

9. Vessel design and airflow configuration shall be furnished to accommodate a cylindrical, vertical carbon bed. Airflow shall be horizontal through the bed.

    a. Support system requirements:
        1) The bed and vessel configuration is to be conducive to easy carbon replacement. Beds shall have carbon fill / access ports and one access manway placed so man-entry of the vessel is not required.
        2) ii. Each vessel shall be provided with independent columns.
        3) iii. Columns shall be manufactured from FRP, 316 Stainless Steel or hastelloy. Unreinforced plastic columns (PVC, PP, HDPE) are not acceptable. Retention screen shall inter-wound in the support column so that it cannot be disturbed during filling / removal of media. If metal is utilized retention screen shall have an independent structure on either side.

10. Each bed shall be grounded with a 316 stainless steel rod to prevent static electricity from accumulating. A predrilled and tapped copper grounding pad shall be located on external vessel walls.

11. All cut-walls from tank wall nozzle cutouts shall be reinforced as required by service conditions. Press molded or compression molded flanged nozzles are not acceptable.

12. Add ultraviolet absorbers to surfacing to improve weather resistance.

13. No dyes, pigments or colorants except in exterior gel coating.

14. Each carbon vessel shall be provided with No-Loss exhaust stack and supported from the unit. Mounting brackets and guy wires (if required) shall be provided with vessel.

15. Vessel access and Safety equipment.

    a. Each vessel shall be provided with OSHA rated handrail with top rail, mid rail, and 4" toe kick. System shall be permanently attached to the vessel. Provide a self-closing gate at the entrance of the hand rail system.

    b. Provide and aluminum access ladder to access top of the vessel. Provide SAF-T-CLIMB fall protection device on the ladder. See Specification 05511 – Fix Metal Ladders for ladder and safety requirements. The vessel shall incorporate mounting bracket for the ladder system.

    c. Provide grounding lug on metal ladder and hand rail system.

2.03 ACTIVATED CARBON

A. TYPE: Carbon shall be a coconut shell based 4mm pellet with a 0.30 g/cc H2S capacity minimum.

B. Sufficient activated carbon shall be provided to fill the reactor vessel to the height of the vessel. The activated carbon shall be virgin pelletized activated carbon. The activated carbon shall be suitable for the vapor phase adsorption of sewage treatment odors. No chemical impregnation of the activated carbon is permitted. Carbon must be an A-grade first quality bituminous coal or coconut shell pellet. Wood based material may not be utilized in the ECS VX radial flow units without exception. H2S capacity will be checked by an independent agency by taking random samples from media delivered. If the carbon is found to have an H2S capacity less than what is specified it will be immediately rejected. Private labeled carbon is not acceptable. The submittals shall include a statement of origin from the factory that produces the carbon. The activated carbon shall have the following specifications:

1.	Iodine No., mg/g	800 min
2.	Butane Activity, weight %	31.4 min
3.	Moisture, weight % as packed	4 max
4.	Hardness No.	95 min
5.	Apparent Density, g/ml	0.44 min
6.	Mean Particle Diameter, mm	4 min
7.	H2S Breakthrough Capacity, g H2S removed/cc Carbon1	0.30 min

    a. The determination of hydrogen sulfide breakthrough capacity shall be made by passing a moist (85 percent R.H.) air stream containing 1 percent hydrogen sulfide at a rate of 1,450 cc/min. through a 1-inch diameter by 9-inch deep bed of uniformly packed activated carbon and monitored to 50 ppm breakthrough. Results shall be expressed in grams hydrogen sulfide removed per cc of carbon.

8. Carbon Type that requires water regeneration are not acceptable.

2.04 FAN

A. The fan shall be a centrifugal industrial FRP fan that meets AMCA requirements. All parts of the fan that are exposed to the airstream shall be encapsulated in FRP with graphite impregnation to insure corrosion resistance and spark proof operation.

B. All fans shall be equipped with the following features and accessories:
1. Flanged inlet/outlet
2. PVC coupling drain

3. Teflon Shaft Seal
4. Shaft and Belt Guards
5. Constant-speed V-belt drive

C. The fan shall be rated for 36,750@ 10" w.c.

D. The fan shall be equipped with a unified base with neoprene vibrations isolators.

E. The motor shall be TEFC heavy duty, with a 1.15 SF, 100 hp, 3-60-230/480 volt

F. Fan and Motor Assembly:

1. The fan shall be a centrifugal industrial FRP fan that is AMCA certified and licensed to bear the AMCA seal. All parts of the fan that are exposed to the airstream shall be encapsulated in FRP to ensure corrosion resistance.

2. All fans shall be equipped with the following features and accessories:

a. Flanged outlet/slip-on inlet.

b. Drain.

c. Shaft seals, Viton.

d. Inspection port.

e. Safety belt guard.

f. Lifting eyes.

g. Epoxy coated, heavy gauge, all-welded steel base.

h. Constant speed V-belt drive.

3. The motor shall be a TEFC unit rated for Class I, Division II, Group D hazards, with a 1.15 service factor and rated for VFD service. Motor shall meet the requirements of Section 16220.

4. Fan Options:

a. Explosion Proof Package: Class 1 Division 2 rated motor, with graphite impregnation of FRP fan body.

b. Stainless steel fan shaft in lieu of standard carbon steel shaft.

G. Sound Attenuation Package:

1. A FRP sound enclosure shall be provided by the system supplier. Construction and performance shall be as follows:

a. Walls shall be vacuum-formed construction with two layers of FRP over a honey-comb core.

b. Resin, liner, color and exterior coating system shall be the same as specified for the adsorber vessel.

c. Enclosure shall have an exhaust fan with explosion-proof motor and acoustic louver installed.

d. Enclosure shall be manufactured so that it can be easily removed for maintenance. A single split-line is to be centered on the fan outlet.

e. Enclosure shall have interior sound absorbing lining.

f. Performance of the enclosure shall provide a 20 dB insertion loss at 3'.

H. Interconnecting Ductwork:

1. Ductwork between the reactor vessel and the exhaust fan shall be provided by odor control manufacturer.

2. Ductwork assembly and design shall be compatible with the fan and vessel.

3. An expansion joint shall be included in the ductwork and installed at the outlet of the exhaust fan. The expansion joint shall dampen axial, lateral, and vibrational duct movement. The expansion joint shall be resistant to ultraviolet degradation and to the corrosive gases being processed. The expansion joint shall be of a flanged design.

I. Instrumentation:

1. Pressure differential instruments shall be provided and include Magnehelic style pressure gauges allowing determination of the pressure loss in inches of water column across the carbon. The range shall be 0-10 inches of water. Tubing shall be bonded to a solid acrylic plastic block that contains safety traps. Magnehelic shall be Dwyer or equal.

2. Sampling Ports: Each adsorption unit shall have three 2-inch diameter sample ports which extend into the carbon bed 1 foot minimum, suitable for extracting carbon samples. Provide one grain thief that is capable of extracting a core sample of the in-place carbon through the sample ports. Ports shall be adequate to provide suitable extraction of air samples from the carbon bed and be nonbinding. Each port nozzle shall extend outside the vessel wall and be blocked off with a 2-inch ball valve. One additional air sampling port shall be provided above the carbon bed.

3. Proof of Fan Operation Switch: Pressure differential instruments shall be provided and include Magnehelic style pressure gauges across the fan to provide feedback that fan is operating. The range shall be 0-10 inches of water. Tubing shall be bonded to a solid acrylic plastic block that contains safety traps. Magnehelic shall be Dwyer or equal. Provide with two contacts to indicate flow (pressure differential) is stratified. These contacts will be monitored by panels provided by others.

J. Controls

1. Control Panel / Motor Starter – The system shall be furnished with a Local Control Panel. The panel shall be housed in a NEMA 4X stainless steel enclosure with 3 point latching system. The control panel shall be mounted 3 feet away for any leakage sources.

2. The Local Control Panel shall control the exhaust fan.

a. NEMA 4X SST enclosure with:
   1) 480v main circuit breaker
   2) Control transformer – 120v
   3) Controls/Contacts/Alarms
      i. HOA switch for fan

ii. Main power disconnect
iii. Red “On” pilot light’
iv. VFD for Exhaust Fan
v. Dry Contacts for:
(i) Exhaust Fan Run
(ii) Fan Fail

K. Pre-Filter:

1. A pre-filter shall be provided upstream of the fan and designed for total airflow through the fan. The pre-filter shall remove moisture and particulate before the air stream is directed into the fan.

2. Housing: Housing shall be manufactured using fiberglass reinforced plastic. Manufacturer shall retain the services for of an independent inspector who is responsible to confirm the pre-filter has been manufactured in accordance with this specification and all FRP work meets or exceeds ASME RTP-1 level 2 visual inspection criteria.

   a. Resin system shall be a corrosion resistant vinyl ester with a class 1 flame spread rating. Acceptable products are AOC K022-AC or Dow Derakane 510-B series. Resin system shall not require any additives such as nyacol or antimony to achieve the class 1 flame spread rating. Finished laminate including liner and structure shall be translucent.
   b. All internal surfaces shall have a 100-mil corrosion liner made up of a single nexus veil followed by two layers of 1.5 oz chopped strand matt.
   c. All exterior surfaces shall have gelcoat applied. This coating shall contain UV inhibitors, color to be selected by the owner.
   d. Housing shall have machined UMHW guides to prevent stainless frame on filter pad from scratching or damaging the corrosion liner.
   e. Filter housing shall be designed for 12” positive and negative pressure with a maximum of 1/8” deflection.
   f. Housing shall have an access door for pad removal complete with EPDM gasket and 316 Stainless hinges / quick latches. For filter housings larger than 3’ across, two access doors shall be provided. Access doors shall have stainless toggle clamps for easy pad access. Bolt-on access doors are not acceptable. Plastic clamps are not acceptable.
   g. Housing shall be provided with a 2” drain connection at the base, and come from the manufacturer complete with ball valve. Drain shall direct liquid from a 2” diameter base sump extending the width of the housing to a point where the effluent can be handled. External drain piping shall have a water trap, no valves are allowed.
   h. For installation, housing shall have (2) 8” diameter FRP legs. Length of legs shall be coordinated with the contactor. Housing shall be supported by these legs independent of the connecting ductwork, anchored with stainless steel HILTI bolts.
   i. Housing shall have a differential gauge bracket and be supplied with a dwyer magnehlic pressure gauge and connections for gauge on either side of filter pad. Unit shall come complete from the factory with all DP equipment pre-assembled and installed.
   j. Filter pad:
      1) Pad shall have 2” of stainless mesh followed by 4” of poly mesh. Mesh shall be held together by a stainless steel frame. Total pad width including pads and frame shall be 8”.
      2) Maximum pad segment width of pads is 24”. Pads larger than 24” wide must be segmented to allow easy removal by the owner. Segment width should not exceed 24”

3. Dimensions / Design:
   a. End connections shall be sized for a maximum air velocity of 2500 f/m. Flange dimensions shall match the connecting ductwork. Flange thickness shall not be less than that listed in ASTM 3982.
   b. Inlet cone shall be designed so that the airstream can spread evenly over the pad surface. Cone angle shall be no less than 60 deg.

c. Housing shall be sized so that air velocity through the filter pad is 400 f/m or less.
d. Particle removal efficiency shall be 99% of particles 10 microns or larger.

L. System Accessories:

1. 16 gauge SST name plate with ¼" die-stamped equipment tag number securely mounted in a readily visible location.

2. 316 Stainless Steel or FRP lifting and anchor lugs for all equipment

3. Flow Monitoring Equipment: Each vessel shall include a manometer sufficient to give a direct read-out of differential pressure in inches water column across the system. The manometer shall be a Dwyer Series 1230-16, or equal.

4. Grease Filters/Mist Eliminator: A grease filter/mist eliminator shall be supplied. This unit shall consist of a 304L stainless steel pad for grease filtration in front of a PPL pad with 316 stainless steel grid for mist elimination, housed inside an FRP enclosure. The pads shall be removable for cleaning and the housing shall have a door, or dropout flange, to allow removal and replacement of the filter pads. A Dwyer Series 2000 Magnehelic gauge shall be installed on the housing to indicate pressure drop through the unit. This unit shall ship loose and be ready for installation into the reactor system supply ductwork. The FRP housing shall be flanged and drilled per PS 15-69 and come complete with gaskets, ready for installation. The filter/eliminator unit shall be manufactured by Diamond Fiberglass Fabricators, Inc., or equal.

PART 3 - EXECUTION

3.01 FACTORY TESTING

A. All equipment shall be factory tested for compliance with the requirements specified herein. In addition, a full hydrostatic atmospheric leak test (zero leakage allowed). Hydro test shall be witnessed by an independent inspector.

3.02 EXAMINATION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.03 ERECTION

A. Equipment provided under this Section shall be fabricated, assembled, erected, and placed in proper operation condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer approved by Engineer.

3.04 FUNCTIONAL TESTING

A. Functional testing shall be conducted after the installation of the carbon vessels and all appurtenances and the equipment has been operated for a sufficient period to make any corrections or adjustments. Each carbon vessel shall be subject to field functional tests under actual operating conditions to determine that operation is satisfactory and in compliance with the Specifications.

B. The Contractor will provide, calibrate, and install all temporary gauges and meters, and install all temporary piping and wiring required for the functional tests.

C. The functional tests shall include the following:

1. Alignment: Test complete assemblies for correct and proper alignment and connection, and quite operation.
2. Flow Throughput: Measured by system or temporary instrumentation.
3. Discharge and Inlet Static Pressure: Measured by system instrumentation or temporary measurement devices.
4. Test all system components for proper adjustment and operation in both manual and automatic operating modes.
5. Prior to filling the vessel with carbon the contractor (under direction of the system supplier) shall run a full water regeneration cycle. The system shall prove to be functional, no leaks are allowed.

D. System Start-up
1. Shall be performed by qualified representative of the manufacture.

3.05 TRAINING

A. Manufacturer's representative shall provide site/classroom training for owner's employees. Training shall include normal operating procedures, controls, set point adjustment, sampling, and overview of the operation of the system. Routine maintenance functions and inspections shall be included in the training.

B. Training shall include three (3) site visits for a duration of 4 hours each. Contractor shall provide two (2) week notice of training and schedule with the owner.

3.06 FIELD QUALITY CONTROL

A. Installation Check: The manufacturer shall provide the services of a factory-trained representative to check the installation of all equipment installed in this Section.

B. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit Site of Work a minimum of 2 times, once prior to installation to review installation procedures with Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit Site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to Engineer.

C. Manufacturer's representative shall provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

D. Each equipment supplier's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment:

1. Has been properly installed and lubricated;
2. Is in accurate alignment;
3. Is free from any undue stress imposed by connecting piping or anchor bolts;
4. Has been operated under full load condition and that it operated satisfactorily to Engineer;
5. That Owner's Representative has been instructed in the proper maintenance and operation of the equipment; and
6. Furnish Owner a copy of all test data recorded during the installation check including noise level and vibration readings.

E. Manufacturer's service representative shall provide site visit to inspect the each unit after the successful startup and operation of system. There shall be a minimum of two site visits/inspections, (1) 6-month and (1) 12-month.

1. During each site visit, the manufacturer's service representative shall pull a sample of the carbon bed and have the manufacture analysis the media for breakdown and recommend any corrective actions for operation of the system.

F. Inspection Report: A written report of the installation check shall be submitted to Engineer.

ODOR CONTROL SYSTEM SCHEDULE

Unit: OCU-1-1&2, DM-1-1&2, OCF-1-1&2

Location:

Performance Requirements:

Odor Sources	Inlet Concentration	Removal Efficiency
Hydrogen Sulfides	__5___ (ppm)	99 percent

Activated Carbon Odor Control System:

Number of Units: (2)

Capacity per Vessel (cfm): 36,750 CFM

Canisters per Reactor: (1) Vessel per unit.

Maximum Unit Size (footprint): 14' diameter

Exhaust Fan:

Fan HP (max.): 100 HP

External Static Pressure (max.): 3.375 INWC. This excludes the Carbon Canister and Demister Filter provided by manufacturer

Electrical Connection: 480/3/60

Remarks:

END OF SECTION

SECTION 15882 - FANS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Centrifugal and Axial Wall Exhausters

B. Bathroom exhaust fans

C. Fan Accessories

1.02 RELATED WORK

A. Section 15090 - Hangers, Supports, and Anchors

B. Section 15095 - Expansion Compensation and Vibration Elimination

C. Section 15170 - Motors

D. Section 15810 - Ductwork

E. Section 15815 - Ductwork Accessories

F. Section 15830 - Air Outlets and Inlets

G. Division 16 - Basic Electrical Provisions

1.03 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

E. ANSI/AFBMA 9 - Load Ratings and Fatigue Life of Ball Bearings.

F. ANSI/AFBMA 11 - Load Ratings and Fatigue Life of Roller Bearings.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 15010. Include component sizes, rough-in requirements, service sizes, temperature and pressure ratings, performance data and finishes. Include product description, model and dimensions.

B. Provide family of fan curves with specified operating point clearly plotted. Dot matrix or single rpm curves will not be accepted for belt drive or variable speed units. Submit sound data for all units.

C. Submit operation and maintenance data under provisions of Section 15010. Include manufacturer's installation instructions, assembly views, lubrication and service instructions, and replacement parts lists, including belts, drives, motors and couplings.

1.05 PROJECT CONDITIONS

A. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated, and fan has been run under observation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and protect products under provisions of Section 15010. Do not allow finish of fans, motors, shafts or bearings to be damaged or to corrode during construction. Dirty, beat up or rusty fans will not be accepted.

1.07 EXTRA STOCK

A. Provide one extra belt or set of belts for each different type or size of belt-driven unit, under provisions of Section 15010.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Provide and install equipment with performance as indicated on fan schedule. Products by Greenheck, Acme, Trane, Cook, Aerovent, Hartzell, New York Blower, Twin Cities, or equal will be considered.

B. Proposed fan selections shall not decrease motor horsepower at all, nor increase brake horsepower (wattage), increase noise level, or increase tip speed by more than 10 percent, or increase inlet air velocity by more than 20 percent, from that specified or indicated on scheduled fan performance.

C. Air handling unit fans shall be provided by unit manufacturer and are specified elsewhere.

2.02 SELECTION AND BALANCING

A. Fan performance shall be based on standard air conditions.

B. Refer to Fan Schedule.

C. Provide fans capable of accommodating static pressure variations of plus or minus 30 percent.

D. Provide balanced variable sheaves for motors 15 HP and under. Provide solid sheaves for larger motors. Provide necessary changes for sheaves during balancing (Adjustable sheaves may be used for balancing).

E. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas of the building. Spin balance to 125% of selected operating speed (maximum tolerance, guaranteed in writing, one mil double amplitude at design speed).

F. Provide fans matching Schedules with regard to style (i.e. SWSI), Fan Class (i.e. Class II), AMCA drive arrangement (i.e. Arrangement 10), AMCA rotation and discharge (i.e. CCW - BAU), and if necessary, AMCA motor position.

2.03 PAINTING

A. Entire fan including housing interior and exterior, backdraft dampers, roof curb, fan blades and motor cover shall be coated with Hi-Pro Polyester or Heresite 500 series air dry phenolic coating, 3 mils DFT minimum

2.04 MOTORS AND DRIVES

A. Motors: As indicated, in compliance with Section 15170. Motor bearings shall be sealed and permanently lubricated.

B. Shafts: Hot rolled carbon steel, ground and polished, with key-way; protectively coated with lubricating oil. Shafts shall be designed to give safe deflection and operate well below first critical speed.

C. Bearings: ANSI/AFBMA 9, L-10 life at 50,000 hours (L-10 life of 200,000 hours)(L-50 life at 100,000 hours) heavy duty pillow block type, self-aligning, grease-lubricated anti-friction ball bearings.

D. ANSI/AFBMA 11 L-10 life at 50,000 hours (L-50 life at 100,000 hours) heavy duty pillow block type, self-aligning, grease-lubricated roller bearings.

E. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheaves for 20 hp and over; matched belts; drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

F. Belt Guard: Fabricate to SMACNA Low Pressure Duct Construction Standards; of 12 gage, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer while guard is in place. Provide guards for all belt drives not enclosed by a weather cover.

2.05 CENTRIFUGAL WALL EXHAUSTERS

A. Provide belt- or direct-drive units as noted on Drawings. Provide adjustable drives on belt-driven units. Provide centrifugal upblast type with all aluminum construction and special coatings where noted. Provide sound levels expressed in sones, determined per AMCA Bulletin No. 301, and not to exceed those shown on Drawings.

B. Wheels: Construct wheels with aluminum, backward-inclined, air foil-type blades, and tapered inlet shroud.

C. Motors: Provide totally enclosed, fan-cooled, premium-efficiency motors. Motor and drive shall be enclosed in a weathertight compartment. Motors shall be self-cooled by outside air vented through motor compartment. Motor compartment shall be completely separated from exhaust air stream. Provide a disconnect mounted in the motor compartment.

D. Accessories:
   1. Provide prefabricated 8-inch raised cant curb and bird screen.
   2. Where Scheduled: Provide gravity-type backdraft dampers of aluminum with brass hinge pins and nylon bearings. Dampers shall close on a neoprene seal. Units in excess of 50 pounds shall be installed on hinged base to provide access for cleaning and servicing. Provide grease fume exhausters with aluminum grease trough and 1-1/2-inch drain connection.
   3. Where Motorized dampers are scheduled, provide damper per section 15815.

E. Special Requirements: Fans shall be made of materials that are corrosion-resistant to fumes or gases noted on the Drawings or coated as required in Section 15010. Fans noted as “spark-resistant” shall be made of nonsparking materials per AMCA Std. 401-66, Type B. Fans noted as “explosion-proof” shall meet the explosion-proof requirements in Section 15010.

B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor. Coordinate with Division 16 for larger motors.

C. Backdraft Damper: (See also Sections 15815 and 15910) Motor-operated or gravity type, as indicated, aluminum multiple blade construction, felt edged with nylon bearings.

D. Provide other accessories as scheduled

2.06 IN-LINE FANS (IF)

A. Fans shall be axial, vane-axial, or centrifugal as noted on Drawings.

B. Unit shall be belt-driven or direct-driven as noted on Drawings. Provide belt-driven fans with adjustable drives.

C. Provide heavy-duty, grease-lubricated ball or roller bearings. Fans shall have airtight door of ample size to allow complete inspection. The housing shall be flanged to fit into the ductwork.

D. Motors: Provide totally enclosed, fan-cooled, premium-efficiency motors.

E. Guards: Motor belts shall be protected with sheet metal guards. Guards shall be easily removed for inspection. Provide openings located at each shaft center for rotation checking. Securely fasten the guard to the fan. The guard shall comply with all the local and State safety codes.

F. Wheels: For axial or vane-axial fans, provide wheels with aluminum propeller blades mounted in a cast aluminum hub.

G. For in-line centrifugal fans, provide backward-curved, non-overloading wheels.

H. Accessories: Motor cover, companion flanges.

2.07 FRP CENTRIFUGAL FANS (CEF)

A. Construction: Install fan wheels on one-piece hollow or solid shafts as required by the unit manufacturer. Parts in contact with the air stream shall be solid FRP or completely encapsulated with FRP to ensure corrosion-resistance. Fan shafts shall not pass through their first critical speed as unit comes up to rated rpm. Provide externally mounted grease fittings for lubricated fan bearings. Fans shall be belt-driven with adjustable drives. Belts shall be static-resistant.

B. Units shall be rated at 190 degrees F. Motor shall be mounted externally to permit smooth air flow pattern and to provide easy maintenance.

C. Motor: Provide totally enclosed, fan-cooled, premium-efficiency motors.

D. Accessories: Provide base and wall support bracket where noted.

E. Special Requirements: Fans shall be made of materials that are corrosion-resistant to fumes or gases noted on Drawings. Fans noted as “spark-resistant” shall be made of nonsparking materials per AMCA Std. 401-66, Type B, and shall remove static electrically by using carbon-rich resins with grounding straps. Fans noted as “explosion-proof” shall remove static electrically by using carbon-rich resins with grounding straps and meet the explosion-proof requirements in Section 15010.

2.08 OPTIONS AND ACCESSORIES - GENERAL

A. Provide safety screen where inlet or outlet are exposed, 1" mesh galvanized steel wire with welded grid.

B. Provide engineered vibration isolation frame for individual fans and equivalent vibration isolation provisions for unit-mounted fans.

C. Inlet Bell: Bell mouth inlet for unducted inlet to centrifugal fan, fabricated of steel, aluminum or fiberglass reinforced plastic with flange.

D. Inlet and Outlet Cones: Tapered adapters for duct transition, fabricated of steel with flanges, outlet area/inlet area ratio of 1.5:1.0, with center pod as recommended by manufacturer.

E. Provide companion flanges and hardware for mounting units in duct.

F. Discharge Dampers: Parallel blade heavy duty steel damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever with locking quadrant or provision for operator as required.

G. Provide spark resistant construction, Type C for all fans handling combustible gases or fumes, in all classified spaces, or where otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount as shown in plans and details and per manufacturer's installation instructions. Install with resilient mountings and flexible electrical leads (See Sections 15090 and 15095).

B. Provide backdraft dampers for all exhaust fans and as otherwise indicated.

C. Follow SMACNA Guidelines for fan discharge and inlet conditions which are not specifically shown.

D. Secure wall fans with cadmium plated or stainless steel bolts and screws; use lag screws.

E. Provide safety screen where inlet or outlet of fan are exposed to personnel.

END OF SECTION

SECTION 15910 - HVAC CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes, but is not limited to, the providing of all material, equipment and services necessary for the complete installation of a system of automatic controls and accessories for the control of all new and existing systems as described on the drawings and indicated within this Section (15910), including the following systems:

1. Unitary Split-System Heat Pump and Fan Coil Units and Air Handlers.

2. Supply and Exhaust Fans

3. Unit Heaters and Duct Heaters

4. Motorized Dampers

B. Electrical power is provided under Division 16 to panels and junction boxes at locations noted on electrical drawings. Power for controls, beyond locations provided under Division 16, whether on emergency or regular power circuits, shall be provided under this Section.

1.02 RELATED WORK

A. Mechanical Equipment Sections

B. Division 16 – Electrical

C. Division 17 – Instrumentation

1.03 CODE AND REGULATORY REQUIREMENTS

A. Comply with all provisions of the National Electric Code (NFPA - 70 and NFPA 820, Current Editions).

B. UL 916 Energy Management Systems

C. FCC-Part 15 Subparagraph J. Class A. Emissions requirements

D All devices connected to line voltages, above 25 volts, shall be housed in NEMA rated enclosures, appropriate to the location.

1.04 QUALITY ASSURANCE

A. The automatic temperature control system shall be furnished/provided by the equipment manufacturer or installed by a contractor regularly engaged in this type of work.

B. Controls described in this section which are provided, as part of factory-furnished prefabricated equipment or control panels shall meet the same requirements as indicated herein including compliance with the NEC and NEMA ratings. Interconnections between these devices and other parts of the control system shall be made under this Section.

1.05 SUBMITTALS

A. Provide Manufacturer's literature and product data for all components per Section 15010 including the following. These may be provided as part of the equipment manufacturer's submittal:

1. Complete sequence of operations.

2. One-line schematics of control piping and wiring of all valves, dampers, switches, sensors and accessories for all controlled items, marked specifically for this project. One-line schematics of all remote control boards and panels and the central control panel.

3. Provide schedules with sizing, location, I.D. for any valves or dampers and locations of all sensors and thermostats.

4. Schematic of all termination points within each local control network as well as central system connection points and cabling diagrams with panel locations.

5. Catalog cut sheets of all components used. This includes, but is not limited to valves, dampers, switches, relays, timers, sensors, thermostats, power supplies, controllers, electronic components, conduit, wire, tubing and the like. Show electrical rough-in requirements for all devices.

B. The Contractor shall provide a description of preventative maintenance as part of the temperature control submittal. This shall contain schedules of service procedures, work task definitions, and recommended frequencies of performance.

C. All submittals shall be approved by the Engineer before installation work on the project commences.

1.06 MAINTENANCE AND OPERATION DATA, TRAINING

A. Submit maintenance and operation data under provisions of Section 15010 included in the Maintenance and Operating Manuals. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts list.

B. Upon completion of the work, the Contractor shall provide the Owner with the minimum of four hours of on-site instructions in programming and operating the system, including systems from equipment Sections.

C. Following completion and acceptance of the job, record drawings shall be submitted to the Engineer in blueline or black and white format, showing layout of system in schematic form with any changes implemented during construction.

1.07 WARRANTY

A. The control system herein specified shall be free from defects in workmanship and material under normal use and service. If within twelve (12) months from the date of acceptance by the Owner or Substantial Completion, any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired, free of charge.

PART 2 - PRODUCTS

2.01 GENERAL

A. System Description: Provide complete fully functional control systems to accomplish the required control functions as indicated by the sequence of operations and as described in

equipment Sections. System may be, at the Contractor's option, electromechanical, DDC or a combination thereof, as appropriate. All components and installation, regardless of system type used shall meet the requirements of these Specifications. All systems shall stand alone, without requirements for external service or network connections.

2.02 CONTROL PANELS

A. Local air handling units and/or equipment control panels shall be fully enclosed cabinets meeting NEMA 4X all stainless steel or FRP construction. Panel shall be wall mounted.

B. All indicating devices manually adjusted during routine operation of system shall be located on cabinet door or cover plate. All other devices shall be located within the cabinet mounted to a sub-panel.

2.03 EQUIPMENT - ELECTRIC/SOLID STATE

A. Single temperature electric thermostats shall utilize fast responding by-metal element make and break silver contact and shall be housed under a cover which shall match exactly the appearance as specified for the solid state room thermostat. Contacts and all parts in the electrical circuit shall be enclosed under a dust cover. The differential of the thermostat contact shall be fully adjustable.

B. Single temperature solid-state thermostats shall utilize wire wound sensing. Calibration of the solid-state equipment shall be capable of being performed at the thermostat location. Thermostats shall be provided with covers, which match in appearance, and features all of the thermostats provided on the project.

C. Solid state sensing elements or transmitters shall be of the wire wound resistance type. Solid-state insertion thermostats, where specified to be of the averaging type, shall have a length not less than the width of the duct in which it is mounted up to a maximum element length of twenty feet.

D. On/off remote bulb thermostats shall have precision snap switches with NEMA 4X electrical rating.

E. Modulating remote bulb thermostats shall be the potentiometer type. The complete potentiometer coil and wiper assembly must be removable for inspection or replacement without disturbing calibration of the instrument.

F. Electric and electronic motors used on motorized damper assemblies shall be of the heavy-duty type and have gear trains. They shall be the completely modulating type unless otherwise specified. They shall have ample capacity to handle the required load under all conditions.

PART 3 - EXECUTION

3.01 EQUIPMENT ONBOARD CONTROLS

A. Provide controls from equipment manufacturer which will conform to the sequences of operation given in the equipment Sections of the Specifications.

3.02 SEQUENCE OF OPERATIONS

A. Electric Unit Heaters: Electric Unit Heaters EUH-1 thru 5 shall be provided with built-in thermostatic controls. When the room temperature falls below the thermostat set point (adjustable), the unit shall be energized. When the room temperature rises above the thermostat set point, the unit shall be de-energized.

B. Supply and Exhaust Fans: Ventilation Fans EF-1 and 3 shall operate from wall mounted “H-O-A” switches. In the “HAND” position, the unit shall be energized. In the “OFF” position the unit shall not run. In the “AUTO” position, the fan shall be controlled by a wall-mounted thermostat to be energized when the room temperature rises above the thermostat setpoint (adjustable) and to be de-energized when the room temperature falls below the thermostat setpoint. The motorized dampers in the wall louvers designated in the equipment schedule to serve the specific fan shall be interlocked with the fan to open whenever the fan is energized and to close whenever the fan is de-energized. The “H-O-A” switch for EF-1 shall be located outside of the Screenings Room.

1. Exhaust Fan and supply fan SF-1 EF-2 shall run continuously and shall be controlled from a wall mounted disconnect switch in the Odor Control Room.

2. Exhaust Fan EF-4 and Supply Fan SF-1 shall have relays which shall allow the units to respond to a signal from the thermostat controlling AHU-1 that the system is in occupied mode. The fans shall run continuously during the occupied mode and shall remain off during the unoccupied mode.

C. Split System Heat Pump and Air Handling Unit: The split system heat pump HP –1 and air handler AHU-1 shall be controlled by a wall mounted programmable electronic digital night setback thermostat with automatic changeover, as supplied by the equipment manufacturer. The thermostat shall have additional output points for signaling the relays to EF-4 and SF-1. The unit shall provide heating setback and cooling setup with 7-day programming capability. The unit fan shall run continuously during the occupied mode and shall cycle with the compressor on a call for heating or cooling in the unoccupied mode.

D. ELECTRICAL WIRING

1. Electrical work required for system interlock and installation of the temperature control system shall be provided by this Contractor in accordance with Division 16, Electrical and all national and local codes.

2. Electrical controls shall be fed from circuit or circuits in the electrical distribution panels and shall not be taken from receptacle or lighting circuits. The circuit or circuits within the distribution panels shall be so marked.

3. Control wiring over 25V shall be in metallic conduit with a minimum conduit size of 3/4". Control wiring 25V and under may be low voltage cable suitable for use in concealed areas and in compliance with all fire codes and regulations. All wiring in exposed areas where physical damage may occur shall be in conduit.

4. Control wiring means the furnishing of wire, conduit, conduit fittings, miscellaneous materials and labor as required for mounting and connecting the electrical control devices furnished under this Section of the Specifications or equipment Sections.

END OF SECTION

SECTION 15961 - TESTING, ADJUSTING AND BALANCING - AIR SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The prime Contractor shall include in his bid an amount for system testing, adjusting and balancing (TAB) in this project, based on the highest quotation from qualified testing and balancing firms. The prime Contractor shall submit to the Engineer, within thirty days of signing the Contract, a minimum of three (3) quotations from qualified firms. After review of the quotations, the Owner will select the TAB firm to be employed by the Contractor and will then adjust the Contract amount to match actual cost, if necessary.

B. Provide instruments, tools, and labor to balance all air systems to quantities shown on the drawings.

C. Perform testing, adjusting and balancing of central equipment, supply and distribution systems, and terminal devices for HVAC air systems as included in the Scope of Work (Section 15011). Include all air handling units, coils, duct systems, air terminal devices, air inlets and outlets, ceiling plenums, and exhaust systems. Test room conditions as required.

D. Furnish complete report summarizing all test results and final settings. Final inspection and acceptance shall not proceed before receipt of report.

E. Provide readjustments and retesting as required during project warranty period. Provide retesting during and after fan drive changes to achieve desired performance and document.

1.02 WORK NOT INCLUDED

A. Start-up of all HVAC equipment shall be completed prior to TAB work specified herein and all units to be operational before testing, adjusting and balancing work is attempted.

B. Adjust control devices furnished under Section 15815 and 15910 to achieve throttling. (This shall to be performed in conjunction with the 15815 and 15910 installer).

C. Providing sheaves for fan speed adjustments (furnished with fans).

1.03 RELATED WORK

A. General Conditions: Retainage to be withheld against installing contractor until final completion of testing, adjusting and balancing for one season.

B. Section 15910: HVAC Controls and Instrumentation.

C. References

1. "National Standards for Field Measurements and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems, Vol. 1, No. 81266", by AABC, current edition.

2. "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems", by NEBB, current edition.

3. "ASHRAE Handbook, 1987 HVAC Systems and Applications Volume", Chapter 57 - Testing, Adjusting and Balancing.

1.04 QUALITY ASSURANCE

A. The organization which performs the service shall be an independent test and balance agency and a current member in good standing, certified to perform services required for the Project, of either:

1. Associated Air Balance Council (AABC).

2. National Environmental Balancing Bureau (NEBB).

B. Within 30 days after award of contract (See Section 15010 - Listing), transmit to A/E the names of the three organizations proposed to perform the services. If the Contractor fails to submit names of the three selected test and balance firms within the above prescribed period, the A/E may then select the agency of his choice and contractor must then issue purchase order for this work as directed.

C. Comply with applicable procedures and standards of the certification-sponsoring association:

1. "National Standards for Field Measurements and instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems", by AABC.

2. "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems", by NEBB.

3. Perform services under direction of the supervisor who is designated and qualified under certification requirements of sponsoring association.

4. Calibration and maintenance of instruments shall be in accord with requirements of the standards, and calibration histories for each instrument shall be available for examination.

5. Accuracy of measurements shall comply with requirements of the standards.

6. All reports shall be stamped and certified by the balancing engineer.

7. All air and water quantities listed on drawings are minimum. Quantities to +5% are acceptable.

1.05 SUBMITTALS

A. Preliminary:

1. Submit three copies of documentation to confirm compliance with Quality Assurance provisions:

a. Organization supervisor and personnel training and qualifications.

b. Specimen copy of each of the report forms proposed for use.

B. Second: At least fifteen days prior to starting field work, submit two copies of:

1. A set of report forms filled out as to the design flow values and the installed equipment pressure drops, and the required CFM for air terminals.

2. A complete list of instruments proposed to be used, organized in appropriate categories. Show:

a. Manufacturer and model number.

b. Description and use when needed to further identify the instrument.

c. Size or capacity range.

d. Latest calibration date.

3. A/E will review submittals for compliance with Contract Documents, and will return one set marked to indicate:

a. Discrepancies noted between data shown and Contract Documents.

b. Additional, or more accurate, instruments required.

c. Requests for re-calibration of specific instruments.

C. Third: At least fifteen days prior to Contractor's request for final inspection, submit four copies of final reports, on applicable reporting forms, for review.

1. Schedule testing and balancing of parts of the systems which is delayed due to seasonal, climatic, occupancy, or other conditions beyond control of the Contractor, as early as the proper conditions will allow, after consultation with A/E.

2. Submit reports of delayed testing promptly after execution of those services.

3. Form of Final Reports:

a. Each individual final reporting form must bear the initials of the person who recorded the data. The complete form shall bear the signature of the person who recorded data and that of the TAB supervisor of the reporting organization.

b. When more than one certified organization performs TAB services, the firm having managerial responsibility shall make the submittals.

c. Identify instruments of all types which were used, and the last date of calibration of each.

d. Include notes, descriptions, and diagrams as required to make clear how data was taken and under what conditions differing from normal.

e. List any discrepancies or items not installed according to plans and specifications which affect the achievement of planned system balance.

D. Guarantee: The agency performing the testing, adjusting and balancing work shall certify in writing that their work was performed in accordance with the technical standards of either AABC or NEBB.

PART 2 - PRODUCTS

2.01 INSTRUMENTS

A. Provide instruments required for testing, adjusting and balancing operations.

1. Make instruments available to A/E to facilitate spot checks during testing.

2. Retain possession of instruments, remove from site at completion of services.

B. Instruments used for testing and balancing must have been calibrated within a period of twelve months, and checked for accuracy before start of work.

2.02 REPORT FORMS

A. Use and completely fill out the AABC or equivalent NEBB forms including but not limited to:

1. HVAC units: No. 12766.

2. Exhaust fans: No. 12866.

3. Diffusers, grilles, registers, and ceiling supply outlets: No. 12666.

4. Coils: No. 12266.

PART 3 - EXECUTION

3.01 GENERAL

A. Testing and balancing shall be performed in complete accordance with AABC National Standards for Field Measurement and Instrumentation, form No. 81266, Volume One, sections applicable to air distribution or equivalent NEBB procedure.

B. All equipment that contributes to the heating, cooling, or ventilation of the building shall be included in the report. Field data shall provide enough information to determine the equipment capacity, existing operating conditions, air movement between areas or pressure zones, and general comfort conditions. All applicable items shown on the equipment schedules shall be secured. Data which does not fit the schedules but is required for capacity analysis shall be recorded. All items requiring repairs or attention shall be noted and described.

C. Contractor shall include sufficient man-days according to the job size (minimum of one, not including the initial required) for call back service to adjust problem areas for airflow and pattern adjustment after balance reports have been completed.

3.02 JOB CONDITIONS

A. Prior to start of testing, adjusting and balancing, verify that required "Job Conditions" are met:

1. Installation is complete and systems are in full operation.

2. Outside conditions are within a reasonable range relative to design conditions. Perform tests during normal working hours.

3. Lights are turned "on" and doors are closed for testing.

4. Special equipment such as computers, laboratory equipment, and electronic equipment are in full operation.

5. Testing, adjusting and balancing personnel have in hand "as built" mechanical sheets and submittal data on equipment and material.

3.03 AIR BALANCING

A. Measure air volume discharged at each outlet and adjust air outlets to design air volumes.

B. Adjust fan speeds and motor drives within drive limitations for required air volume. Set a speed to provide air volume at farthest distance without excess static pressure.

C. Coordinate fan drive sheave changes to insure optimum fan operating conditions to match actual system parameters to avoid excessive system pressures and associated air noise.

D. Measure and adjust air supply and exhaust fan units to deliver design conditions at 100% cooling.

E. Adjust outside air, return air, and exhaust dampers for design conditions.

F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan and the unit.

G. Evaluate building and room pressure conditions and wet and dry bulb temperatures to relate to equipment performance data and to determine supply and return air conditions.

H. Evaluate space and zone temperature conditions to determine adequate performance of the systems in maintaining temperatures without drafts.

I. Measure temperature and pressure conditions across outside air, return air, and exhaust dampers to check leakage.

J. Make throw adjustments on all supply grilles, registers, and diffusers.

K. Air balancing should normally be performed with all doors closed.

3.04 COORDINATION

A. Coordinate services with the work of the various trades to ensure rapid completion of the work.

B. Promptly report to A/E any deficiencies noted during performance of services to allow immediate corrective action.

C. The Division 15 contractor shall cooperate with the selected test and balance agency in the following manner:

1. Notify selected agency within 30 days after award of their contract and provide plans so that the preliminary plan check and field inspection phase may be initiated.

2. Provide sufficient time before final completion date so that tests and balancing can be accomplished.

3. Provide immediate labor and tools to testing, adjusting and balancing organization to make corrections when required to meet design intent without undue delay. Install balancing dampers as required by test and balance agency.

4. Put all heating, ventilating and air conditioning systems and equipment into full operation and continue the operation of same during each working day of testing and balancing.

5. Inform testing and balancing agency of any major changes made to system during construction, and provide for them a set of as built drawings and mechanical equipment submittals.

6. Include the costs of dampers, pulley and belt changes in contract but not to be furnished by testing, adjusting and balancing agency.

7. Coordinate work of the testing, adjusting and balancing agency and the Section 15910 – Controls installer to allow free access to all systems and assistance with control-related items.

END OF SECTION