SECTION 230523
VALVES

PART 1  GENERAL

1.01  ABBREVIATIONS

A.  IBBM: Iron body, bronze mounted.
B.  OS&Y: Outside screw and yoke.
C.  WOG: Water, oil, gas.
D.  WSP: Working steam pressure.

1.02  SUBMITTALS

A.  Product Data: Manufacturer’s catalog sheets and specifications for each valve type.
B.  Valve Schedule: List type of valve, manufacturer’s model number, and size for each service application.

1.03  MAINTENANCE

A.  Special Tools:
   1. One wrench for each type and size wrench operated plug valve.

PART 2  PRODUCTS

2.01  VALVES - GENERAL

A.  Valve Standardization: Valves from one or more manufacturers may be used, however valves supplied for each specific valve type shall be the product of one manufacturer.

B.  Valves shall be first quality, free from all imperfections and defects, with body markings indicating manufacturer and rating.

C.  Valve parts of same manufacturer, size and type shall be interchangeable.

D.  Manually operated gate, globe and angle valves shall be of rising stem type, unless otherwise specified.

E.  Valves which use packing, shall be capable of being packed when wide open and under full working pressure.
F. Size valves the same size as the piping in which they are installed, unless specified otherwise.

2.02 GATE VALVES


B. Type C: 125 psig WSP, 200 psig WOG up to 12 inch size, and 150 psig WOG for 14 inch and 16 inch sizes; IBBM OS&Y, bolted bonnet, solid wedge disc, and threaded or flanged ends depending on size. Acceptable Valves: Crane 464-1/2 & 465-1/2, Hammond IR1140, Milwaukee F2885, Nibco T6170 & F6170, and Stockham G620 & G623.


D. Type F: 250 psig WSP, 500 psig WOG up to 12 inch size, and 200 psig WSP, 300 psig WOG for 14 inch thru 20 inch sizes, IBBM OS&Y, bolted bonnet, solid wedge disc, and threaded or flanged ends depending on size. Acceptable Valves: Crane 7-1/2, Hammond IR330, Jenkins 204C, Milwaukee F2894, Nibco F6670, and Stockham F667.

E. Type G: 300 psig WSP, 600 psig WOG, bronze body, union or bolted bonnet, solid wedge disc, cupro-nickel alloy or stainless steel seat rings, and threaded ends. Acceptable Valves: Crane 634E, Hammond IB658, Jenkins 2280UJ, Milwaukee 1184, Nibco T174SS, and Stockham B145.

F. Type H: 150 psig WSP, 300 psig WOG, bronze body, union bonnet, solid wedge disc, and threaded ends. Acceptable Valves: Crane 431UB, Hammond IB629, Jenkins 47CU, Milwaukee 1151, Nibco T134, and Stockham B120.

G. Type I: 150 psig WSP, 300 psig WOG, bronze body, union bonnet, solid wedge disc, and solder ends. Acceptable Valves: Hammond IB648, Milwaukee 1169, and Nibco S134.

2.03 GLOBE AND ANGLE VALVES


2.04 CHECK VALVES

A. Type S: 125 psig WSP, 200 psig WOG, bronze body, brass or bronze trim, horizontal swing, renewable and regrindable disc, and threaded ends. Face discs for cold water service with teflon. Acceptable Valves: Crane 37, Hammond IB940, Jenkins 4092, Milwaukee 509, Nibco T413Y, and Stockham B319Y.

B. Type T: 150 psig WSP, 300 psig WOG, bronze body, brass or bronze trim, horizontal swing, renewable and regrindable disc, and threaded ends. Face discs for cold water service with Buna-N or teflon. Acceptable Valves: Crane 137, Hammond IB944, Jenkins 4092 & 4037J, Nibco T4331, and Stockham B321.

C. Type U: 125 psig WSP, 200 psig WOG, bronze body, brass or bronze trim, horizontal swing, renewable and regrindable disc, and solder ends. Face discs for cold water service with teflon. Acceptable Valves: Crane 1340, Hammond IB912, Jenkins 4093, Milwaukee 1509, Nibco S413Y, and Stockham 309Y.

D. Type V: 125 psig WSP, 200 psig WOG, IBBM, horizontal swing, bolted bonnet, regrindable and renewable seat ring and disc, and threaded or flanged ends depending on size. Discs on valves 4 inch size and larger may be cast iron with bronze face. Acceptable Valves: Crane 372, & 373, Hammond IR1124, Jenkins 623CJ & 624CJ, Milwaukee F2974, Nibco F918, and Stockham G927 & G931.

E. Type W:
1. Globe Style Silent Check Valve: IBBM or semi-steel with bronze mounting, renewable seat and disc, 18-8 stainless steel spring, and flanged ends.
2. Wafer Style Silent Check Valve: IBBM or semi-steel with bronze mounting, renewable seat and disc, 18-8 stainless steel spring, and flanged ends.


F. Type X: 300 WSP, 600 psig WOG, bronze body, brass or bronze trim, horizontal swing, renewable and regrindable disc, and threaded ends. Face disc for cold water service with Buna-N or teflon. Acceptable Valves: Crane 76E, Hammond IB949, Jenkins 4962J, Milwaukee 507, Nibco T4731, and Stockham B375.

G. Type Y: 250 psig WSP, 500 psig WOG, IBBM, horizontal swing, bolted bonnet, regrindable and renewable seat ring and disc, and threaded or flanged ends depending on size. Discs on valves 4 inch size and larger may be cast iron with bronze face. Acceptable Valves: Crane 39E, Hammond IR322, Jenkins 339C, Milwaukee F2970, Nibco F968B, and Stockham F947.

H. Type Z: 125 psig flange pressure rating, cast iron body, wafer style, split clapper plate type with integral body seat ring, plain or flat face end connections, resilient Buna-N seal vulcanized to body seat ring; aluminum, bronze or stainless steel clapper plates; Type 316 stainless steel clapper springs and hinge pins; and nickel plated steel or stainless steel stop pieces. Acceptable Valves: Apco Series 9000, Nibco W920W, Stockham WG970, and Marlin Duo-Check II.

2.05 PLUG VALVES

A. Type AA: 200 psig WOG, lubricated type with standard port opening, cast iron or semi-steel body, sealed lubrication system with lubricant fitting and dial indicator, cylindrical plug or teflon tapered plug, lubricant grooves in body or plug, threaded or flanged ends depending on size, and capable of lubrication with valve under pressure and plug in any position.

1. Acceptable Valves:
   a. 1/2 inch to 3 inch size: Homestead 611 & 612, Resun R1430 & R1431, and Rockwell 142 & 143.
   b. 4 inch size: Homestead 611 & 612, Resun R1430 & R1431, and Rockwell 142 & 143.
   c. 5 inch size: Homestead 611 & 612, Resun R1431, and Rockwell 143.
   d. 6 inch size: Homestead 611 & 612, Resun R1431, and Rockwell 143.
   e. 8, 10 & 12 inch sizes: Homestead 612G, Resun R1431WGA, and Rockwell 149.

2. Operators:
   a. 6 inch size and Less: Wrench operator.
   b. 8 inch size and Up: Worm gear operator.
B. Type AB: 100 psig WOG, gas cock type with cast iron or bronze body, bronze plug, square head, wrench operator, and threaded ends. Acceptable Manufacturers: Crane, Eclipse Combustion, and McDonald.

2.06 BUTTERFLY VALVES

A. Type BF: Iron body, flangeless wafer or lugged type, (lug for each bolt hole, drilled and tapped for cap screws), with replaceable reinforced resilient EPT (EPDM) seats, bronze or nickel plated ductile iron discs, phosphate coated steel or stainless steel stems, and raised necks able to accommodate 2 inches of insulation. Acceptable Manufacturers: Crane, Demco, De Zurik, Hammond, Keystone, Milwaukee, Nibco, Stockham, and Watts.

1. Pressure Ratings:
   a. 12 inch size and Less: 200 psig WOG at 275 degrees F.
   b. 14 inch size and Up: 150 psig WOG at 275 degrees F.


C. Operators:
   1. 6 inch size and Less: Manual actuator handles with external indication of disc position, and suitable means of locking actuator in any fixed position.
   2. 8 inch size and Up: Worm gear operator.

2.07 COMBINATION BALANCING AND SHUT-OFF VALVES

A. Heavy duty brass construction of angle or straightway pattern with 200 psig working water pressure at 250 degrees F, one union connection and one threaded or solder end, visible graduated dial indicator, memory stop, and wheel handle with full turn opening. Acceptable Manufacturers: Dunham-Bush, and Spirax Sarco.

2.08 PUMP DISCHARGE VALVE, TRIPLE-DUTY VALVE:

A. Angle or straight pattern, 175-psig pressure rating, ductile-iron body, pump-discharge fitting; with drain plug ad bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

2.09 SAFETY AND RELIEF VALVES

A. General Requirements: Valves shall be as specified by ASME Code governing manufacture of such valves within scope of their particular usage, i.e., Heating Boilers, Unfired Pressure Valves, etc., shall be tested, rated and listed, unless otherwise specified. Valves for applications specified shall conform to the ASME Code, Section IV, Heating Boilers and the following:

1. Valves for Unfired Pressure Vessels: Safety and safety relief valves on secondary side of unfired pressure tanks, water heaters and heat exchangers shall comply with Code, requirements governing applicable equipment as outlined, in ASME Code, Section IV, Article 4, Paragraph
HG 400.3 and as follows: Secondary side of heat exchanger shall be protected by officially rated valves, set for same pressure or temperature as heretofore specified, when secondary side furnishes steam or hot water for purpose equivalent to purposes for which a boiler would be installed; valves for this purpose shall be sized in accordance with Unfired Vessel Code.

2. End Connections: Unless otherwise specified, safety valves, relief valves and safety relief valves, in sizes 3/4 inch to 3 inches IPS inclusive, may be furnished with male or female pipe thread inlet and female pipe thread outlet; valves over 3 inches IPS must be furnished with 125 lb. or 250 lb. flanged inlet and may be equipped with female threaded or 125 lb. flanged outlet.

2.10 GAGE COCKS


2.11 BALL VALVES

A. Type BV: 150 psig WSP, 600 psig WOG, 2 piece bronze body, solid blow-out proof stem, teflon seats, chrome plated brass ball, teflon seals, corrosion resistant steel lever handles with vinyl grips, balancing stop, and threaded or solder ends. Acceptable Manufacturers: Conbraco, Hammond, Milwaukee, Nibco, and Watts.

PART 3  EXECUTION

3.01 INSTALLATION

A. General: Install valves at locations noted on the drawings or specified.

3.02 VALVE APPLICATION SCHEDULE

A. Schedule of valve applications for the different services is as follows:

1. Compressed Air (A) 125 psig and less:
   a. 2 inches and Less: A gates, J globe or angles, and W checks.
   b. 2-1/2 inches and Up: C gates, K globe or angles, and W checks.

2. Radiator Water (RWS & RWR) 126 to 250 psig: Flanged end, F or G gates or BF-HP butterflies, M globe or angles and X or Y checks.

3. Fuel Oil No. 2 (FOS, FOR) 125 psig and less:
   a. 2 inches and Less: Screwed end, A gates, J globe or angles and S checks, with flared or ferrule copper tubing adapters.
   b. 2-1/2 inches and Up: Flanged end, C gates, K globe or angles and V checks, with flared or ferrule copper tubing adapters.

4. Gas - Natural, Manufactured or Mixed Fuel (G) 125 psig and Less:
   a. 2 inch and Less: AB plug valves.
   b. 2-1/2 inch and Up: AA plug valves.
5. Drain Valve: 3/4” BV valve with hose connection.
6. Manual Air Vent: bronze body and nonferrous internal parts; 150 psig working pressure, 225°F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8 inch discharge connection and 1/2 inch inlet connection.

END OF SECTION
SECTION 230529

PIPE HANGERS AND SUPPORTS

PART 1   GENERAL

1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Companion high density filler pieces for installation over the top 180 degree surface of pipe or tubing, at points of support where a combination clevis hanger, insulation shield and high density insulating saddle are installed.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Piping Insulation: Section 230719.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Details of trapeze hangers and upper hanger attachments for piping 4 inches in diameter and over. Include the number and size of pipe lines to be supported on each type of trapeze hanger.
   2. Details of pipe anchors.
   3. Details and method of installing restraints, anchors, and supports for grooved end piping systems
   4. Drawings identifying seismic locations with corresponding details of pre-approved seismic restraints, with seismic loads and seismic force level (Fp) calculations; pre-engineered and stamped by a NYS Licensed Professional Engineer experienced in seismic restraint systems.

B. Product Data: Catalog sheets, specifications and installation instructions for each item specified except fasteners.

C. Quality Control Submittals:
   1. Seismic Restraint Manufacturer’s Qualifications Data:
      a. Name of firm producing the seismic restraints, business address and telephone number.
      b. Period of time firm has been in the business producing seismic restraints, and names and addresses of 3 similar projects that the manufacturer has produced seismic restraints for during the past 5 years.
   2. Company Field Advisor Data:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
      b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
      c. Services and each product for which authorization is given by the Company, listed specifically for this project.
   3. Manufacturer’s Certificate of Compliance for Seismic Restraints:
      Certificate from seismic restraint manufacturer stating that the restraint
1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with the applicable requirements of the ASME B31 Piping Codes.
   2. Unless otherwise shown or specified, comply with the requirements of the Manufacturer’s Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58, and SP-69.
   3. The contractor shall provide pre-engineered or stamped and signed details (by a NYS Licensed Professional Engineer) of seismic restraint systems to meet total design lateral force requirements for support and restraint of mechanical and electrical systems.
   4. Seismic components shall be UL listed or California OSHPD (Office of Statewide Health Planning and Development) approved.

B. Seismic Restraint Manufacturer Qualifications: The firm producing the seismic restraints shall be experienced in seismic restraint work and shall have produced seismic restraints for a minimum of 5 years.

C. Company Field Advisor: Secure the services of a Company Field Advisor from seismic restraint manufacturer for the following:
   1. Render advice regarding installation and final adjustment of seismic restraint system.
   2. Render advice on the suitability of each seismic restraint for its particular application.
   3. Inspect completed installation of seismic restraint system and certify with an affidavit that the system is installed in accordance with the Contract Documents and is operating properly.
   4. Train facility maintenance personnel on the installation of seismic restraint system and routine maintenance of the system.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddle with companion high density filler piece.
   1. Insulating saddles and filler pieces shall be of the same thickness and materials as the adjoining pipe insulation. Saddles shall cover the lower 180 degrees of the pipe or tubing, and companion filler pieces shall cover the upper 180 degrees of the pipe or tubing. Physical sizes, gages, etc. of the components of insulated hangers shall be in accordance with the following schedule:

and its mounting system or anchorage has been tested or analyzed and meets the requirements of NYS Building Code (Section 1621).
B. Pipe Insulation Shields: Fabricated of steel, with a minimum arc of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

<table>
<thead>
<tr>
<th>PIPE OR TUBING SIZE (Inches)</th>
<th>SHIELD LENGTH (Inches)</th>
<th>SHIELD GAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2-1/2</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>3 to 6</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>8 to 14</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>16 and up</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Pipe Covering Protection Saddles: 3/16 inch thick steel, of sufficient depth for the insulation thickness specified, notched so that saddle contact with the pipe is approximately 50 percent of the total axial cross section. Saddles for pipe 12 inches in size and larger shall have a center support.

D. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.
   1. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers, when supporting piping 10 inches in size and larger.

E. Adjustable Floor Rests and Base Flanges: Steel.

F. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two nuts at each end for positioning rod and hanger, and locking each in place.

G. Riser Clamps: Malleable iron or steel.

H. Rollers: Cast Iron.

I. Restraints, Anchors, and Supports for Grooved End Piping Systems: As recommended by the grooved end fitting manufacturer, and as required for seismic restraints.
2.02 ANCHORS AND ATTACHMENTS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly’s Div./USM Corp. Parasleeve Series, Ramset’s Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti’s Kwik Bolt Series, Molly’s Div./USM Corp. Parabolt PB Series, Ramset’s Trubolt T Series, or Red Head/Phillips WS Series.

C. Self-Drilling Anchors (Group III, Type 1): Ramset’s RD Series, or Red Head/Phillips S Series.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset’s Dynaset DS Series, Hilti’s HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series.

F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell’s Fig No. 292 (size for load, beam flange width, and rod size required).

G. Continuous Slotted Type Concrete Insert, Galvanized:
   1. Load Rating 800 lbs/ft: Kindorf’s D-986.
   2. Load Rating 1500 lbs/ft: Kindorf’s D-980.
   3. Load Rating 3000 lbs/ft: Hohmann & Barnard’s Inc. Type CS-H.
   4. Load Rating 4500 lbs/ft: Hohmann & Barnard’s Inc. Type CS-HD.

H. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded to receive 3/4 inch diameter machine bolts.

I. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, designed to accept 3/4 inch diameter bolts having special wedge shaped heads.

2.03 VIBRATION ISOLATION FOR PIPING

A. Type: Combination rubber and spring type designed for insertion in a split hanger rod for isolating piping from the overhead construction.
   1. Approved isolators: Amber Booth Type BSSR, Korfund Type VX, Mason Industries, Type DNHS, Vibration Eliminator Co. Type SNRC and Vibration Mountings and Controls Type RSH.

B. To ensure that piping weight is properly distributed and not being supported by equipment flanges, the first three rubber and spring isolators on the inlet and outlet side of all close coupled and base mounted pumps, rotating equipment and
   1. Approved Isolators: Amber Booth Type PBSS, Korfund Type VXLS, Mason Industries Type PDNHS, Vibration Eliminator Co. Type PR2H and Vibration Mountings and Controls Type RSHP.

2.04 SEISMIC RESTRAINT SYSTEM FOR PIPING

A. General:
   1. Coordinate all structural attachments with the Director’s Representative.
2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
4. Design seismic restraint devices to accept without failure the forces calculated per the applicable building code and as specified.
5. Friction from gravity loads shall not be considered resistance to seismic forces.
6. Construct seismic supports constructed so that support engagement is maintained.
7. Stamp seismic supports with manufacturer’s name and part number for identification.
9. Design the stiffness of seismic restraints for mechanical equipment so that the load path for the restraint performs its intended function.
10. Where possible, utilize components designed with tamper resistant break-off bolt heads or break-off nuts to assure visual verification of proper installation.
11. Attachment components shall be UL Listed catalog components with published loads designed specifically for seismic application.

B. Type: Pre-engineered seismic restraint system designed to support and restrain piping to meet applicable lateral force requirements.

C. Acceptable Manufacturers:
   1. B-Line.
   2. Mason Industries.
   3. TOLCO Inc.

D. Strut/Channel Bracing: 12 gauge solid steel with no holes, 1-5/8 inches wide x 1-5/8 inches deep of single lengths or stitch-welded back-to-back configurations.

E. Pipe Bracing: Schedule 40 steel pipe.

F. Cable Bracing: Pre-stretched galvanized aircraft cable 7 x 19 strand core.

G. Rigid Seismic Braces For Single Hung Pipe Systems: A12 strut channel or schedule 40 steel pipe.
   1. Maximum Brace Length: 13 feet 1 inches.

H. Rigid Seismic Braces For Trapeze Supported Pipe Systems: A12 strut channel or schedule 40 steel pipe.
   1. Maximum Brace Length: 13 feet 1 inches.

I. Cable Seismic Braces For Single Hung Pipe Systems: Pre-stretched aircraft cable 7 x 19 core.

J. Cable Seismic Braces For Trapeze Supported Pipe Systems: Pre-stretched aircraft cable 7 x 19 core.
K. Structural Attachments for Rigid and Cable Seismic Braces For Single Hung and Trapeze Supported Pipe Systems:
1. Structural attachments shall be positive.
2. Do not make structural attachments to the bottom of a bar joist.
3. Supplemental steel shall be installed for all pre-cast decks less than 4 inches thick
4. Do not use concrete inserts or continuous concrete insert strut to attach brace.
5. Wedge type anchors are permitted. The size and embedment depth shall be determined by the supplier of the seismic restraint system and as approved.

L. Vertical Brace Component (up-thrust protection)
1. Reinforce Vertical Hanger Rod when lengths exceed the following:
   a. 3/8 inch dia rod: 19 inches.
   b. 1/2 inch dia rod: 25 inches.
   c. 5/8 inch dia rod: 31 inches.
   d. 7/8 inch dia rod: 43 inches.
   e. 1 inch dia rod: 50 inches.
   f. 1-1/4 inch dia rod: 62 inches.

2.05 FASTENERS
A. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.06 SHOP PAINTING AND PLATING
A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with metal primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper pipe or copper tubing.

B. Hanger supports for chromium plated pipe shall be chromium plated brass.

PART 3 EXECUTION

3.01 PREPARATORY WORK
A. Place inserts into construction form work expeditiously, so as not to delay the Work.

3.02 INSTALLATION
A. Do not hang or support one pipe from another or from ductwork.
   1. Do not bend threaded rod.
B. Support all insulated horizontal piping conveying refrigerants or other fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.

C. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.

1. For Steel, Alloy Steel, Threaded Brass Pipe and Fibrous Glass Reinforced Plastic Pipe (FRP):

<table>
<thead>
<tr>
<th>PIPE SIZE (Inches)</th>
<th>MAXIMUM SPACING (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and under</td>
<td>8</td>
</tr>
<tr>
<td>1-1/4 and 1-1/2</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>2-1/2 and up</td>
<td>12</td>
</tr>
</tbody>
</table>

2. For Grooved End Steel Pipe:

<table>
<thead>
<tr>
<th>PIPE SIZE (Inches)</th>
<th>MAXIMUM SPACING (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2 and under</td>
<td>7</td>
</tr>
<tr>
<td>2 through 4</td>
<td>10</td>
</tr>
<tr>
<td>5 and over</td>
<td>12</td>
</tr>
</tbody>
</table>

No pipe length shall be left unsupported between any two coupling joints.

3. For Copper Pipe and Copper Tubing:

<table>
<thead>
<tr>
<th>PIPE OR TUBING SIZE (Inches)</th>
<th>MAXIMUM SPACING (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2 and under</td>
<td>6</td>
</tr>
<tr>
<td>2 and over</td>
<td>10</td>
</tr>
</tbody>
</table>

4. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.

5. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.

6. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.

7. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger
assembly based on a safety factor of five, for the ultimate strength of the material being used.

D. Size hanger rods in accordance with the following:

<table>
<thead>
<tr>
<th>PIPE OR TUBING SIZE (Inches)</th>
<th>SINGLE ROD HANGER SIZE (Inches)</th>
<th>DOUBLE ROD HANGER SIZE (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PIPE</td>
<td>TUBING</td>
</tr>
<tr>
<td>1/2 to 2</td>
<td>3/8</td>
<td>1/4</td>
</tr>
<tr>
<td>2-1/2 and 3</td>
<td>1/2</td>
<td>3/8</td>
</tr>
<tr>
<td>4 and 5</td>
<td>5/8</td>
<td>1/2</td>
</tr>
<tr>
<td>6</td>
<td>3/4</td>
<td>1/2</td>
</tr>
<tr>
<td>8, 10 and 12</td>
<td>7/8</td>
<td>5/8</td>
</tr>
</tbody>
</table>

1. Size hanger rods, for piping over 12 inches in size and multiple line supports, based on a safety factor of five for the ultimate strength of the materials being used.

2. Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each rod, two at upper hanger attachment and two at hanger.

E. Vertical Piping:

1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.

2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.

3. Install intermediate supports between riser clamps on maximum 6 foot centers, for copper tubing risers 1-1/4” in size and smaller, installed in finished rooms or spaces other than mechanical equipment machine or steam service rooms, or penthouse mechanical equipment rooms.

F. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.
3.03 UPPER HANGER ATTACHMENTS

A. General:
1. Secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
2. Do not attach hangers to steel decks that are not to receive concrete fill.
3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.
1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.
4. Beam clamps, with tie rods as specified, may be used as upper hanger attachments for the support of piping, subject to clamp manufacturer’s recommended limits.

C. Attachment to Concrete Filled Steel Decks:
1. New Construction: Install metal deck ceiling bolts.
2. Existing Construction: Install welding studs (except at roof decks). Do not support a load in excess of 250 lbs from any single welded stud.
3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Cast-In-Place Concrete: Secure to overhead construction by means of cast-in-place concrete inserts.

E. Attachment to Existing Cast-In-Place Concrete:
1. For piping up to a maximum of 4 inches in size, secure hangers to overhead construction with self-drilling type expansion shields and machine bolts.
2. Secure hangers to wall or floor construction with single unit expansion shields or self-drilling type expansion shields and machine bolts.

F. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc.): Toggle bolts may be installed in cells for the support of piping up to a maximum of 2-1/2 inches in size.

G. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks:
1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
2. Existing Construction: Break out block or tile to access, and install machine bolt anchors at highest practical point on side of web.

H. Attachment to Waffle Type Concrete Decks:
2. Existing Construction: Install machine bolt expansion anchors at highest practical point on side of web.
I. Attachment to Precast Concrete Tee Construction:
   1. New Construction: Tee hanger inserts between adjacent flanges, except at roof deck without concrete fill.
   2. Existing Construction: Dual unit expansion shields in webs of tees. Install shields as high as possible in the webs.
      a. Exercise extreme care in the field drilling of holes to avoid damage to reinforcing.
      b. Do not use powder driven fasteners.

J. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members, by means of malleable iron side beam connectors, or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.
   1. Secure side beam connectors to wood members with two No. 18 x 1-1/2 inch long wood screws, or two No. 16 x 1-1/2 inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
   2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under 2 inches in size. Install bolts or lag screws, in the sides of a timber or a joist, at the mid-point or above, not less than 2-1/2 inches from the lower edge when supporting branch lines and not less than 3 inches from the lower edge when supporting mains. Install heavy gage steel washers under all nuts.
   3. Secure side beam brackets to wooden beams or joists, with lag screws or bolts of size as follows:

<table>
<thead>
<tr>
<th>PIPE SIZE (Inches)</th>
<th>LAG SCREW SIZE (Inches)</th>
<th>BOLT DIAMETER (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 and under</td>
<td>3/8 diameter x 1-3/4</td>
<td>3/8</td>
</tr>
<tr>
<td>2-1/2 and 3</td>
<td>1/2 diameter x 2</td>
<td>1/2</td>
</tr>
<tr>
<td>4 and 5</td>
<td>Use Bolt</td>
<td>5/8</td>
</tr>
</tbody>
</table>

   a. Do not support piping larger than 3 inches with lag screws. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
   b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

<table>
<thead>
<tr>
<th>LAG SCREW DIAMETER (Inches)</th>
<th>NOMINAL WIDTH OF BEAM FACE (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2</td>
</tr>
<tr>
<td>1/2</td>
<td>3</td>
</tr>
</tbody>
</table>

   4. Do not secure hanger attachment to the diagonals or vertical members of the trusses.
3.04 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS AND SWAY BRACES

A. Install pipe anchors, restraints and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions, away from anchor points. Install anchors independent of all hangers and supports, and in a manner that will not affect the structural integrity of the building.

B. In grooved end piping systems, install restraints, and rigid supports as recommended by the manufacturer of the grooved end fittings to ensure proper support and alignment of the piping under operating and testing pressures (maximum hanger or support spacing shall be as previously specified).

1. Horizontal piping shall maintain a constant pitch without sags, humps, or lateral deflections.
2. Branch piping shall remain perpendicular to main piping and/or risers.
3. Vertical piping shall remain plumb without deflections.
4. Vertical piping shall be rigidly supported, or anchored at both top and bottom, and wherever necessary to prevent movement and/or shearing forces at branch connections.

3.05 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

3.06 PIPE INSULATION SHIELDS

A. Unless otherwise specified, install a pipe insulation shield, at all points of support. Center shields on all hangers and supports outside of high density insulation insert, and install in such a manner so as not to cut, or puncture jacket.

3.07 PIPE COVERING PROTECTION SADDLES

A. Install pipe covering protection saddles at all points of support, for steel piping 6 inches in size and larger, insulated with hot service insulation. Weld saddles to piping to insure movement with pipe.

3.08 VIBRATION ISOLATION FOR PIPING

A. Install vibration isolation in accordance with the manufacturer’s printed installation instructions, unless otherwise specified.

B. Piping: The isolator deflections shall be equal to or greater than the static deflection of the vibration isolators provided for the connected machinery as follows:
1. Piping Connected to Vibration Isolated Equipment: For a distance of 50 feet or 50 pipe diameters, whichever is greater.
2. Radiator Piping: For the full length of the piping.
3. Fuel Oil Piping: For all above ground fuel oil piping.

3.09 SEISMIC RESTRAINT SYSTEMS FOR PIPING

A. General:
1. Install seismic restraints in accordance with seismic restraint manufacturer’s printed installation instructions and guidelines unless otherwise specified.
2. Do not use powder-actuated fasteners for seismic restraint anchorage in tension applications.
3. Laterally support vertical risers with riser clamps at each floor unless otherwise specified.
4. When systems cross building seismic separation points, pass between buildings, or are supported from different portions of the building, install to allow differential support displacements without damaging the pipe, equipment or support connections. Install pipe loops, anchors, offsets, and guides as required to provide specified capability of motion and limit movement of adjacent piping.
5. Do not brace seismic bracing to different parts of the building that may respond differently during seismic activity.
6. Provide adequately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire stopping in fire-rated walls.
7. Seismic restraint installations shall not cause any modifications in the positioning of equipment or piping resulting in stresses or misalignment.
8. No rigid connections between equipment, piping, duct, or conduit shall be made to the building structure that degrades the noise and vibration-isolation system specified.
9. Bracing attached to structural members may present additional stresses. Submit loads to the Director’s Representative.
10. Provide vertical stiffening components to support rods when necessary to accept compressive loads. Welding of components to vertical support rods is not acceptable.
11. Clevis supported pipe must have cross-bolt support at each seismic bracing location.
12. Notify Director’s Representative if any discrepancies between the specifications and field conditions prior to installation.

B. Seismic Restraints for Piping:
1. Trapeze assemblies supporting pipes shall be braced considering the total weight of the pipes on the trapeze.
2. Provide transverse bracing at 40 ft. maximum spacing for welded steel pipe, brazed copper pipe or grooved piping with UL 213 listed connections.
   a. Traverse bracing for threaded steel or copper pipe or non-listed UL grooved connections shall not exceed 20 ft. maximum.
3. Provide longitudinal bracing at 80 ft. maximum spacing for welded steel pipe, brazed copper pipe or grooved piping with UL 213 listed connections.
a. Traverse bracing for threaded steel or copper pipe or non-listed UL grooved connections shall not exceed 40 ft. maximum.

4. Transverse piping restraints for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24-inches of the elbow centerline or tee or combined stresses are within allowable limits at longer distances.

5. Branch line piping shall not be used to brace main piping.
   a. No larger diameter pipe shall be braced by a smaller diameter pipe.

6. Attach all longitudinal seismic braces directly to piping.
   a. Encapsulate clamp and brace with insulation equal to that on the pipe.

7. Use hold down clamps to attach pipe to trapeze hangers before installing seismic restraints.

8. Brace vibration isolated piping with cables to allow flexibility.

END OF SECTION
PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Liquid fuel Piping: Section 231100.
B. Insulation: Section 230719.

1.02 REFERENCES

A. FM, IEEE.

1.03 SYSTEM DESCRIPTION

A. Provide a low temperature, all electric, self-regulating type heating cable trace system for plastic and metallic pipes that will maintain the above grade outdoor pipeline fuel oil temperature at approximately 40 degrees F when the ambient temperature drops below 40 degrees F. The heat tracing systems including all components and installations shall be suitable for No. 2 fuel oil piping service.

1.04 SUBMITTALS

A. Waiver of Submittals: The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.

B. Submittals Package: Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.

C. Shop Drawings:
   1. Composite wiring and/or schematic diagrams of the complete system as proposed to be installed (standard diagrams will not be acceptable). Include:
      a. Actual location length, routing, and rating of each heating cable.
      b. Location of branch circuit connections, including conductor size and overcurrent rating recommended for each branch circuit.
      c. Location of terminations, thermostats, etc.
      d. Expected current draw of each heating cable (Data to be used in conjunction with system acceptance test).

D. Product Data:
   1. Catalog sheets, specifications and installation instructions.
   2. Bill of materials.

E. Samples: One of each product if different from Company or catalog number specified.
F. Quality Control Submittals:
1. Company Field Advisor Data: Include:
   a. Name, business address and telephone number of Company Field Advisor secured for the required services.
   b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
   c. Services and each product for which authorization is given by the Company, listed specifically for this project.
2. Installation Training: Certificate of training from the heating cable manufacturer for each person performing the Work.
3. List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address and telephone number of at least 3 comparable installations which can prove the proposed products have operated satisfactorily for one year.

G. Contract Closeout Submittals:
1. System acceptance test report.
2. Certificates:
   a. Affidavit, signed by the Company Field Advisor and notarized, certifying that the system meets the contract requirements and is operating properly.
3. Operation and Maintenance Data:
   a. Deliver 2 copies, covering the installed products, to the Director’s Representative. Include:
      1) Operation and maintenance data for each product.

1.05 QUALITY ASSURANCE

A. Heating cables shall be Factory Mutual (FM) approved, in compliance with IEEE 515.

B. The heat tracing systems including all components and installations shall be suitable for No. 2 fuel oil piping service. All heating-cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide flow maintenance. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires, or that use crimps or terminal blocks, shall not be acceptable. All components that make an electrical connection shall be re-enterable for servicing. No component shall use silicone to seal the electrical connections. An exception will be made in areas where a conduit transition is required.

C. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of 8 working hours for the following:
1. Render advice regarding installation of the system.
2. Witness final system test and then certify with an affidavit that the system is installed in accordance with the contract documents and is operating properly.
PART 2 PRODUCTS

2.01 HEATING CABLES

A. Type SR-8: Self-regulating, Raychem Corp.’s XL-Trace 8XL2-CR (208V/1PH), or approved equal.
   1. Thermal output of 7.5 watts or 8 watts/ft (208V cable operated at 208V).

2.02 SYSTEM ACCESSORIES

A. Furnish the heating cable manufacturer’s accessories to suit the system requirements:
   1. Power connection, end seal, splice, and tee kit components shall be applied in the field.
   2. Heating-cable circuit shall be protected by a ground-fault device for equipment protection.
   3. Provide self-contained line sensing thermostatic control. The system shall be controlled by a line sensing thermostat with variable set point between 40 F and 50 F.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Examine areas and conditions under which electric heating cables are to be installed.
   2. Notify Director’s Representative in writing of conditions detrimental to proper completion of the work.
   3. Ensure that surfaces, and pipes to which electric heating cables are to be installed are free of burrs and other sharp protrusions and that pipes have been pressure tested for leakage.
   4. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 INSTALLATION

A. Install the Work of this Section in accordance with manufacturer’s printed instructions.

B. Install and test heat trace system first before insulation is installed for piping and valves.

C. Apply aluminum foil tape on plastic pipe to avoid overheating areas of the plastic pipe in contact with the heating cable and to aid overall heat transfer from heating cable to the entire pipe surface.
D. After attaching heating cables to pipe, test cables for insulation resistance of 20 megaohms or greater, measured to ground. Where leakage is detected replace cable and retest.

E. Install electric traced warning labels every 10 feet on the exterior of the pipe insulation.

F. Set thermostats so that heating cables will be de-energized when the pipeline temperature rises above 50 degrees F.

3.03 FIELD QUALITY CONTROL

A. System Test:
   1. Preparation: Notify the Director’s Representative at least 3 working days prior to the test so arrangements can be made to have a Facility Representative witness the test.
   2. Make the following tests:
      a. Verify that each heating cable is operating properly by noting and recording its current draw. Note surface temperature of pipe to which cable is attached and ambient air temperature. Use manufacturers approved shop drawing data for expected current draw for each tape at given surface/ambient temperature. Compare actual current draw with expected draw. Any cable with a +15 percent variance from the manufacturer’s expected draw will be rejected.
   3. Supply all equipment necessary for system adjustment and testing.
   4. Submit written report of test results signed by Company Field Advisor and the Director’s Representative.

END OF SECTION
SECTION 230550

VIBRATION ISOLATION

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Vibration Isolation for Piping: Section 230529.

1.02 DEFINITIONS

A. Ground Floor: Floor or floor slab of building resting directly on earth.

1.03 SUBMITTALS

A. Waiver of Submittals: The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.

B. Shop Drawings:
   1. Details of intermediate structural steel members and method of attachment required for installation of vibration isolating devices.
   2. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
   3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
   4. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.
   5. Drawings identifying seismic locations with corresponding details of pre-approved seismic restraints, with seismic loads and seismic force level (Fp) calculations; pre-engineered and stamped by a NYS Licensed Professional Engineer experienced in seismic restraint systems.

C. Product Data:
   1. Catalog sheets, specifications, and installation instructions.
   2. Vibration isolator schedule showing usage.

D. Quality Control Submittals:
   1. Seismic Restraint Manufacturer’s Qualifications Data:
      a. Name of firm producing the seismic restraints, business address and telephone number.
      b. Period of time firm has been in the business producing seismic restraints, and names and addresses of 3 similar projects that the manufacturer has produced seismic restraints for during the past 5 years.
   2. Company Field Advisor Data:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
b. Certified statement from the Company listing the qualifications of the Company Field Advisor.

c. Services and each product for which authorization is given by the Company, listed specifically for this project.

3. Manufacturer’s Certificate of Compliance for Seismic Restraints: Certificate from seismic restraint manufacturer stating that the restraint and its mounting system or anchorage has been tested or analyzed and meets the requirements of NYS Building Code (Section 1621).

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Seismic components shall be UL listed or California OSHPD (Office of Statewide Health Planning and Development) approved.

B. Seismic Restraint Manufacturer Qualifications: The firm producing the seismic restraints shall be experienced in seismic restraint work and shall have produced seismic restraints on a minimum of 3 similar projects over the past 5 years.

C. Company Field Advisor: Secure the services of a Company Field Advisor from seismic restraint manufacturer for a minimum of 16 working hours for the following:
1. Render advice regarding installation and final adjustment of seismic restraint system.
2. Render advice on the suitability of each seismic restraint for its particular application.
3. Inspect completed installation of seismic restraint system and certify with an affidavit that the system is installed in accordance with the Contract Documents and is operating properly.
4. Train facility maintenance personnel on the installation of seismic restraint system and routine maintenance of the system.

PART 2 PRODUCTS

2.01 MANUFACTURERS/COMPANIES

A. Amber-Booth Co.

B. Korfund Dynamics Corp.

C. Mason Industries Inc.

D. Vibration Eliminator Co., Inc.

E. Vibration Mountings and Controls, Inc.
2.02 RUBBER-IN-SHEAR ISOLATORS

A. Provide molded mound shaped rubber or neoprene elements designed to provide the required deflection under imposed load. Furnish isolators properly housed, with steel top plate and base plate completely imbedded in rubber or neoprene, for bolting to equipment and foundations, of type as follows:

1. Single Rubber-In-Shear: Single element designed for static deflection of 1/4 inch.
2. Double Rubber-In-Shear: Two single elements assembled in series, to provide for a static deflection of 1/2 inch.

2.03 STEEL SPRING ISOLATORS

A. Types:

1. Free Standing Springs: Provide laterally stable units, without housing, with a minimum 1/4 inch thick rubber or neoprene sound deadening pad between spring and its support. Use for isolating equipment having a static deflection in excess of 1 inch, unless otherwise indicated.
2. Housed Springs: Provide units with telescoping cast iron or steel housings, containing one or more springs, complete with resilient alignment inserts and a minimum 1/4 inch thick rubber or neoprene sound deadening pad bonded to the base of housing.

B. Construction Features Required:

1. Provide limit stops for spring isolators with deflections of 2 inch or more so as to prevent undue motion during start and stop, but unrestrained movement during normal operation.
2. Hot dip galvanize all steel parts of isolators for outdoor use, with the exception of springs. Cadmium plate or neoprene coat springs.
3. Do not use isolator leveling bolts for jacking screws.

2.04 INTEGRAL STRUCTURAL STEEL OR RAIL TYPE BASES

A. Provide bases, factory fabricated from structural steel members of sufficient rigidity to maintain drive alignment and resist starting torque, without the use of restraining snubber devices. Provide bases complete with rubber-in-shear or spring type isolators, as specified for the particular equipment.

2.05 CONCRETE INERTIA BLOCKS

A. Type: Factory fabricated welded structural steel pouring frames with the following:

1. Sheet metal casing a minimum of 6 inches deep.
2. Integral steel reinforcing rods on 9 inch centers in both directions, welded to steel frame;
3. Height saving mounting lugs and spring isolators designed to provide the required deflection and efficiency.

B. Configure bases to accommodate supported equipment.

1. Provide bases for isolating pumps of physical size and shape as required to accommodate base elbow supports. Provide mounting templates.
2.06 VIBRATION ISOLATION BASES

A. Type: Factory fabricated welded structural steel (ASTM A36) bases and rails with the following:
   1. Support brackets to anchor base to vibration isolation.
   2. Pre-located equipment anchor bolts.
   3. Auxiliary motor slide bases or rails.
   4. Steel angles welded to frame for outrigger isolation mountings.
   5. Factory Finish: Corrosive resistant finish.

B. Design bases to result in lowest possible mounting height with not less than one inch clearance above housekeeping pad or floor.

C. Configure bases to accommodate supported equipment.
   1. Provide bases for isolating pumps of physical size and shape as required to accommodate base elbow supports. Provide mounting templates.

2.07 COMBINATION RUBBER AND SPRING ISOLATORS

A. Type: Combination rubber and spring type designed for insertion in a split hanger rod for isolating equipment from the overhead construction.
   1. Approved isolators: Amber Booth Type BSSR, Korfund Type VX, Mason Industries, Type DNHS, Vibration Eliminator Co. Type SNRC and Vibration Mountings and Controls Type RSH.

2.08 PAD TYPE ISOLATORS

A. Provide neoprene or rubber mountings, corrugated or waffle faced both sides, single or double layered or laminated, or size and thickness as specified for the particular equipment.

2.09 SEISMIC RESTRAINT SYSTEM FOR MECHANICAL EQUIPMENT

A. General:
   1. Coordinate all structural attachments with the Director’s Representative.
   2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
   3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
   4. Design seismic restraint devices to accept without failure the forces calculated per the applicable building code and as specified.
   5. Determine by calculation the number and size of seismic restraints required by each piece of mechanical equipment.
   6. Construct seismic supports so that support engagement is maintained.
   7. Stamp seismic supports with manufacturer’s name and part number for identification.
9. Design the stiffness of seismic restraints for mechanical equipment so that the load path for the restraint performs its intended function.
10. Where possible, utilize components designed with tamper resistant break-off bolt heads or break-off nuts to assure visual verification of proper installation.
11. Attachment components shall be UL Listed catalog components with published loads designed specifically for seismic application.
12. Seismic restraint manufacturer shall have ratings verified by independent testing laboratory.

B. Type: Pre-engineered seismic restraint system designed to support and restrain mechanical equipment to meet applicable lateral force requirements.

C. Acceptable Manufacturers:
   1. B-Line.
   2. Mason Industries.
   3. TOLCO Inc.

D. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression, factory set for thrust.
   1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
   3. Minimum Additional Travel: 50 percent of required deflection at rated load.
   4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

E. Manufactured Seismic Snubbers: All-directional, double-acting snubbers.

F. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during seismic event. Design laterally restrained isolators to resist gravity forces of 4g.

G. Restrained Spring Mountings: Spring isolators with ductile iron or steel rigid housings with the following:
   1. Molded neoprene cup or 1/4 inch neoprene acoustical friction pad between base plate and support.
   2. Leveling bolts which are rigidly bolted to equipment.
   3. Restraining bolts with neoprene bushing between bolt and housing.
4. Vertical Limit Stops: Prevent spring extension when weight is removed; out of contact during normal operation.
5. Internal isolation pad required where housings are bolted or welded into position.
6. Minimum Clearance Around Restraining Bolts and Between Housing and Spring: 1/2 inch.
7. Vertically adjustable allowing maximum of 1/4 inch travel in all directions before contacting resilient snubbing collars.

PART 3 EXECUTION

3.01 INSTALLATION

A. Jack equipment bases or inertia bases into position and block or wedge before springs are loaded. After equipment is bolted in place and springs are loaded, by means of the leveling bolts, remove the temporary blocking or wedging.

B. Housekeeping Pads:
   1. Coordinate size and location of pads with the Work of related contracts.
   2. Coordinate housekeeping pads with restraint manufacturer to provide minimum edge distance of 10 bolt diameters around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings.
      a. If cast-in anchors are being used, size housekeeping pads in accordance with ACI requirements for bolt coverage and embedment.

C. Vibration Isolation Bases:
   1. Coordinate size and location of bases with the Work of related contracts.

3.02 APPLICATION

A. Provide vibration isolators or vibration isolation bases for mechanical equipment, piping and high velocity ductwork of type as specified.

B. Select isolation devices for uniform static deflection, in accordance with the distribution of weight and forces.
   1. Whenever rotational speed is the cause of disturbing frequency, utilize the lowest operating speed of the equipment in determining the type of isolation required.
   2. Selection shall result in uniform loading and deflection, even when equipment weight is not evenly distributed.
   3. Select springs for a total deflection greater than the selected static deflection, to provide an adequate safety factor.

C. Isolate floor mounted fan units, air handling units and self-contained air conditioning units, (with the exception of utility sets, fan units with wheels less than 27 inches and all equipment mounted on the ground floor), to obtain the following efficiencies:
<table>
<thead>
<tr>
<th>RPM</th>
<th>MINIMUM DEFLECTION</th>
<th>EFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 325</td>
<td>3.5</td>
<td>80</td>
</tr>
<tr>
<td>326 to 525</td>
<td>2.0</td>
<td>80-90*</td>
</tr>
<tr>
<td>526 to 575</td>
<td>1.5</td>
<td>90</td>
</tr>
<tr>
<td>576 to 1000</td>
<td>1.25</td>
<td>90-95*</td>
</tr>
<tr>
<td>1001 to 1200</td>
<td>.75</td>
<td>95</td>
</tr>
<tr>
<td>1201 and over</td>
<td>.50</td>
<td>95</td>
</tr>
</tbody>
</table>

*Lower efficiency at lowest RPM - higher efficiency at highest RPM.

### 3.03 VIBRATION ISOLATION SCHEDULE

#### A. Fans and Air Handling Units:
1. Equip fans and air handling units, located above the ground floor and not indicated to be provided with a concrete inertia block or be ceiling mounted or suspended with vibration elimination equipment as follows:
   a. Provide an integral structural steel base with a common steel member running the full length of the fan and motor, with built-in motor slide rails, so as to form a common support for fan unit and motor, with spring type isolators, unless otherwise indicated.
   b. Provide spring unit isolators, or steel rail type isolator bases with spring type isolators, for floor mounted units with motors mounted on the casings or frames.

#### B. Pumps:
1. Located Above the Ground Floor:
   a. Driven by Electric Motors 1/4 to 15 HP: Provide structural steel rails, running full length of bed plate, with housed type spring isolators, and in the case of close coupled pumps, rails shall extend full length under and over hang so as to compensate for the cantilever effect. Provide isolators designed for a minimum 1/2 inch static deflection.
   b. Driven by Electric Motors 20 to 40 HP: Provide inertia blocks, minimum of 1-1/2 times the weight of equipment.
   c. Driven by Electric Motors 50 HP and Larger: Provide inertia blocks, minimum of 2 times the weight of equipment.

#### C. Compressors and Radiators:
Provide housed spring type isolators, complete with vertical resilient limit stops, so as to prevent spring extension when equipment is unloaded. Approved isolators: Amber Booth Type CT, Korfund Type WSCL, Mason Industries Type SLR, Vibration Eliminator Type FRS, Vibration Mountings Type, designed for a minimum 3/4 inch static deflection.

#### D. Air Storage Tanks and Dyatanks:
Provide 1/2 inch thick rubber or neoprene pads.
3.04 SEISMIC RESTRAINT SYSTEM FOR MECHANICAL EQUIPMENT

A. General:
1. Do not use powder-actuated fasteners for seismic restraint anchorage in tension applications.
2. Install seismic restraints in accordance with seismic restraint manufacturer’s printed installation instructions and guidelines unless otherwise specified.
3. When systems cross building seismic separation points, pass between buildings, or are supported from different portions of the building, install to allow differential support displacements without damaging the duct, equipment or support connections.
4. Do not brace seismic bracing to different parts of the building that may respond differently during seismic activity.
5. Provide adequately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire stopping in fire-rated walls.
6. Seismic restraint installations shall not cause any modifications in the positioning of equipment or piping resulting in stresses or misalignment.
7. No rigid connections between equipment, piping, duct, or conduit shall be made to the building structure that degrades the noise and vibration-isolation system specified.
8. Bracing attached to structural members may present additional stresses. Submit loads to the Director’s Representative record for approval.
9. Provide vertical stiffening components to support rods when necessary to accept compressive loads. Welding of components to vertical support rods is not acceptable.
10. Notify Director’s Representative if any discrepancies between the specifications and field conditions prior to installation.

B. Seismic Restraints for mechanical Equipment:
1. Protect each piece of vibration isolated mechanical equipment with protected spring isolators or separate seismic restraints.
   a. Provide protected spring isolators and seismic restraints rated in 3 principle axes.
2. Installation of seismic restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.
3. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
4. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
5. Prior to installation, bring to the Director’s Representative’s attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
6. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or wedge-type concrete anchors. Bracing attached to structural members may present additional stresses. Submit loads to the Director’s Representative.
7. Expansion anchors shall not be used for non-vibration isolated equipment rated over 10 HP.
C. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors.

D. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required.

E. Vertical Stops: For equipment affected by wind pressure or having an operational weight different from installed weight, provide resilient vertical limit stops that prevent spring extension when weight is removed.
   1. Provide vertical stops for equipment containing liquid, such as water chillers, evaporative coolers, boilers, and cooling towers.
   2. Spring isolated or protected spring isolated equipment must rock and move freely within limits of stops or seismic restraint devices.

F. Thrust Restraints: Where required, provide pairs of thrust restraints, symmetrically installed on both sides of the steady state line of thrust.

G. Seismic Snubbers: Provide snubbers as close as possible to each vibration isolator as indicated. After installing and leveling of the equipment, adjust snubbers in accordance with the snubber manufacturer's instructions.

H. Equipment: Provide vibration isolators, flexible connectors and seismic snubbers in accordance with manufacturer's recommendations. Equipment with spring isolators or protected spring isolators shall rock or move freely within limits of stops or seismic snubber restraints.

I. Stability: Isolators shall be stable during starting and stopping of equipment without traverse and eccentric movement of machinery that would damage or adversely affect the equipment or attachments.

J. Lateral Motion: The installed vibration isolation system for each piece of floor or ceiling mounted equipment shall have a maximum lateral motion under machinery start up and shut down conditions of not more than 1/4 inch. Restrain motions in excess by approved spring mountings.

K. Unbalanced Equipment: Provide foundation suspension systems specifically designed to resist horizontal forces for equipment with large unbalanced horizontal forces. Vibration isolator systems shall conform to the equipment manufacturer's recommendations.

L. Non-rotating Equipment: Mount non-rotating equipment in systems which includes rotating or vibrating equipment on isolators having the same deflection as the hangers and supports for the pipe connected to.

M. Install flexible pipe connectors at connections for equipment supported on vibration isolators.

N. Equipment Room Sound Isolation: Do not allow direct contact between pipe or ducts and walls, floor slabs, roofs, ceilings or partitions of equipment rooms.
3.05 FIELD QUALITY CONTROL

A. Provide equipment and apparatus required for performing inspections and tests.
   1. Notify Director’s Representative a minimum of 14 days prior to equipment sound, vibration, and seismic testing.
   2. Rebalance, adjust, or replace equipment with noise or vibration levels in excess of those given in the equipment specifications, or equipment manufacturer's data.

B. Field Inspections:
   1. Prior to initial operation, inspect the vibration isolators and seismic snubbers for conformance to drawings, specifications, and manufacturer's data and instructions.
      a. Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls.
      b. Check connector alignment before and after filling of system and during operation.
      c. Correct misalignment without damage to connector and in accordance with manufacturer's recommendations.

C. Spring Isolator Inspection
   1. After installation of spring isolators or protected spring isolators, and seismic restraint devices, the equipment shall rock freely on its spring isolators within limits of stops or seismic restraint devices. Eliminate or correct any interferences.

D. Tests
   1. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.
   2. Equipment Vibration Tests
      a. Perform vibration tests to determine conformance with vibration isolation schedule specified.

END OF SECTION
SECTION 230553

PIPE AND VALVE IDENTIFICATION

PART 1   GENERAL

1.01 REFERENCES


1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each item specified.

PART 2   PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. W.H. Brady Co., Milwaukee, WI.
B. Emed Co., Buffalo, NY.
C. Panduit Corp., Tinley Park, IL.
D. Seton Nameplate Corp., New Haven, CT.

2.02 PIPE MARKERS AND ACCESSORIES

A. Snap-on Marker: One piece wrap around type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4 inch adhesive strip on inside edge, and 360 degree visibility.

B. Strap-On Marker: Strip type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, factory applied grommets, and pair of stainless steel spring fasteners.

C. Stick-On Marker: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.

D. Pipe Marker Legend and Color Field Sizes:
### OUTSIDE DIAMETER OF PIPE OR INSULATION

<table>
<thead>
<tr>
<th>OUTSIDE DIAMETER OF PIPE OR INSULATION (Inches)</th>
<th>LETTER SIZE (Inches)</th>
<th>LENGTH OF COLOR FIELD (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 to 1-1/4</td>
<td>1/2</td>
<td>8</td>
</tr>
<tr>
<td>1-1/2 to 2</td>
<td>3/4</td>
<td>8</td>
</tr>
<tr>
<td>2-1/2 to 6</td>
<td>1-1/4</td>
<td>12</td>
</tr>
<tr>
<td>8 to 10</td>
<td>2-1/2</td>
<td>24</td>
</tr>
<tr>
<td>Over 10</td>
<td>3-1/2</td>
<td>32</td>
</tr>
</tbody>
</table>

### E. Banding Tapes: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.
1. Plain Tape: Unprinted type; color to match pipe marker background.
2. Flow Arrow Tape: Printed type with integral flow arrows; color to match pipe marker background.

### F. Pipe Size Labels: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, vertical reading pipe size in inches, and legend size matching adjacent pipe marker.

### 2.03 PIPE SERVICE IDENTIFICATION TAGS

A. Type: No. 19 B & S gage brass, with 1/4 inch high pipe service abbreviated legend on one line, over 1/2 inch high pipe size legend in inches, both deep stamped and black filled; and 3/16 inch top hole for fastener.

B. Size: 2 inch square tag.

C. Fasteners: Brass “S” hook or brass jack chain of size as required for pipe to which tag is attached.

### 2.04 VALVE SERVICE IDENTIFICATION TAGS

A. Type: No. 19 B & S gage brass, with 1/4 inch high valve service abbreviated lettering on one line over 1/2 inch high valve service chart number, both deep stamped and black filled; and with 3/16 inch top hole for fastener.

B. Sizes:
   1. HVAC Use: 1-1/2 inch dia round.

C. Fasteners: Brass “S” hook or brass jack chain of size as required for valve stem or handle to which tag is attached.

### 2.05 VALVE SERVICE IDENTIFICATION CHART FRAMES

A. Type: Satin finished extruded aluminum frame with rigid clear plastic glazing, size to fit 8-1/2 x 11 inches valve chart.
PART 3  EXECUTION

3.01  PREPARATION

A. Complete testing, insulation and finish painting work prior to completing the Work of this Section.

B. Clean pipe surfaces with cleaning solvents prior to installing piping identification.

C. Remove dust from insulation surfaces with clean cloths prior to installing piping identification.

3.02  INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer’s printed installation instructions, unless otherwise specified.

B. Stick-On Pipe Markers:
   1. Install minimum of 2 markers at each specified location, 90 degrees apart on visible side of pipe.
   2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.

C. Pipe Size Labels: Install labels adjacent to each pipe marker and upstream from flow arrow. Install a minimum of 2 pipe size labels at each specified location, 90 degrees apart on visible side of pipe.

D. Pipe Service Identification Tags: Attach tags to piping being identified with “S” hooks or jack chains.

3.03  PIPING IDENTIFICATION SCHEDULE

A. Piping Identification Types:
   1. Piping or Insulation under 3/4 inch od: Pipe identification tags.
   2. Piping or Insulation 3/4 inch to 5-7/8 inch od: Snap-on marker or stick-on marker.
   3. Piping or Insulation 6 inch od and Larger: Strap-on marker or stick-on marker.

B. Identify exposed piping, bare or insulated, as to content, size of pipe and direction of flow, with the following exceptions:
   1. Piping in non-walk-in tunnels or underground conduits between manholes.
   2. Piping in furred spaces or suspended ceilings, except at valve access panels where valves and piping shall be identified as specified for exposed piping systems.
3. Piping in finished spaces such as offices, class rooms, wards, toilet rooms, shower rooms and spaces as specified.

C. Locate piping identification to be visible from exposed points of observation.
   1. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs.
   2. Where 2 or more pipes run in parallel, place printed legend and other markers in same relative location.

3.04 VALVE IDENTIFICATION SCHEDULE

A. Valve Service Identification Tags:
   1. Tag control valves, except valves at equipment, with a brass tag fastened to the valve handle or stem, marked to indicate service and numbered in sequence for the following applications:
      a. Domestic water valves controlling mains, risers and branch runouts.
      b. Gas valves controlling mains, risers, and branch runouts.
      c. Valves in heating, ventilating, air conditioning and refrigeration systems.

B. Valve Service Identification Charts:
   1. Provide 2 framed valve charts for each piping system specified to be provided with valve identification tags. Type charts on 8-1/2 x 11 inches heavy white bond paper, indicating valve number, service and location.
   2. Hang framed charts at locations as directed.

END OF SECTION
SECTION 230554

DUCT AND EQUIPMENT IDENTIFICATION

PART 1   GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Mechanical Painting: Section 099103.

1.02 DELIVERY, STORAGE AND HANDLING

A. Deliver paint to the Site in original, new unopened containers, bearing manufacturers' printed labels.

B. Store materials at the site where directed. Keep storage space clean and accessible to the Director's Representative at all times.

PART 2   PRODUCTS

2.01 MATERIALS

A. Paint: Type IAL-3 specified in Section 099103.

PART 3   EXECUTION

3.01 PREPARATION

A. Protection: Cover and protect surfaces to be painted, adjacent surfaces not to be painted, and removed furnishings and equipment from existing paint removals, airborne sanding particles, cleaning fluids and paint spills using suitable drop cloths, barriers and other protective devices.

1. Schedule and coordinate surface preparations so as not to interfere with work of other trades or allow airborne sanding dust particle to fall on freshly painted surfaces. Do not perform the Work of this Section until testing, insulation and finish painting Work have been completed.

2. Provide adequate natural or mechanical ventilation to allow surfaces to be prepared and painted in accordance with product manufacturer’s instructions and applicable regulations.

3. Provide and maintain “Wet Paint” signs, temporary barriers and other protective devices necessary to protect prepared and freshly painted surfaces from damages until Work has been accepted.

B. Clean and prepare surfaces to be painted in accordance with specifications, paint manufacturer’s approved product data sheets and printed label instructions. In the event of conflicting instructions or directions, the more stringent requirements shall apply.
1. Cleaners: Use only approved products manufactured or recommended by finish paint manufacturer. Unless otherwise recommended by cleaner manufacturer, thoroughly rinse with clean water to remove surface contaminants and cleaner residue.

3.02 DUCT IDENTIFICATION

A. Identify exposed ductwork, bare or insulated, directly connected to air handling apparatus, in the following spaces or rooms, by means of painted stenciled legends:
   1. Mechanical Equipment.

B. Locate stenciled legends to be readily visible from any point of observation. Stencil identification along center line of duct, close to equipment. Where view is unobstructed from two directions, apply two sets of stenciling (both sides), visible from each direction.


D. Samples of Ductwork Identification:
   1. Fresh Air Supply.
   2. Exhaust Air.

E. Colors: Paint stenciled letters black. Where the background color is dark, paint background white before stenciling.

3.03 EQUIPMENT IDENTIFICATION

A. Identify mechanical equipment, bare or insulated, installed in the following spaces or rooms, by means of painted stenciled legends:
   1. Mechanical Equipment.

B. Paint stenciled legends black, a minimum of 1-1/2 inches in height, located to be readily visible from a reasonable point of view. Place identification along center line of equipment, if possible.

C. Samples of Equipment Identification:
   1. Supply Fan S 1.
   2. Exhaust Fan E 1.

3.04 APPLICATION OF PAINT

A. Stencil Painting: Apply with a brush or aerosol type spray can.

3.05 CLEANING

A. Clean adjacent surfaces of paint spatters resulting from the Work of this Section.

END OF SECTION
SECTION 230593
CLEANING AND TESTING

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Balancing of Systems: Section 230594.

1.02 SUBMITTALS

A. Quality Control Submittals
   1. Test Reports (Field Tests):
      a. Refrigeration Systems: Submit test results on Refrigeration Systems Pressure - Dehydration Tests, Form BDC-228, a sample of which can be obtained from the Director’s Representative, or a similar test report form, which includes the data shown on Form BDC-228.
      b. Low Pressure Steam or Hot Water Heating Boilers: Submit test results on Boiler Test Record, Form BDC-360, a sample of which can be obtained from the Director’s Representative, or a similar test report form, which includes the data shown on Form BDC-360.
      c. Submit data for each system tested, and/or disinfected; include date performed, description, and test results for each system.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Perform factory testing of factory fabricated equipment in complete accordance with the agencies having jurisdiction.
   2. Perform field testing of piping systems in complete accordance with the local utilities and other agencies having jurisdiction and as specified.

1.04 PROJECT CONDITIONS

A. Protection: During test Work, protect controls, gages and accessories which are not designed to withstand test pressures. Do not utilize permanently installed gages for field testing of systems.

1.05 SEQUENCING AND SCHEDULING

A. Transmit written notification of proposed date and time of operational tests to the Director’s Representative at least 5 days in advance of such tests.

B. Perform cleaning and testing Work in the presence of the Director’s Representative.
C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the Work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Test Equipment and Instruments: Type and kind as required for the particular system under test.

B. Test Media (air, gas, refrigerant, dry nitrogen, vacuum, water): As specified for the particular piping or system under test.

C. Cleaning Agent (chemical solution, steam, water): As specified for the particular piping, apparatus or system being cleaned.

PART 3 EXECUTION

3.01 PRELIMINARY WORK

A. Thoroughly clean pipe and tubing prior to installation. During installation, prevent foreign matter from entering systems. Prevent if possible and remove stoppages or obstructions from piping and systems.

B. Thoroughly clean compressed air and similar systems prior to pressure or vacuum testing.

3.02 PRESSURE TESTING OF PIPING

A. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.

B. Water Systems:
   1. Circulating water systems, including glycol solution systems and piping connections to radiators, unless otherwise specified:
      a. Before final connections are made perform hydrostatic test at 1-1/2 times the maximum working pressure, but not less than 125 psig, for 4 hours.
b. After final connections are made perform hydrostatic retest at a pressure equal to maximum operating system design pressure, but not less than 30 psig, for 4 hours.

C. Gas Piping: Before backfilling or concealment perform air test of duration and pressure as required by the local gas company. However, for gas piping designed for pressures of from 4 inches to 6 inches water column, air test at 15 inches Hg for one hour, without drop in pressure. Test gas piping with air only. Check joints for leaks with soap suds.

D. Air Piping:
1. Compressed Air: Test with air at 150 psig for one hour.
2. Check joints for leaks with soap suds.

E. Vacuum Piping: Perform air test at 150 psig for one hour, followed by a vacuum test of 25 inches Hg for one hour, during which time the mercury shall remain stationary for the last 30 minutes of test.

F. Fuel Oil Piping (Suction and Return): Perform air test at 150 psig for one hour, followed by a vacuum test of 25 inches Hg for one hour, during which time the mercury shall remain stationary for the last 30 minutes of test.

3.04 TESTING OF EQUIPMENT, APPARATUS AND APPURTENANCES

A. Relief Valves: Increase pressure in equipment or apparatus to relief valve setting, to test opening of valves at required relief pressures.

3.05 CLEANING AND OPERATIONAL TESTING

A. Radiator Piping:
1. Cleaning:
   a. Flush systems and apparatus, upon completion of pressure test(s).
   b. Completely open valves and flush each system with clean water, prior to chemical cleaning.
   c. Repeatedly flush at short intervals until twice the system water capacity has been flushed through.
   d. Chemically clean systems immediately following flushing operations.
   e. Circulate a solution consisting of trisodium phosphate, in a proportion of one pound of chemical to every 50 gallons of water in the system.
   f. Completely fill system with cleaning solution; vent as required, and place in operation, with automatic controls operating and valves fully open.
   g. Circulate the solution through the system for a minimum of 4 consecutive hours; immediately drain system and flush with clean water until the pH at the farthest drain matches the clean water input.
   h. Provide temporary pipe and /or hose required to drain system.
i. Keep strainers unplugged during cleaning operations. Remove and clean strainer screens prior to operational test.

j. Upon completion of flushing, remove temporary piping and reconnect steam coil.

k. All disposals shall be per applicable environmental regulations.

END OF SECTION
SECTION 230594

BALANCING OF SYSTEMS

PART 1   GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

   A. Systems Cleaning, Pressure and Operational Testing: Section 230593.

1.02 SUBMITTALS

   A. Quality Control Submittals:

      1. Testing, Adjustment and Balancing Reports:

         a. Hydronic Systems: Submit results on Form BDC-374, which can
            be obtained from the Director’s Representative or use a
            similar test report form which includes all of the items and data
            included on Form BDC-374.

         b. Air Systems: Submit results on Forms BDC-340 and 341 which
            can be obtained from the Director’s Representative, or use
            similar test report forms, which includes all the items and data
            included on Forms BDC-340 and 341.

         c. Submit final testing and balancing results on applicable report
            forms, as approved or furnished by the environmental systems
            balancing council or bureau, which is certifying the independent
            member agency performing the Work, required by this Section.
            Each final systems report form shall bear the signature of the
            person performing the Work and recording the data and the
            signature of the certified supervisor for the performing agency.
            Submit simultaneously with the final reports, a list of the
            instruments used with the last date of calibration for each
            instrument.

1.03 QUALITY ASSURANCE

   A. Qualifications:

      1. Provide the services of a certified independent agency for the testing,
         adjustment and balancing of all air distribution and hydronic distribution
         systems complete with all connected apparatus and equipment. The
         agency shall be certified by the Associated Air Balance Council Bureau -
         AABC, Los Angeles, Cal. 90026 or by National Environmental

      2. The Work shall be performed by skilled mechanical technicians under
         the direct supervision of certified personnel in the employ of the
         independent agency. The supervisor shall be personally certified by the
         national council or bureau, as approved by the Director.
1.04 SEQUENCING AND SCHEDULING

A. Scheduling:
   1. Perform environmental systems testing and balancing after cleaning, miscellaneous testing, adjustment and operational testing Work has been completed.
   2. Test and balance system during a period of time when outside temperature conditions will impose a significant load on the system; i.e., summer months for air conditioning system, winter months for heating system. Balance and adjust systems accordingly.
   3. Send written notification to the Director a minimum of five days prior to the performance of testing and balancing Work. Perform testing and balancing Work in the presence of the Director’s Representative.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

A. General Information: Test instruments are included in this specification for information only. Balancing of air and hydronic systems shall be performed by qualified personnel utilizing company owned test instruments, which will remain the property of the company. Use test instruments which are in first class operating condition, with individual calibration histories to guarantee their accuracy. Test instruments shall be of type and kind as required by the type of system installed. Trade names and manufacturer’s names are mentioned in this section for descriptive purposes only; instruments of equivalent range and capabilities may be utilized.

B. Air Balancing Instruments:
   1. Manometers: Inclined with ranges of 0 to 1/4 inch and 0 to 1 inch; Combination inclined and vertical with a range of 0 to 5 inches and U tube type, 18 inches.
   2. Portable “Magnehelic” Draft Gages: Ranges 0 to 1/2 inch, 0 to 1 inch and 0 to 5 inches.
   3. Anemometers: Deflecting vane type with a range of 100 to 3000 fpm, similar to Alnor Velometer Model 6000 BP and 4 inches diameter rotating vane type.
   4. Pitot Tubes: ASHRAE standard type, stainless steel, 5/16 inch diameter, lengths as required.
   5. Sling Psychrometer.
   6. Smoke Candles and Smoke Generator.

C. Hydronic Balancing Instruments:
   1. Calibrated Test Gages: Ranges 0 to 30 lbs., 0 to 60 lbs., 0 to 200 lbs.
   2. Calibrated Test Gages (Compound Type): Ranges from -30 inches to 30 lbs. and -30 inches to 60 lbs.
   3. U Tube Manometer: 36 inches.
D. Air and Hydronic Systems Balancing Instruments:
1. Thermometers: 12 inches mercury column type and dial type, with a range of -40 to +120 degrees F. and 0 to 220 degrees F. Total of four thermometers.
2. Universal Hand Tachometer: Herman H. Sticht Type UH.
3. Stop Watch.
4. Stroboscope.
5. Contact Pyrometer: Thermocouple type.
6. Volt-Ohm-Ammeter Test Kit, High Current Type: Sperry “Ohmprobe”.
7. Volt-Ammeter: With leads for connecting to lugs.

PART 3 EXECUTION

3.01 PRELIMINARY WORK

A. Circulating Water Systems: Prior to balancing the system, bleed all air vents so as to completely flood the system; check pumps for proper rotation; clean strainers and set balancing and system stop valves in the full-open position.

B. Ventilating and Air Conditioning Systems: Prior to balancing the system, check fans for proper rotation; check filters for cleanliness and proper installation and set dampers in the normal operating position.

3.02 BALANCING OF CIRCULATING WATER SYSTEM AND ETHYLENE GLYCOL SYSTEMS

A. Equipment Schedules and Report Sheets: Prepare itemized equipment schedules, listing all heating or cooling elements and equipment in the system to be balanced. List in order on equipment schedules, by pump or zone according to the design, all heating or cooling elements and all zone balancing valves or balancing devices. Break down schedules into zones to circuits, starting from the zone or circuit pump and terminating with the last item of equipment or transfer element in the respective zone or circuit. Include on schedule sheets, column titles listing the location, type of element or apparatus, design conditions and water balance readings. Prepare individual pump report sheets for each individual system or zone pump.

B. Balancing:
1. Place system in full automatic operation, with automatic controls set in accordance with design conditions, and allow water to reach design temperature.
2. Test pumps and balance flow. Record the following on pump report sheets:
   a. Suction and discharge pressure.
   b. Running amps and brake horsepower of pump motor under full flow and no flow conditions.
   c. Pressure drop across pump in feet of water and total gpm pump is handling under full flow conditions.
3. Set zone or circuit balancing valve at each pump, to handle the design GPM.
4. When the design incorporates the use of air handling units containing coils, check and adjust each unit to insure the proper volume of air is passing through the coils, while the balancing procedure is in progress.
5. Check pumps for flow, after the system has been balanced.
6. Record test readings, calculations and results.

3.03 BALANCING OF VENTILATING AND AIR CONDITIONING SYSTEMS

A. Equipment Schedules and Report Sheets:
1. Prepare itemized air balance schedules for each system listing all air handling units and air outlets for each system. Schedule multi-zone systems by individual zones. Start each schedule from the inlet or the air handling unit and terminate with the last air inlet or outlet device in the system or zone.
2. Prepare individual air handling unit report sheets, noting manufacturer’s published performance data.
3. Record all test readings, calculations and results.

B. Balancing:
1. Inspect All Equipment: Establish a definite operational test condition for test and air balance purposes. In accordance with test condition selected, such as minimum fresh air dampers open, turn on all air handling systems in the building, including all exhaust systems.
2. Balance a system starting with the air handling unit. Check fan speed, using a tachometer with a self-timing device and the power reading of the fan motor using a volt-amp meter. Calculate the actual brake horse power from the tachometer and volt-amp meter readings. Compare the actual fan speed reading and the motor power reading, with the air handling unit manufacturer’s published performance data, and if they check within reasonable limits, make duct velocity readings on the main ducts. Drill holes in the main ducts and using a velocity measuring instrument take velocity readings. Take velocity readings in each zone duct of a multi-zone system and in addition, in the main branch ducts of a reheat type system. Close and seal test holes with metal snap hole plugs and duct tape. Calculate the cfms of the ducts. Establish the total air for the fan or system under test. Compare the design data with the test results, and if the total air is high or low, adjust the fan speed accordingly. Repeat the described test procedure for all air handling units, including all supply air, return air and exhaust air apparatus. With the total air for the system established, use the same duct velocity check system for adjusting the main splitter dampers or other volume control devices for the various branches of the system. Test and adjust the individual air inlet or outlet devices, after the main ducts, zone ducts and branch ducts have been set at design conditions. Adjust individual air inlet and outlet devices, such as registers and diffusers, for air pattern and volume, in the manner recommended by the manufacturer of the devices. The total cfm of all inlets or outlets shall equal the total cfm of all branches, which in turn shall equal the total air volume of the air.
handling units. The system is balanced, when the results of the specified test procedures check with the design data, that is, fan speed and horsepower; total air by velocity readings and total air by inlet or outlet volume.

3.04 FIELD QUALITY CONTROL

A. Inspection: Prior to the environmental testing and balancing of hydronic and air distribution systems, the certified supervisor in the employ of the testing and balancing agency shall inspect the installations and notify the Director’s Representative of any Work which must be performed or modified prior to initiating testing and balancing procedures.

B. Performance: Test and balance environmental hydronic and air distribution systems, including all connected equipment and apparatus, so as to conform to the design conditions. Perform the Work of this section in accordance with the published standards of the balancing council or bureau, which is certifying the member firm. Record all test readings, calculations and results.

END OF SECTION
SECTION 230719
INSULATION

PART 1  GENERAL

1.01  RELATED WORK SPECIFIED ELSEWHERE

A. Through Penetration Firestops: Section 078400.
B. Painting: Section 099103.
C. Pipe Hangers and Supports: Section 230529.

1.02  ABBREVIATIONS

B. K: Thermal Conductivity, i.e., maximum Btu per inch thickness per hour per square foot.
C. pcf: Pounds per cubic foot.
D. PVC: Polyvinylchloride.

1.03  SUBMITTALS

A. Product Data:
   1. Manufacturer’s catalog sheets, specifications and installation instructions for insulation materials and jacket materials.
   2. Materials Schedule: Itemize insulation materials and thicknesses for each specified application in Insulation Material Schedules in Part 3 of this Section. Where optional materials are specified, indicate option selected.

B. Quality Control Submittals:
   1. Installers Qualification Data:
      a. Name of each person who will be performing the Work, and their employer’s name, business address and telephone number.
      b. Furnish names and addresses of the required number of similar projects that each person has worked on which meet the qualifications.

1.04  QUALITY ASSURANCE

A. Qualifications: The persons installing the Work of this Section and their Supervisor shall be personally experienced in mechanical insulation work and shall have been regularly employed by a company installing mechanical insulation for a minimum of 5 years.
B. Regulatory Requirements:
1. Insulation installed inside buildings, including duct lining materials, laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

PART 2 PRODUCTS

2.01 INSULATION

A. Fibrous Glass (Mineral Fiber) Insulation: Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.

1. Preformed Pipe Insulation: Minimum density 3 pcf; ASTM C 547:
   a. Class 1 (Suitable for Temperatures Up to 450 degrees F): K of 0.26 at 75 degrees F.
   b. Class 2 (Suitable for Temperatures 451 to 650 degrees F): K of 0.46 at 300 degrees F.
   c. Class 3 (Suitable for Temperatures 651 to 1200 degrees F): K of 0.56 at 300 degrees F.

2. Premolded Fitting Insulation: Minimum density 4.0 pcf, K of 0.26 at 75 degrees F; ASTM C 547, Class 1.

3. Insulation Inserts for PVC Fitting Jackets: Minimum density 1.5 pcf, K of 0.28 at 75 degrees F; ASTM C 553, Type III.
   a. Suitable for temperatures up to 450 degrees F.

4. Block or Board Insulation: Minimum density 3.0 pcf and 6.0 pcf as specified; ASTM C 612:
   a. Type IA or IB (Suitable for Temperatures Up to 450 degrees F): K of 0.26 at 75 degrees F.
   b. Type II (Suitable for Temperatures 451 to 850 degrees F): K of 0.44 at 300 degrees F.
   c. Type III (Suitable for Temperatures 851 to 1000 degrees F): K of 0.44 at 300 degrees F.
   d. Type IV (Suitable for Temperatures 1001 to 1200 degrees F): K of 0.37 at 300 degrees F.
   e. Type V (Suitable for Temperatures 1201 to 1800 degrees F): K of 0.42 at 300 degrees F.

5. Thermal and Acoustic Board Insulation: Minimum density 3.0 pcf, K of 0.27 at 75 degrees F; ASTM C 1071, Type II.
   a. Air Stream Side: Erosion, temperature, and fire resistant type; NFPA 90-A and 90-B.

6. Blanket Insulation:
   a. For Ductwork (Suitable for Temperatures Up to 450 Degrees F): Minimum density 1.0 pcf, K of 0.31 at 75 degrees F; ASTM C 553, Type II.
   b. For Breeching (Suitable for Temperatures up to 1200 degrees F): Minimum density 8 pcf, K of 0.55 at 400 degrees F, metal mesh faced one side; ASTM C 553, Type VII.
B. Flexible Elastomeric Foam Insulation:
1. FM tested and approved, meeting the following:
   a. Maximum Water Vapor Transmission: 0.10 perm - inch based on ASTM E 96, Procedure A.
   b. K of 0.27 at 75 degrees F based on ASTM C 518 or C 177.
   c. Fire Spread/Smoke Developed Rating: 25/50 or less based on ASTM E 84.
2. Pipe Insulation: ASTM C 534, Type I.
4. Polyethylene and polyolefin insulation is not acceptable.

C. Calcium Silicate Insulation:
1. Calcium Silicate: ASTM C 533, Type I or II, above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket/vapor barrier.

D. High Density Jacketed Insulation Inserts for Hangers and Supports:
1. For Use with Fibrous Glass Insulation:
   a. Cold Service Piping:
      1) Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.
   b. Hot Service Piping:
      1) Calcium Silicate: Minimum density 15 pcf, K of 0.50 at 300 degrees F; ASTM C 533.
      2) Perlite: Minimum density 12 pcf, K of 0.60 at 300 degrees F; ASTM C 610.
   c. Ductwork: Fibrous glass board, minimum density 6 pcf, K of 0.26 at 75 degrees F, conforming to ASTM C 612, Type IA or IB.
2. For Use with Flexible Elastomeric Foam Insulation:
   a. Ductwork and Piping: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as specified or required.

E. Cements:
2. Fibrous Glass Hydraulic Setting Thermal Insulating and Finishing Cement: ASTM C 449/C 449M.

2.02 JACKETS

A. Laminated Vapor Barrier Jackets for Piping and Ductwork: Factory applied by insulation manufacturer, conforming to ASTM C 1136, Types I and II.
1. Type I: Reinforced white kraft and aluminum foil laminate with kraft facing out.
   a. Pipe Jackets: Furnished with integral 1-1/2 inch self sealing longitudinal lap, and separate 3 inch wide adhesive backed butt strips.
2. Type II: Reinforced aluminum foil and kraft laminate with foil facing out.

3. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.

B. Canvas Jackets: Cotton duck, fire retardant, complying with NFPA 701, 4 oz or 6 oz per sq yd as specified.

C. Premolded PVC Fitting Jackets:
   1. Constructed of high impact, UV resistant PVC.
      a. ASTM D 1784, Class 14253-C.
      b. Working Temperature: 0-150 degrees F.

D. Metal Jacketing:
   1. Aluminum: ASTM B 209, Alloys 1100, 30003, 3105 or 5005, Temper H14, 0.016 inch thick.
      a. Factory Pre-formed Sectional Pipe Jacketing:
         1) Smooth outer finish with integral bonded laminated polyethylene film - kraft paper moisture barrier underside.
         2) Pittsburg or modified Pittsburg longitudinal lock seams.
         3) 2 inch overlapping circumferential joints with integral locking clips, or butt joints sealed with 2 inch wide mastic backed aluminum snap bands.
      c. Sheet Jacketing: Corrugated 1-1/4 inch x 1/4 inch deep with integral bonded laminated polyethylene film - kraft paper moisture barrier underside.
      d. Fastening Devices:
         1) Strapping: Type 18-8 stainless steel, 0.020 inch thick, 1/2 and 3/4 inch wide as specified.
         2) Wing Seals: Type 18-8 stainless steel, 0.032 inch thick.
         3) Sheet Metal Screws: Panhead, Type A, hardened aluminum, and stainless steel.
   2. Circumferentially Corrugated Aluminum Jacketing: Childer’s Corrolon.
      a. Construction: 3/16 inch circumferentially corrugated embossed aluminum, ASTM B 209, Types 1100, 3003, 3105, or 505, H-14 temper, 0.016 inch thick.
      b. Moisture Barrier: Integrally bonded to jacket over entire surface in contact with insulation.
      c. Fastening Devices:
         1) Strapping: 0.020 inch thick by 1/2 inch wide, Type 3003, 3105, 5005, H-14 temper.
         2) Wing Seals: 0.032 inch thick Type 5005, H-14 temper aluminum.
2.03 ADHESIVES, MASTICS, AND SEALERS


B. Vapor Seal Adhesive (Fibrous Glass Insulation): Childers’ CP-82, Epolux’s Cadoprene 400, Foster’s 85-75 or 85-20.

C. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation): Childers’ CP-30, Epolux’s Cadalar 670, Foster’s 95-44 or 30-35.

D. Adhesive (Flexible Elastomeric Foam): Armstrong’s 520, Childers’ CP-80, Epolux’s Cadoprene 488, Foster’s 82-40.

E. Adhesive (Reinforcing Membrane): Childers’ Chil-Spray WB CP-56.

F. Mastic (Reinforcing Membrane): Childers’ AK-CRYL CP-9.

G. Sealant (Metal Pipe Jacket): One-part silicone sealant for high temperatures; Dow Corning’s Silastic 736 RTV or General Electric’s RTV 106.

2.04 MISCELLANEOUS MATERIALS

A. Insulation Fasteners for Ductwork and Equipment:
   2. Type: Weld pins, complete with self-locking insulation retaining washers.

B. Pressure Sensitive Tape for Sealing Laminated Jackets:
   2. Type: Same construction as jacket.

C. Wire, Bands, and Wire Mesh:
   1. Binding and Lacing Wire: Nickel copper alloy or copper clad steel, gage as specified.
   2. Bands: Galvanized steel, 1/2 inch wide x 0.015 inch thick, with 0.032 inch thick galvanized wing seals.
   3. Wire Mesh: Woven 20 gage steel wire with 1 inch hexagonal openings, galvanized after weaving.

D. Metal Corner Angles: Galvanized steel, 2 x 2 inch 28 gage.

E. Reinforcing Membrane: Glass or Polyester, 10 x 10 mesh. Alpha Associates Style 59, Childer’s Chil-Glas, Foster’s MAST-A-FAB.
PART 3 EXECUTION

3.01 PREPARATION

A. Perform the following before starting insulation Work:
   1. Install hangers, supports and appurtenances in their permanent locations.
   2. Complete testing of piping, ductwork, and equipment.
   3. Clean and dry surfaces to be insulated.

3.02 INSTALLATION, GENERAL

A. Install the Work of this Section in accordance with the manufacturer’s printed installation instructions unless otherwise specified.

B. Piping Insulation: Provide continuous insulation and jacketing when passing thru interior wall, floor, and ceiling construction.
   1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 078400.
      a. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.

C. Do not intermix different insulation materials on individual runs of piping.

3.03 INSTALLATION AT HANGERS AND SUPPORTS

A. Reset and realign hangers and supports if they are displaced while installing insulation.

B. Install high density jacketed insulation inserts at hangers and supports for insulated ductwork, piping, and equipment.

C. Insulation Inserts For Use with Fibrous Glass Insulation:
   1. Ductwork: Install 6 pcf density jacketed fibrous glass board, same thickness as adjoining insulation, sized for full bearing on supporting trapeze member, and as required to enable abutting to adjoining insulation and overlapping of jacketing.
   2. Piping: Where clevis hangers are used, install insulation shields and high density jacketed insulation inserts between shield and pipe.
      a. Where insulation is subject to compression at points over 180 degrees apart, e.g. riser clamps, U-bolts, trapezes, etc.; fully encircle pipe with 2 protection shields and 2 high density jacketed fibrous glass insulation inserts within supporting members.
      1) Exception: Locations where pipe covering protection saddles are specified for hot service piping, 6 inch and larger.
D. Insulation Inserts For Use with Flexible Elastomeric Foam Insulation:

1. Ductwork: Install hardwood block, same thickness as adjoining insulation, sized for full bearing on supporting trapeze member and as required to abutt and seal vapor tight with adjoining insulation.

2. Piping:
   a. Where clevis hangers are used, install insulation shields with hardwood filler pieces, same thickness as adjoining insulation, inserted in undersized die cut or slotted holes in insulation at support points.
   b. Contour hardwood blocks to match the curvature of pipe, and shield.
   c. Coat dowels and blocks with insulation adhesive, and insert while still wet.
   d. Vapor seal outer surfaces of dowels and blocks with adhesive after insertion.
   e. Install filler pieces as follows:

<table>
<thead>
<tr>
<th>PIPE/TUBING SIZE</th>
<th>FILLER PIECES</th>
<th>POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thru 1-1/2”</td>
<td>2 dowel plugs</td>
<td>6 o’clock; in tandem</td>
</tr>
<tr>
<td>2” thru 4”</td>
<td>1 block 2 dowel plugs</td>
<td>6 o’clock, and 4 &amp; 8 o’clock respectively</td>
</tr>
<tr>
<td>6” thru 8”</td>
<td>2 blocks 4 dowel plugs</td>
<td>6 o’clock; in tandem and 4 &amp; 8 o’clock; in tandem</td>
</tr>
</tbody>
</table>

3.04 INSTALLATION OF FIBROUS GLASS HOT SERVICE INSULATION

A. Install insulation materials with field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket unless otherwise specified.

B. Canvas Jackets on Piping, Fittings, Valves, Flanges, Unions, and Irregular Surfaces:

1. For Piping 2 inch Size and Smaller: 4 oz per sq yd unless otherwise specified.
2. For Piping Over 2 inch Size: 6 oz per sq yd unless otherwise specified.

C. Piping:

1. Butt insulation joints together, continuously seal minimum 1-1/2 inch wide self sealing longitudinal jacket laps and 3 inch wide adhesive backed butt strips.
   a. Substitution: 3 inch wide pressure sensitive sealing tape, of same material as the jacket, may be used in lieu of butt strips.
2. Fill voids in insulation at hanger with insulating cement.
3. Exceptions:
   a. Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Spaces and Concealed Piping: Butt insulation joints together and secure minimum 1-1/2 inch wide longitudinal jacket laps and 3 inch wide butt strips of same material as jacket, with outward clinching staples on maximum 4 inch centers. Fill voids in insulation at hangers with insulating cement.
b. Piping in Tunnels: Butt insulation joints together and secure minimum 1-1/2 inch wide longitudinal jacket laps and 3 inch wide butt strips, of same material as jacket, with outward clinching staples on maximum 4 inch centers and 16 gage wires a minimum of 4 loops per section. Fill voids in insulation with insulating cement.

D. Fittings, Valves, Flanges and Irregular Surfaces:
1. Insulate with mitre cut or premolded fitting insulation of same material and thickness as insulation.
2. Secure in place with 16 gage wire, with ends twisted and turned down into insulation.
3. Butt fitting, valve and flange insulation against pipe insulation, and fill voids with insulating cement.
4. Insulate valves up to and including bonnets, without interfering with packing nuts.
5. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.
6. After insulating cement has dried, coat insulated surface with lagging adhesive, and apply 4 oz or 6 oz canvas jacket as required by pipe size.
   a. Lap canvas jacket on itself and adjoining pipe insulation at least 2 inches.
   b. Size entire canvas jacket with lagging adhesive.

7. Exceptions:
   a. In Types E, F and G Service Piping Systems: Valves, fittings and flanges may be insulated with premolded PVC fitting jackets, with fibrous glass insulation inserts.
      1) Additional insulation inserts are required for services with operating temperatures over 250 degrees F or where insulation thickness exceeds 1-1/2 inches. The surface temperature of PVC fitting jacket must not exceed 150 degrees F.
   b. In Types E, F, and G Service Piping Systems: Insulate fittings, valves, and irregular surfaces 3 inch size and smaller with insulating cement covered with 4 oz or 6 oz canvas jacket as required by pipe size.
      1) Terminate pipe insulation adjacent to flanges and unions with insulating cement trowelled down to pipe on a bevel.
   c. In Type H Service Piping System: Insulate fittings, valves, flanges, unions, and irregular surfaces 3 inch size and smaller with insulating cement covered with 4 oz or 6 oz canvas jacket as required by pipe size.
   d. Fittings, Valves, Flanges, and Irregular Surfaces In Concealed Piping, Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Rooms, Unfinished Spaces, and Tunnels: Sizing of canvas surface is not required.

E. Equipment:
1. Secure fibrous glass block or board insulation in place with wire or galvanized steel bands.
a. Small Areas: Secure insulation with 16 gage wire on maximum 6 inch centers.
b. Large Areas: Secure insulation with 14 gage wire or .015 inch thick by 1/2 inch wide galvanized steel bands on maximum 10 inch centers. Stagger insulation joints.
c. Irregular Surfaces: Where application of block or board insulation is not practical, insulate with insulating cement built-up to same thickness as adjoining insulation.

2. Fill joints, voids and irregular surfaces with insulating cement, to a uniform thickness.
3. Stretch wire mesh over entire insulated surface and secure to anchors, with wire edges laced together.
4. Apply finishing cement, total of 1/2 inch thick, in 1/4 inch thick coats.
   a. Trowel second coat to a smooth hard finish.
5. Neatly bevel insulation around manholes, handholes, cleanouts, ASME stamp, boiler manufacturer’s name and catalog number.

3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

A. Where possible, slip insulation over the pipe, and seal butt joints with adhesive.
   1. Where the slip-on technique is not possible, slit the insulation and install.
   2. Re-seal with adhesive, making sure the mating surfaces are completely joined.

B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer, and assemble the cut sections in accordance with the manufacturer’s printed instructions.
   1. Insulate threaded fittings and valves with sleeved fitting covers. Over lap and seal the covers to the adjoining pipe insulation with adhesive.

C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier of the system.

D. Insulated Covers for Pumps:
   1. Do not extend pump insulation beyond or interfere with stuffing boxes, or interfere with adjustment and servicing of parts requiring regular maintenance or operating attention.

E. Piping Exposed Exterior to a Building, Totally Exposed to the Elements:
   1. Apply flexible elastomeric foam insulation to piping with adhesive.
   2. Apply reinforcing membrane around piping insulation with adhesive or mastic.

3.06 INSTALLATION OF SHEET METAL JACKETING ON PIPING

A. Secure jacketing to insulated piping with preformed aluminum snap straps and stainless steel strapping installed with special banding wrench.
B. Jacket exposed insulated fittings, valves and flanges with mitred sections of aluminum jacketing.
   1. Seal joints with sealant and secure with preformed aluminum bands.
   2. Substitution: Factory fabricated, preformed, sectional aluminum fitting covers may be used in lieu of mitred sections of aluminum jacketing for covering fittings, valves and flanges.
   3. Substitution: Factory fabricated, preformed, sectional aluminum fitting covers or premolded polyvinylchloride fitting covers may be used in lieu of mitred sections of aluminum jacketing for covering fittings, valves and flanges.

3.07 INSTALLATION OF ENGINE SILENCER EXHAUST PIPE INSULATION

A. Secure insulation in place with wire or galvanized steel bands unless otherwise specified.
   1. Small Areas: Secure insulation with 16 gage wire on maximum 6 inch centers.
   2. Large Areas: Secure insulation with 14 gage wire or 0.015 inch thick by 1/2 inch wide galvanized steel bands on maximum 10 inch centers.

B. Stagger insulation joints.

C. On irregular surfaces, where application of block or board insulation is not practical, insulate with insulating cement built-up to same thickness as adjoining insulation.

D. Fill joints, voids and irregular surfaces with insulating cement, to a uniform thickness.

E. Install aluminum roll jacketing on insulated surfaces of engine silencer, drain pipe and exhaust pipes.

F. Lap longitudinal and circumferential joints a minimum of 2 inches.

G. Secure jacketing in place with 1/2 inch by 0.020 inch thick stainless steel bands and stainless steel wing type seals, on maximum 12 inch centers.

H. Terminate exposed ends of insulation with insulating cement trowelled down to metal surface on a bevel.

I. Insulate exterior surfaces of engine silencer, drain pipe and exhaust pipes as shown on the drawings.

J. Insulate vertical steel exhaust stacks as shown on the drawings.

K. Do not insulate the expansion joints, flexible connectors and engine exhaust manifold.
3.08 FIELD QUALITY CONTROL

A. Field Samples: The Director’s Representative, may at his discretion, take field samples of installed insulation for the purpose of checking materials and application. Reinsulate sample cut areas.

3.09 PIPING AND EQUIPMENT INSULATION SCHEDULE

A. Insulate all hot service piping, equipment, and appurtenances except where otherwise specified.

B. Schedule of Items Not to be Insulated:
   1. Do not insulate the following cold service items:
      a. Actual heat transfer surfaces.
      b. Cold water piping buried in direct contact with ground.
      c. Chromium plated piping, unless otherwise specified.
      d. Flexible vibration eliminators.
      e. Water meters.
      f. Chemical feed piping.
   2. Do not insulate the following hot service piping:
      a. Plated or white metal piping.
      b. Fuel oil fill, fuel oil vent and other unheated fuel oil piping.
      c. Gas piping.
      d. Water and other fluids 81 degrees F to 104 degrees F.
      e. Vent piping to atmosphere from installed exposed in Mechanical Equipment Rooms, and Power Plants, and connected to the following:
         1) Blow-off tanks.
         2) Flash tanks.
         3) Condensate tanks.
   3. Do not insulate the following hot service fittings, valves, flanges and irregular surfaces:
      a. Flanges and unions in Type E, F and G service piping systems.
      b. Hydronic Specialties:
         1) Flow indicators.
         2) Zone control valves.
         3) Air vents.
         4) Air control fittings.
      c. Pressure reducing valves and pilot lines.
      d. Safety and relief valves.
      e. Back pressure valves.
      f. Float chambers and level controllers.
   4. Do not insulate the following hot service equipment:
      a. Actual heat transfer surfaces.
      b. Radiator pumps.
      c. Fuel oil pumps.
      d. Fuel oil blow-off tanks, flash tanks, expansion and compression tanks.
      e. Gas meters.
      k. Equipment manholes, handholes, and cleanouts.
1. ASME stamps, nameplates with manufacturer’s name and model number.
5. Do not insulate items installed under other Contracts.
6. Do not insulate mechanical equipment with a factory applied insulated steel jacket.

3.10 HOT SERVICE INSULATION MATERIAL SCHEDULE

<table>
<thead>
<tr>
<th>TYPE</th>
<th>SERVICE AND TEMPERATURES</th>
<th>INSULATION MATERIAL</th>
<th>PIPE SIZES (INCHES)</th>
<th>MINIMUM (NOMINAL) INSULATION THICKNESS (INCHES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Fuel oil piping (outdoor above ground piping with heat tracing and indoor piping)</td>
<td>Flex. Elastomeric Foam or Fibrous Glass</td>
<td>2-1/2 &amp; Less Over 3</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>B</td>
<td>ENGINE SILENCER, EXHAUST PIPE</td>
<td>Calcium Silicate</td>
<td>4 &amp; Less</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>ENGINE SILENCER DRAIN PIPE</td>
<td>Calcium Silicate</td>
<td>4 &amp; Less</td>
<td>3</td>
</tr>
</tbody>
</table>

A. NOTES:
1. Provide aluminum metal jacketing, in Types A to C insulation.
2. Install insulation per heat tracing manufacturer’s instructions and recommendations in Type A insulation for outdoor above ground heat traced fuel oil piping.

3.11 SCHEDULE OF METAL JACKETING FOR INSULATED PIPE

A. Jacket exposed insulated risers with preformed sectional aluminum metal jacketing, in Types E to H service piping systems, installed in finished rooms or finished spaces above Basement Floor Level.
1. Exception: Preformed sectional aluminum metal jacketing is not required on piping in Mechanical Equipment Rooms, Steam Service Rooms, Penthouse, Mechanical Equipment Rooms and Machine Rooms.

B. Install jacketing from floor to ceiling or from floor to first change of direction in riser, when such change in direction is a minimum of 9'-0” above finished floor, whichever is applicable.
1. The aforementioned also applies to down feed piping systems.

C. General:
1. Jacket exposed insulated piping with preformed sectional aluminum metal pipe jacketing.
D. Piping Exterior to Building: Jacket insulated piping with circumferentially corrugated aluminum jacketing.

1. Lap longitudinal and circumferential joints a minimum of 2 inches.
2. Secure jacketing in place with 1/2 inch x 0.020 inch thick aluminum bands secured with aluminum wing type seals, on maximum 12 inch centers.
3. Cover insulated fittings, valves, and offsets with mitered sections of jacketing. Seal joints with mastic, and secure with aluminum strapping and wing seals.
4. Factory fabricated, preformed fitting covers of same material as jacketing may be used instead of mitered jacketing.
5. Install jacketing so as to avoid trapping condensation and precipitation.

END OF SECTION
SECTION 230933
TEMPERATURE CONTROL SYSTEM – ELECTRIC ELECTRIC

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Control Wiring: Section 260523.
B. Motors: Section 260221.

1.02 SCOPE

A. The work included in this Section shall consist of installation of the complete and operating controls and instrumentation systems and associated specialties as indicated on the Drawings and as required by this Section. The control system shall be complete in all respects with system completeness (turnkey system) for the automatic HVAC control. Control system consists of controllers, control panels, sensors, indicators, actuators, final control elements, interface equipment, other apparatus, wiring, and accessories connected to control system to operate mechanical systems according to sequences of operation as specified in this section. Provide all hardware, software and ancillary components, and wiring not specifically indicated or specified, but necessary to make the system function according to the intent of the specification. The control system contractor shall also be responsible for the proper operation of the control system and shall provide all necessary debugging and calibration. Size all control apparatus to properly supply and/or operate and control the apparatus served. Note that the control specifications in the design documents may be generic or have limited amount interfacing information. Examine not only the plans and specifications for this specification section, but plans and specifications of other related sections and visit the site to become acquainted with all project conditions including existing conditions. The control system shall fully integrate all ventilation controls, temperature controls, fuel oil management system, fuel oil leak detection and leak monitoring system, CO & CH4 gas monitoring, and interfaces to mechanical equipment specified in Division 23. The control system shall have capabilities for remote monitoring and controlling of the systems as stated in this section. Provide a workstation for the control system. The workstation shall be located at the designated location by the facility and shall be IBM-compatible PCs with a minimum of: Intel Core 2 Duo 3 GHz processor; 2 GB RAM; 80 GB hard disk providing data at 100 MB/sec; 24x CD-RW/DVD drive; Serial, parallel, and network communication ports and cables required for proper system operation. Provide interface for future integration with the centralized building control system. Coordinate with electrical PLC controls for fuel oil management system, fuel oil leak detection and leak monitoring system, and CO & CH4 gas monitoring system. The DDC controllers and panels shall be located as indicated on the drawing.
B. Furnish and install a complete electronic system of automatic HVAC controls. The system shall be complete in all respects, including labor, materials, equipment, and services.

C. Verify voltages prior to ordering equipment.

1.03 SUBMITTALS

A. Shop Drawings: Control System Schematic Drawings and Wiring Diagrams.

B. Provide submittals for the following items.

1. DDC Controllers and DDC panels
2. Equipment Controllers
3. Sensors
4. Thermostats
5. Damper and Damper Actuator
6. Miscellaneous
7. Control Wiring
8. Control System Schematic Drawings and Wiring Diagrams
9. Catalog sheets, specifications, standard schematic drawings and installation instructions for each item specified. Include a valve schedule and flow diagram of system.
10. Valve Schedule: List type of valve, manufacturer’s model number, and size for each service application.

C. Contract Closeout Submittals:
1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director’s Representative.

PART 2 PRODUCTS

2.01 MANUFACTURERS/COMPANIES

A. Barber Colman Co.
B. Honeywell Co.
C. Johnson Service Co.

2.02 MATERIALS

A. General:
1. Control diagrams shown on the drawings, in general, indicate the equipment required for the control sequences specified. Variations in the selection of temperature control equipment, which will produce the required control sequences may be submitted for approval.
2. All temperature control equipment shall be the product of one manufacturer, unless otherwise specified.
B  SENSORS: All sensors shall be suitable for specific applications for this project.

1. Electronic Sensors: Vibration and corrosion resistant, for wall, immersion, or duct mounting as required.

   1). Resistance Temperature Detectors: Platinum.
      a. Accuracy: Plus or minus 0.2 percent at calibration point.
      b. Wire: Twisted, shielded-pair cable.
      c. Insertion Elements in Ducts: Use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (1 sq. m).
      d. Averaging Elements in Ducts: Use where ducts are larger than 9 sq. ft. (1 sq. m) or where prone to stratification, length as required.
      e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
      f. Room Sensors: Match room thermostats, locking cover.
      g. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
      h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

   2). Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, temperature compensated.
      a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
      b. Output: 4 to 20 mA.
      c. Building Static-Pressure Range: 0 to 0.25 inch wg (0 to 62 Pa).
      d. Duct Static-Pressure Range: 0 to 5 inches wg (0 to 1243 Pa).

   3). Analog Input/Differential Pressure: Velocity or static pressure transducers shall be NIST traceable, temperature compensated, capacitance pressure sensors. All input transducers shall sized and specified for the particular application it is to be used. Control contractor shall gain submittal data to size said devices. They shall match the input size and range for the controller.
4). Flow Sensor for fluid:
a. Type: Model DNT (1/2 inch to 2 inch sizes) and Model DCR (2 inch to 24 inch sizes) by Dieterich Standard Corp., Boulder, CO.
b. Features:
   i Diamond cross sectional shaped sensing tube which causes flow separation to occur at a fixed point independent of flow rate, pressure or temperature, resulting in stable flow coefficient over a wide range of Reynolds numbers.
   ii Each flow sensing unit complete with blow out proof mounting hardware, instrument shutoff valves and connections for electronic transmitter.
   iii Nameplate: Permanently attached to flow sensor indicating design flow rate, meter reading for design flow rate, metered fluid, line size, and station number or location.
   iv Construction: Rated up to 600 psi ANSI equivalent (1440 psig at 100 degrees F) with type 316L stainless steel sensing element and mounting coupling constructed of material compatible with piping.
   v Accuracy: Flow element shall be within +1 percent of actual flow rate over a minimum flow turndown of 10:1. The bi-directional primary sensing device shall be accurate to within +1 percent.
   vi Repeatability: +0.1 percent of actual valve over flow range.
   vii Differential Pressure Transmitter: Model FCX by ITT Barton.
      a) Consists of silicone based variable capacitance sensor, Type 316 stainless steel body, Hastelloy C isolation diaphragm, silicone fill fluid, and NEMA 4X enclosure with local digital indication in engineering units.
      b) Provides 4 - 20 mA outlet signal and capable of minimum 20:1 turndown with accuracy of +0.1 percent of calibrated span up to 10:1 turndown, including combined effects of linearity, hysteresis and repeatability.
      c) Power Supply: 11 - 45 Vdc two wire.

2. Equipment Operation Sensors: As follows:

1). Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg (0 to 1243 Pa).

2). Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
3). Current Sensing Switch/Current Transducer: Sensor supply voltage and supply current shall be induced from monitored conductor. Contact rating shall be 0.2 amperes at 30 volts DC/AC. Trip setpoint shall be adjustable to +/-1% of range. Current sensing switch wiring shall not be polarity sensitive.

3. Valve/Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank-arm assembly connected to damper to transmit 0 to 100 percent valve/damper travel.

C THERMOSTAT:

1. Low-Voltage Modulating Thermostats: Potentiometer, operated by vapor-filled bellows.

2. Room Thermostat Construction: Modulating key adjustment type with bakelite insulator back plates, cover with accurate thermometer and guard. Provide guard concealing temperature setting and leaving thermometer visible.

D DAMPERS

1. The Building Automation System supplier shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment.

2. Dampers shall be low leakage or high velocity low leakage as specified in the sequence of operations. All proportional dampers shall be opposed blade type. Two position dampers may be opposed or parallel blade type.

3. Damper frames and blades shall be galvanized steel and a minimum of 16 gauge. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of -40 to 200 degrees F.

4. Standard Low Leakage Dampers shall be provided to conserve energy. Dampers shall be equipped with neoprene edge seals and compressible metal jamb seals. Leakage shall not exceed 10 CFM/Sq. Ft. at 4" W.G. differential.

E. DAMPER OPERATORS

1. Damper operators shall be electronic, spring return, low voltage (24VAC) and shall be properly sized to operate with sufficient reserve power to provide smooth modulating action or 2-position action. Actuator response shall be linear in response to sensed load.
DIRECT DIGITAL CONTROL (DDC) EQUIPMENT

1. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; back-up power source; and power line surge protection. The DDC panel(s) shall have been totally programmed and verified as satisfying the requirements of the Sequence of Operation contained hereinafter. However, it shall be possible to reprogram the panels on site either by the ATC Contractor or the Owner. The software programs shall be provided as an integral part of the DDC panel and shall not be dependent upon any higher level computer for execution.

1). Units monitor or control each input/output point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator station.

2). Stand-alone mode control functions operate. Functions include the following:

   a. Global communications.

   b. Discrete/digital, analog, and pulse input/output.

   c. Monitoring, controlling, or addressing data points.

   d. 365-day calendar and scheduling.

   e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

CONTROL PANELS

1. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled.

2. Local Control Panels (LCP): Provide a unitized cabinet assembly, with a hinged panel type locking door designed for installing flush mounted indicating gages and accessories on same, each complete with an identification nameplate. Fabricate panels in sections with back cover, so that basic enclosure can be installed early in construction and front panel door at “finishing stage” of construction. Panels shall enclose all temperature control relays, controllers, switches, temperature indicators, manual positioning switches, accessories and remote hardware for respective control system, and other indicating or manually operated devices on the front face of the panel with suitable engraved nameplates. Factory mount and shop wire all panel mounted equipment to pre-
numbered master terminal strips. Mount panels complete with floor or wall brackets and structural supports, at a height as directed and approved. Provide graphic illustrations of the systems consisting of plastic enclosed flow control diagrams and sequence of operation sheets mounted on panel door

1. Each Standalone DDC Controller shall be able to extend its performance and capacity through the use of remote application specific Local Control Panel (LCP).

2. Each LCP shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each LCP shall be a microprocessor based, multi tasking, real time digital control processor.

3. Each LCP shall have sufficient memory to support its own operating system and data bases including control Processes.

H. MISCELLANEOUS PRODUCT REQUIREMENTS

1. Unless otherwise specified or indicated, the following features are required for the equipment specified:
   1). Modulating Control Valves: Provide with straight line flow characteristics over entire valve range. Control valves shall be suitable for specific applications.
   2). Temperature Controllers: Modulating type with scale range to include temperature setting near center of range.

I  CONTROL WIRING:

1. All control wiring (below 120 volt) shall be provided by the control contractor. Provide wiring to the controls and instrumentation system. Installation shall be in accordance with NEC and Division 26, ELECTRICAL. Wiring shall be installed in conduit. Minimum wire size shall be 14 gauge.

2. Refer to Division 26, ELECTRICAL for conduit requirements.

K  CONTROL SYSTEM SCHEMATIC DRAWINGS AND WIRING DIAGRAMS

1. Provide complete operating data, system drawings, wiring diagrams, written detailed operational descriptions of sequences, and description and engineering data on each control system component. Include sizing as required.
PART 3  EXECUTION

3.01  INSTALLATION

A.  Provide electric-electronic and DDC operated control systems as noted on the drawings and as specified. Provide all necessary relays, mounting brackets, gages, switches and accessories required, even though not specifically called for, so as to result in complete workable systems.

B.  Control Wiring:  Install complete control wiring systems in accordance with applicable electric sections included in this specification.

C.  General Notes:
   1.  Control panels shall be located in Switchgear Room.
   2.  Install separable well sockets for all capillary thermostats thermometers, temperature controllers, sensors and transmitters for piping or tank insertion.
   4.  Test all electric and electronic and DDC equipment provided under this Section.

3.02  PERFORMANCE

A.  Ventilation Fans for Generator Room (EF-1, 2, 3, 4)

   1.  EF-1 and EF-3 are two speed fans. EF-1 shall run at low speed when GENERATOR #1 is running (signaled by equipment status sensor from the generator.) and the generator room temperature is at 82 F or below. EF-1 shall run at high speed when the generator room temperature is above 82 F. EF-1 shall stop when GENERATOR #1 is not running (signaled by equipment status sensor from the generator.) and the generator room temperature is below 80 F. EF-3 shall run at low speed when GENERATOR #2 is running (signaled by equipment status sensor from the generator.) and the generator room temperature is at 82 F or below. EF-3 shall run at high speed when the generator room temperature is above 82 F. EF-3 shall stop when GENERATOR #2 is not running (signaled by equipment status sensor from the generator.) and the generator room temperature is below 82 F. EF-2 and EF-4 shall run when the generator room temperature is above 85 F, and EF-2 and EF-4 will stop when the generator room temperature is at 82 F or below.

   2.  The associated motor operated fan damper and louver damper shall be interlocked with each fan. The dampers shall be open when its fan is started and shall be closed when its fan is stopped. The motorized damper with LV-1 shall be interlocked with EF-1, the motorized damper with LV-2 shall be interlocked with EF-2, the motorized damper with LV-3 shall be interlocked with EF-3 and the motorized damper with LV-4 shall be interlocked with EF-4.
3. Fan Failure Mode. Current monitoring relay shall monitor for fan failure. Upon detection of a failure an alarm signal shall be sent to control system operator.

B. Ventilation Fans for Switchgear Room (EF-5, 6)

1. EF-5 is a two speed fan. EF-5 shall run at low speed when the switchgear room temperature is at 82°F or below. EF-5 shall stop when room temperature is below 80°F. EF-5 shall run at high speed when the switchgear room temperature is above 85°F. EF-6 shall run when the switchgear room temperature is above 85°F. EF-6 shall stop when the switchgear room temperature is below 85°F.

2. The associated motor operated fan damper and louver damper shall be interlocked with each fan. The dampers shall be open when its fan is started and shall be closed when its fan is stopped. The motorized damper with LV-5 shall be interlocked with EF-5, and the motorized damper with LV-6 shall be interlocked with EF-6.

3. Fan Failure Mode. Current monitoring relay shall monitor for fan failure. Upon detection of a failure an alarm signal shall be sent to control system operator.

D. Fuel Oil Pumps (FOP-1, 2, & 3)

1. Normal Mode.
   a. When the high & low level sensor on Daytank 1 senses a low level condition, fuel oil pump FOP-1 is to start up and provide fuel oil from Main Storage Tank 1. When the high & low level sensor senses a high level condition, FOP-1 is to stop.

   b. When the high & low level sensor on Daytank 2 senses a low level condition FOP-2 is to start up and provide fuel oil from Main Storage Tank 2. When the high & low level sensor senses a high level condition FOP-2 is to stop.

2. Failure Mode.
   a. When the Daytank 1 high-high level sensor senses a excessively high level condition, solenoid valve SV-1 is to close and the fuel oil return pump from Daytank #1 is to start up and return fuel oil to the Main Storage Tank 1. If the same condition is sensed by the high-high level sensor in Daytank 2, SV-2 is to close and the fuel oil return pump from Daytank #2 is to start up and return fuel oil to the Main Storage Tank 2.

   b. When the level sensor in Main Storage Tank 1 senses a low level, the appropriate solenoid valves are to open and close allowing FOP-1 to transfer fuel oil from main storage tank 2 to Daytank 1. This sequence is opposite for Main Storage Tank 2.
c. If at any point either of the two main fuel oil pumps FOP-1 or FOP-2 fail to operate, the appropriate solenoid valves are to open and close to allow FOP-3 to be able to be used to provide fuel oil to Daytanks 1 or 2 from Main Storage Tanks 1 or 2.

3. Alarms:
   a. An alarm is to be sent to the control system upon identification of any abnormal condition as stated above.
   b. An alarm is to be sent to the control system upon detection of fuel oil leak from any fuel oil containment sumps from the fuel oil piping system and storage tanks.

E. Fuel Oil Filtration (FOF-1, 2)
   1. Normal Mode.
      a. FOF-1 shall automatically cycle for filtration of fuel oil from Main Storage Tank 1 based on the time of day and the day of the week (as directed by the facility) to ensure continuous fuel maintenance.
      b. FOF-2 shall automatically cycle for filtration of fuel oil from Main Storage Tank 2 based on the time of day and the day of the week (as directed by the facility) to ensure continuous fuel maintenance.
   2. Failure and Alarms:
      a. FOF-1/FOF-2 shall be shutdown when the following occur: filter water level “High”, filter “Saturated”, system base “Leak” detected.
      b. An alarm is to be sent to the control system upon identification of any alarming condition as stated above.

F. CO & CH4 Gas Monitors (QTY: 2 as shown on the plan)
   The combination CO and CH4 gas monitor, KELE Model GDS Series Gas Detector, or approved equal shall monitor the space CO level and methane (CH4) level. The gas monitor shall activate the alarms when the gas monitor detects the space CO level at 25 ppm or above, or when the gas monitor detects the space methane (CH4) level at 500 ppm or above. The gas alarms shall be sent to the control system upon identification of any alarming condition as stated above. The alarms shall be monitored by HVAC DDC control system and Electrical PLC controls.

G. Temperature Monitoring for Generator Equipment Room and Switchgear Room
   1. Provide one temperature sensor in each room to monitor the room temperature. Alarm shall be sent to the control system if the sensors sense the temperature in any room below 40 F (adjustable). The temperature sensor should be wall-mounted type.
3.03 FIELD QUALITY CONTROL

A. Provide the services of a qualified engineer, in the employ of the control systems manufacturer, for the initial start-up and calibration of control systems, and the instruction of State Personnel.

B. Upon completion of the installation, adjustment and operational testing of control systems, a Company Field Advisor in the employ of the control systems manufacturer, shall for a period of 16 hours, instruct duly authorized State Personnel in the operation and maintenance of the installed systems. The aforementioned hours of instruction shall not include any time spent by field engineers in the start-up, adjustment or calibration of the systems, and this instruction time shall be as scheduled and recorded by the Director’s Representative.

END OF SECTION
SECTION 231010

FUEL FILTRATION SYSTEM

PART 1 GENERAL

1.01 REFERENCES

A. NFPA 30 - Flammable and Combustible Liquids Code.
B. NFPA 30A - Automotive and Marine Service Station Code.
C. NFPA 31 - Oil Burning Equipment.
D. Underwriter’s Laboratories (UL).
E. ETL Testing Laboratories (ETL).
F. Factory Mutual Engineering and Research (FM).

1.02 DEFINITIONS

A. Fuel Filtration System for No. 2 Diesel Fuel Oil in compliance with the applicable requirements of UL 2085, NFPA 30 and NFPA 30A: Fuel Filtration system shall including leak containment and detection and underground piping, alarms, gage system, and required valves, piping, accessories, including interconnection control and power wiring.

1.03 SUBMITTALS

A. Waiver of Submittals: The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.
B. Submittals Package: Submit the Product Data, and Quality Control Submittals specified below at the same time as a package.
C. Product Data: Catalog sheets, specifications, illustrations, wiring diagrams, and installation instructions for each item specified for each type of system.
D. Quality Control Submittals:
   1. Fuel Filtration System Installation Contractor’s Qualifications Data:
      a. Name of Contractor, business address and telephone number.
b. Names and addresses of 3 similar projects that the Contractor has worked on during the past 5 years.

2. Pipe Installer’s Qualifications Data:
   a. Name of each person who will be performing the Work and their employer’s name, business address and telephone number.
   b. Names and addresses of 3 similar projects that each person has worked on during the past 5 years.
   c. Copy of certification from pipe manufacturer(s).

3. Factory Test Certificate: For each tank.

4. Company Field Advisor Data:
   a. Name, business address and telephone number of Company Field Advisor secured for the required services.
   b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
   c. Services and each product for which authorization is given by the Company, listed specifically for this project.

E. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Two copies, covering the installed products.
   2. Warranty: Copy of specified warranty.
   3. Fuel Filtration System Manufacturer Installation Check List: Two copies.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Fuel Filtration System Installation Contractor: The firm performing the Work of this Section shall have been regularly engaged in the installation and maintenance of fuel filtration systems for a minimum of 5 years, and shall have completed 3 similar projects.
   2. Pipe Installer: Individual with minimum 5 years experience in installing underground fuel piping, have worked 3 similar projects, and shall be certified by pipe manufacturer of the type of pipe being installed.

B. Listings: Components of the system(s) for which Underwriters’ Laboratories, Inc. (UL) provides product listing service, shall be listed and bear the listing mark.

C. Company Field Advisor:
   1. Secure the services of a Company Field Advisor of the manufacturer of fuel filtration system for a minimum of two 2 hour training sessions to train facility personnel in the operation and
maintenance of the system. Schedule training sessions with the Director’s Representative.

1.05 WARRANTY

A. Warranty: Five year manufacturer’s warranty for fuel filtration system.

1.06 MAINTENANCE

A. Spare Parts:
   1. Three primary and three secondary replacement filter elements shall be provided.
   2. A digital flow meter (counter) shall be provided to be externally mounted and display total amount of fuel processed.

PART 2 PRODUCTS

2.01 FUEL QUALITY MAINTENANCE SYSTEM

A. Acceptable Manufacturer:
   a. Model PF by Preferred Utilities Mfg. Corp. Danbury, CT.
   b. Model No. STS 6000
   c. Algae-X International
      5400-1 Division Drive
      Fort Myers, FL 33905
   d. Tel. No.’s: 877 425 4239; 239 690 9589
   e. Web Address: www.algae-x.net

B. Description: Single, stand alone, factory complete, automatic, programmable turn key fuel filtration and maintenance system shall be provided for each diesel fuel storage tank. The system shall be capable of removing water, sediment, particulate and microbial contamination below levels stated in ASTM D 975 (Standard Specification for Diesel Fuel Oils).

C. Enclosure: All system components shall be contained within a powder coated, weatherproof, outdoor UL 50 listed enclosure with appropriate ventilation. Hinged front door shall be equipped with quarter turn key lockable handle. Drip tray with leak detection shall be installed. Literature pocket and brackets for wall or rack mounting to be included.

D. Plumbing: System shall be furnished with shutoff ball valves on the inlet and outlet for easy filter / water separator maintenance. A see through flow meter shall be installed to observe fuel flow and flow rate.
Above mentioned components shall be located within the enclosure. All internal plumbing stainless steel.

E. Filtration / water separation: 4 stage filtration / water separation process:
   a. Stage 1: Centrifugal water and particulate separation
   b. Stage 2: Coalescing water (99.9% water removal) and 30 micron particulate filter element – with water detection sensor and “push and turn” safety drain valve
   c. Stage 3: LG-X Fuel Conditioner – to break down sediments and solids naturally forming in diesel fuel to submicron levels
   d. Stage 4: Secondary 3 Micron particulate and water absorbing spin-on filter
   e. Primary and secondary filter shall be equipped with liquid filled, stainless steel gauges.

F. Controls / Display functions: System control features, indicator lights and emergency stop button shall be located on a descriptive external control panel on the front door of the enclosure for easy operator access. Additional alarm and system status information shall be displayed inside system on PLC text screen. System shall provide following control and display function:
   a. Programmable Digital Timer – Memory backup to retain program memory during power outages
   b. Pump operating hour counter
   c. Pump control switch (Auto-Off-Manual), weatherproof, key operated, front access
   d. Alarm Reset - weatherproof push button, external access
   e. Power available indicator, green indicator, external display
   f. Pump running indicator, amber indicator, external display
   g. High vacuum, high pressure, no flow, high water alarm and leak detection, red indicator, external display
   h. Emergency stop mushroom push button, red, latching - turn reset, external access

G. Electrical enclosure/Controller: All electrical control features shall be contained within a separate UL 508A listed industrial control panel located within the mechanical enclosure. The controller shall monitor the following system alarm points:
   a. Leak in enclosure detection (system shutdown)
   b. Primary filter high vacuum sensor (system shutdown)
   c. Primary filter high water sensor (system shutdown)
   d. Secondary filter high pressure sensor (system shutdown)
e. Flow switch (system shutdown after priming delay)

f. External system shut down input

H. Pump: Positive displacement, rotary type gear pump, direct coupled, cast iron housing, with built in pressure relief bypass valve, shall be 480 GPH capacity at minimum.

I. Motor: UL, TEFC, Thermal overload protection

J. Performance / Design Criteria: System shall be capable to turn complete tank volume over once a month with a required run time of no more than 48 hour. Sufficient dirt as well as water holding capacity should be ensured.

K. Operation: System shall provide dry contacts for summary alarm and leak detection to interface with building monitoring or alarm system. An external shut down feature shall be provided to disable or control pump operation from remote point.

L. The system shall have the capacity to make two complete changes of bulk stored diesel fuel per month for each 10000 storage gallon tank.

2.15 FUEL FOR TESTING

A. Coordinate with the Facility thru the Director’s Representative for the delivery of a full tank of each appropriate fuel type for testing to verify that fuel filtration equipment and instrumentation is operating properly.

2.17 FASTENERS

A. Vandal Resistant Fasteners: Stainless steel, allen or torx head, both with center post.

PART 3 EXECUTION

3.01 PREPARATION

A. Testing Prior to Installation:
   1. Before placing the fuel filtration system in place, check manufacturer furnished literature/drawings to ensure product compliance in accordance to approved submittals.

3.02 INSTALLATION

A. Install the Work of this section in accordance with manufacturer’s printed installation instructions, unless otherwise shown or specified.

B. System supply and return lines are to be black iron pipe. Reducers, elbows, or other piping restrictions are to be avoided where possible. The fuel filtration system shall be located as close as possible to the bulk storage tanks.
C. System shall provide male pipe connections protruding the enclosure for external connections.

D. System shall be located as close as possible to designated fuel tanks.

E. The fuel oil supply and return lines to the system shall be independent and separate from other fuel lines with the supply line originating at the bottom of the tank in the deepest spot and the return line as far away as possible from the supply line in the tank.

### 3.04 FIELD QUALITY CONTROL

A. Testing: After installation of fuel filtration system complete with associated piping and controls, test the system in the presence of the Director’s representative.

1. Fuel System for No. 2 Fuel Oil:
   a. After reconnecting all piping and control/monitoring systems, and when directed, perform a system acceptance test in the presence of the Director’s Representative to demonstrate that the fuel filtration system is operating properly.
   b. Make required repairs and final adjustments.

**END OF SECTION**
PREFUNCTIONAL CHECKLIST

ELMIRA CORRECTIONAL FACILITY - EMERGENCY GENERATOR

PC-M- [ ] - DIESEL FUEL FILTRATION SYSTEM

Components Included:

- Strainers
- Filters
- Coalescing Filter
- Piping
- Supports
- Cabinet
- Wiring
- Piping
- Controls
- Fuel Pumps

Associated Checklists:

- Electrical
- Fuel Pumps

1. Submittal/Approvals:

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

____ List attached.

<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Date</th>
<th>Manufacturer / Vendor</th>
<th>Date</th>
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<tr>
<td>Electrical</td>
<td>Date</td>
<td>General Contractor</td>
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Prefunctional checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor, sub-contractor, trade or vendor responsible to verify completion of this item. A/E = Architect/Engineer, All = All Contractors, CA = Commissioning Agent, CC = Controls Contractor, EC = Electrical Contractor, GC = General Contractor, MC = Mechanical Contractor, SC = Sheet Metal Contractor, TAB = Test and Balance Contractor, M/V = Manufacturer/Vendor.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted.

| Commissioning Agent | Date | Owner's Representative | Date |

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2. **Requested Documentation Submitted:**

Check if Okay. Enter comment or note number if deficient.

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<th>Check</th>
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<td>Manufacturer's cut sheets.</td>
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<td>Performance data (pump curves, etc.).</td>
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<td>Installation and startup manual and plan.</td>
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<td>Sequences and control strategies.</td>
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<td>O&amp;M manuals.</td>
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<td>Performance data.</td>
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<td>Operating manual.</td>
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<td>Complete control Drawing.</td>
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<td>Design Criteria.</td>
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Documentation complete as per contract documents for given trade. ______ Yes ______ No

3. **Model Verification:**

1 = As Specified, 2 = As Submitted, 3 = As Installed. Check if Okay. Enter note number if deficient.

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Model 1 2 3

| Serial # | 3 |

The equipment installed matches the specifications for given trade. ______ Yes ______ No

4. **Diesel Fuel Filtration System Check:**

Check if Okay. Enter comment or note number if deficient.

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<tr>
<th>Check</th>
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<tr>
<td>General appearance good, no apparent damage.</td>
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<td>Equipment labels affixed.</td>
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<td>Layout per manufacturer's recommendations.</td>
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<td>All equipment, materials and methods of installation are in compliance with NFPA 30, NFPA 30A and NFPA 31.</td>
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<tr>
<td>All equipment, components and materials required by the specifications and contract documents are identified with the appropriate Underwriters Laboratories (UL) listing.</td>
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<tr>
<td>The complete No.2 Diesel Fuel Oil filtration system meets the requirements of UL 2085.</td>
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<td>The installed equipment will maintain the diesel fuel contamination levels below the stated values of ASTM D 975.</td>
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231010.1 - 2

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The fuel filtration system installation contractor is fully qualified to perform the work associated with this type of equipment. The contractor has been engaged in the installation and maintenance of fuel filtration systems for a minimum of five years and has completed three similar projects.

The piping installers have a minimum of five years in installing underground fuel piping systems and have worked on three similar projects. The piping installers have been certified by the piping system manufacturer.

The manufacturer has provided the services of a Company Field Advisor to supervise the installation of the equipment and fuel piping system.

The NEMA 3R weatherproof Control Panels are UL508A listed and properly mounted and equipped with vandal resistant hardware.

The four stage water and particulate removal system is equipped with strainers and filters to remove microbial contamination, water, sludge and particulates down to 3 micron.

The positive displacement gear pump and continuous duty motor assembly is fully operational.

The leak detection system is installed and is operational.

The high vacuum, high filter pressure, leak and flow interruption detection and alarm controller functions are operational.

All safety and operational controls, indicators, displays and devices are installed and functioning.

Spare parts provided.

Wiring labeled.

Control components labeled /tagged.

110 volt AC power available to panel.

Service space and clearances in compliances with manufacture.

Sensors calibrated.

Panels properly grounded.

Operator interface operational.

<table>
<thead>
<tr>
<th>Check</th>
<th>Equip Tag-&gt;</th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The fuel filtration system installation contractor is fully qualified to perform the work associated with this type of equipment. The contractor has been engaged in the installation and maintenance of fuel filtration systems for a minimum of five years and has completed three similar projects.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The piping installers have a minimum of five years in installing underground fuel piping systems and have worked on three similar projects. The piping installers have been certified by the piping system manufacturer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The manufacturer has provided the services of a Company Field Advisor to supervise the installation of the equipment and fuel piping system.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The NEMA 3R weatherproof Control Panels are UL508A listed and properly mounted and equipped with vandal resistant hardware.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The four stage water and particulate removal system is equipped with strainers and filters to remove microbial contamination, water, sludge and particulates down to 3 micron.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The positive displacement gear pump and continuous duty motor assembly is fully operational.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The leak detection system is installed and is operational.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The high vacuum, high filter pressure, leak and flow interruption detection and alarm controller functions are operational.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All safety and operational controls, indicators, displays and devices are installed and functioning.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spare parts provided.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wiring labeled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control components labeled /tagged.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110 volt AC power available to panel.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service space and clearances in compliances with manufacture.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensors calibrated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panels properly grounded.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator interface operational.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The checklist items of Part 4 are all successfully completed for given trade. _____ Yes _____ No

Notes:

END OF CHECKLIST
FUNCTIONAL TEST PROCEDURE

ELMIRA CORRECTIONAL FACILITY - EMERGENCY GENERATOR

FTP-M-[ ] - DIESEL FUEL FILTRATION SYSTEM

Associated Equipment:

- Fuel Filter
- Control Panel
- Pump
- Piping
- Associated Checklists:
- Fuel Pumps
- Controls
- Electrical Power

1. Participants:

<table>
<thead>
<tr>
<th>Party</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Party filling out this form and witnessing testing:

Date of Test:

2. Prerequisite Checklist:

a. The following have been started up and startup reports and pre-functional checklists submitted and approved ready for functional testing:

- Diesel Fuel Pumps
- Controls
- Electrical Power System

b. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

Controls Contractor Signature: __________________________
Date: __________________________

c. Fuel piping system tested and required reports approved.
d. Fuel filter system is complete and operational.
e. All A/E punch list items for this equipment corrected.
f. The functional test procedures reviewed and approved by installing contractor.
g. Safeties and operating ranges reviewed.
h. Test requirements and sequences of operation attached.

i. Schedules and setpoints attached.

j. Have all energy savings control strategies, setpoints and schedules been incorporated that this equipment and control system are capable of? If not, list recommendations below.

k. Control Program Review. Review the software control program(s) for this equipment. Parameters, setpoints and logic sequences appear to follow the specified written sequences.

l. Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays, Lockouts, Schedules, Etc. Changed to Accommodate Testing.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pre-Test Values</th>
<th>Returned to Pre-Test Values</th>
<th>Parameter</th>
<th>Pre-Test Values</th>
<th>Returned to Pre-Test Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge pressure</td>
<td></td>
<td></td>
<td>Particulate filter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High vacuum alarm setpoint</td>
<td></td>
<td></td>
<td>Coalescing water %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter pressure drop setpoint</td>
<td></td>
<td></td>
<td>Secondary filter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Sensor Calibration Checks: Check the sensors listed below for calibration and adequate location. This is a sampling. Check if Okay. Enter comment if not.

<table>
<thead>
<tr>
<th>Device</th>
<th>Device Calibrated</th>
<th>Device Location Appropriate</th>
<th>Comment</th>
<th>Verified Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge pressure setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High vacuum alarm setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter pressure drop setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No flow setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High pressure setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High water setpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leak detection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Start-Up Installation Test: Check if Okay. Enter comment if not.

<table>
<thead>
<tr>
<th>Item</th>
<th>Procedure</th>
<th>Observation</th>
<th>Comment</th>
<th>Verified (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piping connections</td>
<td>Verify connections eliminate vibrations into piping.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical connections</td>
<td>Flexible conduit provided to limit vibration.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe supports</td>
<td>Piping supported to eliminate stresses on piping connections to equipment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure gauges and sensors</td>
<td>Devices installed and operational.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Diesel Fuel Filtration System Functional Test Procedure

**FTP-M-[ ]**

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## Item Procedure Observation Comment Verified (Y/N)

<table>
<thead>
<tr>
<th>Pumps</th>
<th>Pumps are operational and under control.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical power</td>
<td>Voltage within 5% of nameplate.</td>
</tr>
<tr>
<td>Circuit breaker</td>
<td>Circuit breaker rating sized properly for equipment.</td>
</tr>
</tbody>
</table>

## 5. System DFFS-1 Operational Test Record:

<table>
<thead>
<tr>
<th>Item</th>
<th>Test Procedure</th>
<th>Result</th>
<th>Comment</th>
<th>Pass (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Command filter pump to start.</td>
<td>Positive displacement pump 10 GPM flow rate confirmed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Display timer program.</td>
<td>Pump starts and stops per the predetermined schedule. Duration should be capable of providing two complete changeovers of bulk stored diesel fuel per month.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Display retained timer program memory with power outage.</td>
<td>The system returns to the reset time intervals once power is returned.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Display operating hour counter.</td>
<td>Counter indicates total hours of pump operation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Operate system in auto and manual modes.</td>
<td>System operates as normal in manual and automatic modes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Display all indicating pilot lights during normal operation.</td>
<td>All pilot lights are properly displayed for the modes of operation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Simulate high vacuum condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Simulate high pressure condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Simulate no flow condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Simulate high water condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## DIESEL FUEL FILTRATION SYSTEM FUNCTIONAL TEST PROCEDURE

### FTP-M-[ ]

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(New 09/01/10)

<table>
<thead>
<tr>
<th>Item</th>
<th>Test Procedure</th>
<th>Result</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.</td>
<td>Simulate leak detection condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Record all alarm and leak detection indicators on the BMS.</td>
<td>All predetermined points are indicated at the BMS.</td>
<td></td>
</tr>
</tbody>
</table>

### System DFFS-2 Operational Test Record:

<table>
<thead>
<tr>
<th>Item</th>
<th>Test Procedure</th>
<th>Result</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Display timer program.</td>
<td>Pump starts and stops per the predetermined schedule. Duration should be capable of providing two complete changeovers of bulk stored diesel fuel per month.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Display retained timer program memory with power outage.</td>
<td>The system returns to the reset time intervals once power is returned.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Display operating hour counter.</td>
<td>Counter indicates total hours of pump operation.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Operate system in auto and manual modes.</td>
<td>System operates as normal in manual and automatic modes.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Display all indicating pilot lights during normal operation.</td>
<td>All pilot lights are properly displayed for the modes of operation.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Simulate high vacuum condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Simulate high pressure condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Simulate no flow condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Simulate high water condition and alarm indications.</td>
<td>Alarm noted.</td>
<td></td>
</tr>
</tbody>
</table>
**Item** | **Test Procedure** | **Result** | **Comment** | **Pass (Y/N)**
---|---|---|---|---
12. | Simulate leak detection condition and alarm indications. | Alarm noted. | | |
14. | Record all alarm and leak detection indicators on the BMS. | All predetermined points are indicated at the BMS. | | |

Note: Refer to attached startup and water treatment reports.

**Notes:**

**END OF TEST PROCEDURE**
SECTION 231100
LIQUID FUEL PIPING AND SPECIALTIES

PART 1   GENERAL

1.01   RELATED WORK SPECIFIED ELSEWHERE

A. Thru Through Penetration Firestops: Section 078400.

1.02   SUBMITTALS

A. Product Data:
   1. Catalog sheets and specifications indicating manufacturer’s name, type, 
      applicable reference standard, schedule, or class for specified pipe and 
      fittings.
   2. Material Schedule: Itemize pipe and fitting materials for each specified 
      application in Pipe and Fittings Schedule in Part 3 of this Section.
      Where optional materials are specified indicate option selected.

B. Quality Control Submittals:
   1. Brazer Qualification Data: Copies of certification; include names, home 
      addresses and social security numbers of brazers.
   2. Welder Qualification Data: Copies of certification; include names, home 
      addresses and social security numbers of welders.

1.03   QUALITY ASSURANCE

A. Qualification of Brazers: Comply with the following:
   1. The persons performing the brazing and their supervisors shall be 
      personally experienced in brazing procedures.

B. Qualifications of Welding Procedures, Welders and Welding Operators: Comply 
   with the following:
   1. American Welding Society Standard AWS B2.1

PART 2   PRODUCTS

2.01   STEEL PIPE AND FITTINGS

A. Steel Pipe for Threading: Standard Weight, Schedule 40, black or galvanized; 
   ASTM A 53, or ASTM A 135.

B. Malleable Iron, Steam Pattern Threaded Fittings:
   1. 150 lb Class: ASME B16.3.

C. Unions: Malleable iron, 250 lb class, brass to iron or brass to brass seats.
D. Couplings: Same material and pressure rating as adjoining pipe, conforming to standards for fittings in such pipe. Use taper tapped threaded type in screwed pipe systems operating in excess of 15 psig.

E. Nipples: Same material and strength as adjoining pipe, except nipples having a length of less than one inch between threads shall be extra heavy.

F. Flanges, Welding Neck Type, Same Pressure Rating as Adjoining Pipe: ASME B16.5.

G. Weld Fittings, Carbon Steel:
      a. Allied Piping Products Co., Inc.’s Branchlets, Type 1 or 2.
      b. Bonney Forge Corp.’s Weldolets.
   2. Socket Welding Type: ASME B16.11.
      a. Allied Piping Products Co., Inc.’s Branchlets, Type 1 or 2.
      b. Bonney Forge Corp.’s Thredolets or Sockolets.

2.02 COPPER TUBING AND FITTINGS

A. Copper Tube, Types K and L: ASTM B 88.

B. Wrot Copper Tube Fittings, Solder Joint: ASME B16.22.

C. Cast Copper Alloy Tube Fittings, Solder Joint: ASME B16.18.

D. Flared Tube Fittings:
   1. Automotive Tube Type: SAE JS12.

2.03 JOINING AND SEALANT MATERIALS

A. Fuel Resistant Thread Sealant:
   1. Rectorseal Corp.’s Rectorseal No. 5.
   2. EMCO Wheaton Inc.’s Joint Seal.

B. Brazing Alloys:
   1. Type 1: AWS A5.8, Class BCuP-5, for brazing copper to brass, bronze, or copper; Engelhard’s Silvaloy 15, J.W. Harris Co. Inc.’s Stay-Silv 15, and Handy & Harman’s Sil-Fos.
   2. Type 2: AWS A5.8, Class BAg-7, for brazing copper to steel or stainless steel; Engelhard’s Silvaloy-56T, J.W. Harris Co. Inc.’s Safety-Silv 56, and Handy & Harman’s Braze 560.

C. Brazing Flux: FS O-F-499, Type B; Handy & Harman’s Handy Flux or J.W. Harris Co. Inc.’s Stay-Silv.

D. Joint Packing:
E. Anti-Seize Lubricant: Bostik Inc.’s Never Seez or Dow Corning Corp.’s Molykote 1000.

F. Electrodes and Welding Rods:
   1. Electrodes for Use in Arc Welding: Heavily coated, not larger than 3/16 inch diameter exclusive of coating, unless otherwise approved.
   2. Welding Rods: Free flowing when fused, so as to avoid excessive puddling.
   3. Electrodes for Welding Stainless Steels: Coated and used with reverse polarity.
   4. Filler material shall conform to the appropriate AWS-ASTM specification.

G. Corrosion Protective Tape System: 3M Co., St. Paul, MN.
   1. Tape: Scotchrap 50 or 51.
   2. Primer: Scotchrap pipe primer.

2.04 PACKING MATERIALS FOR BUILDING CONSTRUCTION PENETRATIONS


B. Mechanical Modular Seals: Thunderline Corp.’s Link Seal wall and floor seals designed for the service of piping system in which installed.

2.05 PIPE SLEEVES

A. Type A: Schedule 40 steel pipe.

B. Type B: No. 16 gage galvanized sheet steel.

2.06 FLOOR, WALL AND CEILING PLATES

A. Cast Brass: Solid type with polished chrome plated finish, and set screw.
   1. Series Z89 by Zurn, 929 Riverside Drive, Grosvenordale, CT 06255, (800) 243-1830.

B. Cast Iron or Malleable Iron: Solid type, galvanized finish, with set screw:

2.07 REINFORCED THERMOSETTING RESIN PIPING (RTRP)

A. UL listed for conveying flammable petroleum products underground.
B. Conform with ASTM D 2310, Classification RTRP-11; and ASTM D 2996, Classification RTRP-11.

C. Fittings and Joining Materials: Comply with the RTRP Manufacturer’s recommendations for the intended service.

2.08 POLYETHYLENE CONTAINMENT PIPING AND FITTINGS

A. Acceptable Piping: OPW Pices II AXP Access Pipe.

B. Piping: Double wall corrugated, crush and puncture resistant, high density polyethylene.

C. Fittings, Seals, and Joining Materials: Comply with the pipe manufacturer’s recommendations.

2.09 FLEXIBLE PRIMARY PIPING

A. Acceptable Piping: OPW Pices II Primary Pipe.
   1. Double Wall: PVDF inner barrier layer, tie layer, PVDF outer barrier layer, PVDF secondary jacket, with stainless steel swage couplers

B. UL 1971 listed for underground service with petroleum products.

2.10 FLEXIBLE COUPLINGS FOR CONTAINMENT PIPING

A. Type: Flexible PVC construction with stainless steel hose clamps, and sized to match secondary containment pipe diameter.

2.11 FLEXIBLE CONNECTIONS FOR FUEL OIL PIPING

A. Underground Application:
   1. Acceptable Companies:
      a. Teleflex Inc., Windsor, CT.
      b. Titeflex Inc., Springfield, MA.
   2. Features:
      a. Construction: Convoluted PTFE innercore covered with braided type 304 stainless steel outer jacket.
      b. UL listed for underground fuel storage tank systems.
      c. Permanently crimped stainless steel collars with one threaded end and one threaded swivel end.

B. Underground or Above Ground Application:
   1. Acceptable Companies:
      a. Anamet Inc., Waterbury, CT.
      b. Titeflex Inc., Springfield, MA.
   2. Features:
      a. Construction: Convoluted, Type 321 stainless steel inner core, minimum .012 inch wall thickness covered with braided Type 304 stainless steel outer jacket.
b. UL listed for above ground and underground use.
c. Factory installed male swivel on one end.

2.12 FLEXIBLE CONNECTION ISOLATION JACKET

A. Type: High density polyethylene flexible tube with Buna-N rubber compression seals, air valve stem, and stainless steel clamps; Titeflex Inc.’s Model 111466-1.

2.13 TEST BOOTS

A. Flexible pelethane reducer clamp with air valve stem; OPW PTB-2 series.

2.14 FIBERGLASS REINFORCED PLASTIC CONTAINMENT SUMP

A. Sump shall be constructed of fiberglass reinforced plastic (FRP) that is chemically compatible with the fuels to be handled. Do not connect sump in any way to the manway cover or concrete above. Cap the top of each containment sump with a friction fit watertight access cover. Construct cover of the same material as the sump. Cover shall have a minimum diameter of 22 inches. Cover shall be easily removable through the manway above.

1. Rainfall drainage shall not drain into a sump. Sump shall be capable of withstanding underground burial loads to be encountered. Container shall have a minimum 15 gal fuel storage capacity. Container shall not contain any type of drain.

2. The sides of a containment sump shall allow the penetration of carrier pipes, exterior containment pipes, conduits, and vapor pipes as required. Boot or seal penetrations in the containment sump sides to ensure that liquid will not escape from the sump in the event that the liquid level within the sump rises above the pipe penetration. Provide boots and seals that are chemically compatible with the fuel to be handled and that are water resistant to the influx of ground water. Boots and seals shall be designed and installed to accommodate the anticipated amount of thermal expansion and contraction in the piping system.

2.15 FUEL OIL SPECIALTIES

A. Anti-Syphon Valve

1. Furnish and install inside the building, at the high point of the oil suction line, from each fuel oil tank, a U.L. listed and labeled Anti-Syphon Valve per NFPA 30 Flammable and Combustible Liquids Code. Valves that do not have a Underwriters Laboratory certification, listing and label and do not conform to Local, State and Federal Fire Codes shall not be acceptable. The installing contractor shall assume all liability for the installation of this valve and shall certify to the consulting engineer that a U.L. tested and labeled anti-syphon valve has been supplied and installed per manufacturer’s instructions. Anti-Syphon valves supplied without a U.L. label shall be removed and a U.L. certified valve installed at the contractor’s expense. The valve shall be sized to meet the flow...
requirements of the system and piping and shall be equipped with a spring to match the vertical distance between the highest oil storage level, of the main tank, and the inlet to the fuel oil pumps. Valve shall be Model A Anti-Syphon Valve Preferred Utilities Mfg. Corp. Danbury, CT, or approved equal.

B. Duplex Fuel Oil Strainer
1. Furnish and install where shown duplex fuel oil strainer. Strainer shall have one piece cast iron body (ASTM A-126), and shall be hydrostatically tested to U.L. quality control specifications. The strainer baskets shall be constructed of (1/16" perforated, 40 mesh & 100 mesh stainless steel. Strainer shall be Model 72 by Preferred Utilities Mfg. Corp., Danbury, CT or approved equal.

C. Fusomatic Gate Valve
1. Furnish and install where shown on contract drawings a quick-closing, spring-loaded and thermally-actuated fusible element that melts at 165° F causing the valve to close tightly. The valve shall be Fusomatic Gate Valve or Model 110 Lever Gate Valves by Preferred Utilities Mfg. Corp., Danbury, CT, or approved equal.

D. Overfill Prevention Valves
1. Provide and install, in the tank fill pipe. The unit shall have a float-operated, two-stage valve system. The main valve shall shut-off at approximately 95% of the tank capacity leaving a small bypass valve open to permit hose drain down. At approximately 98% capacity, the bypass valve will close completely to shut off all flow.
   2. Valve Body: Cast Aluminum
   3. Float: Nitrile rubber
   4. Closed Cell Foam
   5. Valve: Aluminum
   6. Seals: Viton
   7. Upper and Lower Drop Tubes: Aluminum
   8. The valve shall be Model 71 Overfill Prevention Valve system by Preferred Utilities Mfg. Corp., Danbury, CT, or approved equal.

PART 3   EXECUTION

3.01 INSTALLATION

A. Install piping at approximate locations indicated, and at maximum height.

B. Install piping clear of door swings, and above sash heads.

C. Make allowances for expansion and contraction.

D. Allow for a minimum of one inch free air space around pipe or pipe covering, unless otherwise specified.
E. Install horizontal piping with a constant pitch, and without sags or humps.

F. Install vertical piping plumb.

G. Use fittings for offsets and direction changes, except for Type K soft temper water tube.

H. Cut pipe and tubing ends square; ream before joining.


3.02 FUEL OIL SYSTEM PIPING

A. Underground Piping:
   1. Pitch horizontal piping upward from containment sump 1/8 inch per foot minimum.
   2. Install copper tubing in continuous lengths from containment sump to fuel burning apparatus.
      a. Exception: Where black steel piping is used for fuel oil supply, return, and gage piping inside building, run copper tubing in continuous lengths from containment sump to one foot beyond interior surface of exterior building wall.
   3. Run fuel oil supply, return, and gage piping in single containment pipe from containment sump to one foot beyond interior surface of exterior building wall.
      a. Exception: Where flexible primary piping is used for fuel oil supply and return, run copper tubing gage line in polyethylene (PE) piping from containment sump to one foot beyond interior surface of exterior building wall.
   4. Install flexible primary piping in continuous lengths from containment sump to one foot beyond interior surface of exterior building wall.

B. Piping Inside Building:
   1. Pitch horizontal piping downward from wall 1/8 inch per foot minimum.
   2. Where copper tubing is used, install in continuous lengths to burning apparatus and gage display.

C. Above Ground Piping (Exterior to Building):
   1. Pitch horizontal piping from tank 1/8 inch per foot minimum.
   2. Run piping from tank to one foot beyond interior surface of exterior building wall.
   3. At interior surface of exterior building wall, provide required adapters.
      a. Run fuel oil supply and return piping to burning apparatus.
      b. Run gage piping to gage display.
   4. Run above ground piping in galvanized steel protection pipe, and run from tank to interior surface of exterior building wall, or to connection with underground piping.
3.03 PIPE JOINT MAKE-UP

A. Threaded Joint: Make up joint with a pipe thread compound applied in accordance with manufacturer’s printed application instructions for the intended service.

B. Brazed Joint: Thoroughly clean tube end and inside of fitting with emery cloth, sand cloth, or wire brush. Apply flux to the pre-cleaned surfaces. Install fitting, heat to brazing temperature, and join the metals with brazing alloy. Remove residue.

C. Welded Pipe Joint: Make changes in direction in welded piping with weld fittings, including elbows and tees. V bevel pipe and fitting ends (70 degrees to 90 degrees included angle).

D. Reinforced Thermosetting Resin Pipe Joint: Follow the manufacturer’s printed installation instructions.

E. Polyethylene Containment Pipe Joint: Follow manufacturer’s printed installation instructions.

F. Polyethylene Pipe Joint (PE): Follow manufacturer’s printed installation instructions.

G. Dissimilar Pipe Joint:
   1. Joining Dissimilar Threaded Piping: Make up connection with a threaded coupling or with companion flanges.
   2. Joining Dissimilar Non-Threaded Piping: Make up connection with adapters recommended by the manufacturers of the piping to be joined.
   3. Joining Galvanized Steel Pipe and Copper Tubing: Make up connection with a dielectric connector.
   4. Joining RTRP and Threaded Pipe: Make up connection with adapters as recommended by manufacturers of piping being joined.

3.04 PIPING PENETRATIONS

A. Sleeve Schedule: Unless otherwise shown, comply with the following schedule for the type of sleeve to be used where piping penetrates wall or floor construction:

<table>
<thead>
<tr>
<th>CONSTRUCTION</th>
<th>SLEEVE TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Frame construction.</td>
<td>None Required</td>
</tr>
<tr>
<td>2. Foundation walls.</td>
<td>A*</td>
</tr>
<tr>
<td>3. Non-waterproof interior walls.</td>
<td>B*</td>
</tr>
<tr>
<td>4. Floors not on grade having a floor drain.</td>
<td>A</td>
</tr>
<tr>
<td>5. Floors over mechanical equipment, steam service, machine, and boiler rooms.</td>
<td>A</td>
</tr>
<tr>
<td>6. Earth supported concrete floors.</td>
<td>None Required</td>
</tr>
<tr>
<td>7. Exterior concrete slabs on grade.</td>
<td>A</td>
</tr>
<tr>
<td>8. Waterproof walls.</td>
<td>A</td>
</tr>
</tbody>
</table>
*Core drilling is permissible in lieu of sleeves where marked with asterisks.

B. Diameter of Sleeves and Core Drilled Holes:
   1. Unless otherwise specified, size holes thru floors and walls in accordance with the through penetration fire stopping system being used.
   2. Size holes thru exterior walls or waterproofed walls above inside earth or finished floors, and exterior concrete slabs in accordance with the following:
      a. Uninsulated (Bare) Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of pipe, unless otherwise specified.

C. Length of Sleeves (except as shown otherwise on Drawings):
   1. Walls and Partitions: Equal in length to total finished thickness of wall or partition.
   2. Floors, Finished: Equal in length to total finished thickness of floor and extending 1/2 inch above the finished floor level, except as follows:
      a. In furred spaces at exterior walls, extend sleeve one inch above the finished floor level.
   3. Exterior Concrete Slabs: Equal in length to total thickness of slab and extending 1/2 inch above the concrete slab.
   4. Roofs: Equal in length to the total thickness of roof construction, including insulation and roofing materials, and extending one inch above the finished roof level.

D. Packing of Sleeves and Core Drilled Holes:
   1. Unless otherwise specified, pack sleeves or cored drilled holes in accordance with Section 078400 - FIRESTOPPING.
   2. Pack sleeves in exterior walls or waterproofed walls above inside earth or finished floors with oakum to within 1/2 inch of each wall face, and finish both sides with Type 1C (2 part) sealant. See Section 079200.
      a. Mechanical modular seals may be used in lieu of packing and sealant for sleeves and core drilled holes.
   3. Pack sleeves in exterior concrete slabs with oakum to full depth, and within 1/2 inch of top of sleeve and finish the remainder with Type 1C (2 part) sealant. See Section 079200.

3.05 FLOOR AND WALL PLATES

A. Install plates for exposed uninsulated piping passing thru floors, walls, ceilings, and exterior concrete slabs as follows:
   1. Piping 2 Inch Size and Smaller In Finished Spaces:
      a. Solid Type: Chrome plated cast brass construction with set screw.
   2. Piping over 2 inch size In Finished Spaces, and Piping in Unfinished Spaces:
      a. Solid Type: Galvanized cast iron construction with set screw.
   3. Piping in Unfinished Spaces (Including Exterior Concrete Slabs): Solid type, galvanized, cast iron or malleable iron construction.
4. Fasten plates with set screws.
5. Plates are not required in pipe shafts or furred spaces.

3.06 PIPE AND FITTING SCHEDULE

A. Abbreviations: The following abbreviations are applicable to the Pipe and Fitting Schedule.

BS  Black Steel.
CI  Cast iron.
MI  Malleable iron.
RTRP  Reinforced thermosetting resin pipe.
SE  Screwed end.
ST  Steel.
SW  Standard weight.
WE  Weld end.
XH  Extra heavy weight.

B. Where options are given, choose only one option for each piping service. No deviations from the selected option will be allowed.

C. Piping for No. 2 Fuel Oil and Diesel Fuel for Diesel-Alternators:
   a. Vent Piping:
      1) Underground: Single wall RTRP with fittings, joining methods, and materials as recommended by the piping system manufacturer.
      2) In Containment Sump, and Above Ground: SW BS pipe, with SE 150 lb MI fittings, and fuel resistant thread sealant.
   b. Fuel Oil Product Piping (FOS and FOR):
      1) Underground:
         a) Option No. 2: Double wall flexible primary piping with polyethylene containment pipe, with fittings, joining methods, and materials as recommended by flexible primary piping and polyethylene containment pipe manufacturers.
      2) Above Ground:
         a) Option No. 1: SW BS pipe, with SE 150 lb. MI fittings, and fuel resistant thread sealant.
         b) Option No. 2: Type L hard drawn copper tubing with wrot copper or cast copper alloy fittings, and brazing alloy.
      3) Inside Building (125 psig and Less):
         a) 3/4 Inch and Less: Type K soft annealed copper tubing with automotive tube type flared fittings.
         b) 1 Inch and Up: SW BS pipe, with SE 150 lb MI fittings and fuel resistant thread sealant, or WE SW ST fittings.
         c) All Sizes: SW BS pipe, with SE 150 lb MI fittings and fuel resistant thread sealant, or WE SW ST fittings.
   4) Inside Building (126 to 300 psig):
a) 1-1/2 inch and Less: XH BS pipe, with SE 300 lb. MI fittings and fuel resistant thread sealant, or WE XH ST fittings.

b) 2 inch and Up: XH BS pipe with WE XH ST fittings.

5) Inside Containment Sump:
   a) Option No. 1: Type K soft annealed copper tubing with automotive tube type flared fittings.
   b) Option No. 2: Double wall flexible primary piping with fittings, joining methods, and materials as recommended by flexible primary piping manufacturer.

c. Gage Piping:
   1) Underground, and Inside Containment Sump: Type K soft annealed copper tubing with drawn automotive tube type flared fittings.
   2) Above Ground: Type L hard drawn copper tubing with wrot copper or cast copper alloy solder fittings, and brazing alloy.
   3) Inside Building:
      a) Option No. 1: Type K soft annealed copper tubing with automotive tube type flared fittings.
      b) Option No. 2: SW BS pipe, with SE 150 lb. MI fittings and fuel resistant thread sealant, or WE SW ST fittings.

d. Protection Piping:
   1) Above Ground: SW BS pipe with SE 150 lb. MI fittings, and fuel resistant thread sealant.

e. Fill Piping (Underground): SW BS pipe with SE 150 lb MI fittings, and fuel resistant sealant. Coat piping with corrosion protective tape primer, and wrap with corrosion protective tape.

f. Interstitial Leak Monitor Riser Piping: SW BS pipe with SE 150 lb MI fittings, and fuel resistant sealant. Coat piping with corrosion protective tape primer, and wrap with corrosion protective tape.

g. Fuel Oil Suction Drop Pipe: SW BS pipe, length as required to reach within 4 inches of tank bottom.

END OF SECTION
SECTION 231323
ABOVE GROUND FUEL STORAGE TANKS AND FUEL SYSTEMS

PART 1   GENERAL

1.01  RELATED WORK SPECIFIED ELSEWHERE

A. Seismic Restraints: Section 230550.

1.02  PERFORMANCE REQUIREMENTS

A. Design tanks, and supports to withstand all seismic loads. Refer to seismic loading criteria on the Contract Drawings.

B. Seismic Performance: Design and install tanks to assure continued performance of their intended function when subjected to the specified seismic forces.

C. Seismic Performance: Design and install tanks to assure that they remain in place with no separation of any parts when subjected to the specified seismic forces.

D. The design of the tanks, and supports shall be performed by a professional engineer experienced in the seismic design of tanks.

1.03  REFERENCES

A. NFPA 30 - Flammable and Combustible Liquids Code.

B. NFPA 30A - Automotive and Marine Service Station Code.

C. NFPA 31 - Oil Burning Equipment.

D. Underwriter’s Laboratories (UL).

E. ETL Testing Laboratories (ETL).

F. Factory Mutual Engineering and Research (FM).

1.04  DEFINITIONS

A. Fuel System for No. 2 Fuel Oil: Fuel storage tank including leak containment and detection for tank and underground piping, overfill prevention, high level alarm, gage system, and required accessories to connect to fuel burning apparatus.

B. Motor Fuel Dispensing System: Fuel storage tank including leak containment and detection for tank and underground piping, overfill prevention, high level alarm, gage system, remote pump, dispenser, optional automated fuel management system, and automated fire extinguishing system with manual backup operation (unleaded gasoline systems only).
C. Fuel System for Diesel-Generators: Fuel storage tank including leak containment and detection for tank and underground piping, overfill prevention, high level alarm, gage system, and required accessories to connect to diesel-generator.

1.05 SUBMITTALS

A. Waiver of Submittals: The “Waiver of Certain Submittal Requirements” in Section 013300 does not apply to this Section.

B. Submittals Package: Submit the Product Data, and Quality Control Submittals specified below at the same time as a package.

C. Product Data: Catalog sheets, specifications, illustrations, wiring diagrams, CARB Stamp (where applicable), and installation instructions for each item specified for each type of system.

D. Quality Control Submittals:
   1. Tank Installation Contractor’s Qualifications Data:
      a. Name of Contractor, business address and telephone number.
      b. Names and addresses of 3 similar projects that the Contractor has worked on during the past 5 years.
   2. Pipe Installer’s Qualifications Data:
      a. Name of each person who will be performing the Work and their employer’s name, business address and telephone number.
      b. Names and addresses of 3 similar projects that each person has worked on during the past 5 years.
      c. Copy of certification from pipe manufacturer(s).
   3. Factory Test Certificate: For each tank.
   4. Company Field Advisor Data:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
      b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
      c. Services and each product for which authorization is given by the Company, listed specifically for this project.
   5. Copy of Seismic Qualifications Certificate.

E. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Two copies, covering the installed products.
   2. Warranty: Copy of specified warranty.
   3. Tank Manufacturer Installation Check List: Two copies.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Tank Installation Contractor: The firm performing the Work of this Section shall have been regularly engaged in the installation and maintenance of underground fuel storage tanks for a minimum of 5 years, and shall have completed 3 similar projects.
   2. Pipe Installer: Individual with minimum 5 years experience in installing underground fuel piping, have worked 3 similar projects, and shall be certified by pipe manufacturer of the type of pipe being installed.
B. Listings: Components of the system(s) for which Underwriters’ Laboratories, Inc. (UL) provides product listing service, shall be listed and bear the listing mark.

C. Regulatory Requirements:
1. Systems for storing No. 2 fuel oil, and diesel fuel for diesel-generators shall comply with the applicable requirements of UL 2085, NFPA 30 and NFPA 31.
2. Systems for storing diesel fuel or unleaded gasoline for motor fuel dispensing systems shall comply with the applicable requirements of UL 2085, NFPA 30 and NFPA 30A.
3. New York State Department of Environmental Conservation Bulk Storage Regulations 6NYCRR Parts 612, 613, and 614.
5. Stage I and II vapor recovery systems shall be certified by the California Air Resources Board (C.A.R.B.).

D. Company Field Advisor:
1. Secure the services of a Company Field Advisor of the manufacturer of the leak and overfill monitoring system for a minimum of two 2 hour training sessions to train facility personnel in the operation and maintenance of the system. Schedule training sessions with the Director’s Representative.
2. Secure the services of a Company Field Advisor of the manufacturer of the fuel management system for a minimum of 2 hours to train facility personnel in the operation and maintenance of the system.

E. Seismic Qualification Certificate: Certificate from tank manufacturer covering tank, accessories, supports, and components; and consisting of the following:
1. Basis for Certification: Indicate whether Withstand Certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions, and loads transmitted to structure at each attachment point.
3. Detailed description of equipment anchorage devices on which the certification is based including installation requirements.
4. Comprehensive seismic engineering analysis of tank, and supports.

1.07 WARRANTY

A. Warranty: Twenty year manufacturer’s warranty for each tank.

1.08 MAINTENANCE

A. Spare Parts:
1. Two keys for each padlock.

B. Special Tools:
1. One stick gage and two calibration charts for each fuel tank.
2. Two tools for each type and size vandal resistant fastener.

PART 2 PRODUCTS
2.01 TYPE 4 FUEL STORAGE TANKS WITH OVERFILL

A. Tanks shall be listed as secondary containment in accordance with UL 2085, and shall be marked for fire resistance, and protected from vehicle impact and projectile hazards.

B. Type: Double wall steel interior tank with minimum 3 inch interstitial space filled with lightweight, porous, monolithic insulation material. Tank shall have exterior steel surface coated with minimum 10 mil thickness of epoxy paint.
   1. The tank shall be designed to have an integral overfill protection chamber to contain a spill of at least 20% of the tank’s storage volume. This capacity shall be in addition to the 10% safety factor provided by normally filling the tank to only 90% of maximum capacity.

C. Acceptable Tanks:
   1. Fireguard Thermally Protected Double-Wall Steel Storage OP-Tank by Highland Tanks, Manheim, PA, (717) 664-0600.
   2. Fireguard Tank by Modern Welding Company, Newark, OH, (740) 344-9425.

2.02 TANK ACCESSORIES

A. Stair/Platform Assembly:
   1. Stairs and railings shall meet OSHA Standard 29 CFR Ch. XVII, paragraph 2910.24. Provide tank identification on tank and at fill port as well.
   2. Platform Mounting Height: 30 to 36 inches from the top of tank.
   3. Platform provides access to the fill port, Stage I vapor recovery port (gasoline only), and stick gage port.
   4. Assemblies shall either be painted per Section 099103, or galvanized in accordance ASTM Standard A53-96.
   5. Provide right and left hand stairs/platform assemblies with railings on exposed sides only.

B. Gaging Equipment:
   1. Stick Gage Port (Furnished with all tanks): Accessible from ground level or stair/platform assembly.
   2. Mechanical Gaging: Field adjustable float type gage with minimum 4-1/2 inch dia. display face, vapor tight construction, and stainless steel float; 818 Clock Gage by Morrison Bros., Dubuque, IA.
   3. Electronic Gaging: Magnetostrictive probe which include temperature sensors and both product and water floats capable of sensing product level to nearest 0.001 inch.
      a. Acceptable Manufacturers: Intelligent Controls Inc., Saco, ME, (800) 872-3455 or (207) 283-0156; Veeder Root, Simsbury, CT, (800) 873-3313 or OMNTEC, Ronkonkoma, NY, (516) 467-5787.
      b. Upon demand, the system shall indicate water level, product level, and average product temperature.
      c. System shall sense and alarm leakage rates greater than 0.2 gal/hr.

C. Venting:
   1. Vent primary tank with normal and emergency venting (NFPA 30 and UL 2085 test configuration. Vent interstitial space with emergency venting only.
2. Vent each compartment of primary tank and overfill chamber with normal and emergency venting. Vent interstitial space with emergency venting only.

3. Pipe: Standard weight black steel pipe (2 inch size) with 150 lb malleable iron fittings with fuel resistant thread sealant.
   a. Finish: Paint pipe and fittings in accordance with Section 099103.
   b. Terminate pipe minimum 12 feet above grade.

4. Vent Caps:
   a. Fuel Oil or Diesel Fuel: Open type with 40 mesh screen; OPW 23, EMCO Wheaton AH10, or Morrison Bros. 354.

5. Emergency Vent: Aluminum body with cast iron lid, zinc plated steel shaft, and Buna-N O-ring; OPW 201.
   a. Conforming to NFPA 30, and UL 2085 test configuration.

D. Tank Identification:
   1. Type: Two layer etched plastic or metal permanently attached to the tank.
      a. Decals or stenciling is not acceptable.
   2. Signs shall include the following information:
      a. Manufacturer's statement that tank conforms with Bulk Storage Regulation 6 NYCRR Part 614.
      b. Standards of Design by which tank was manufactured.
      c. List of products and additives which may be permanently stored in tank.
      d. Year in which tank was manufactured.
      e. Unique identification number.
      f. Dimensions, working capacity, and tank model number. Provide signs to show design capacity of tank.
      g. Name of tank manufacturer.
      h. Date of tank installation.

E. Fill Limiting Valve:
   1. Tanks 6000 gallons and up: Clay & Bailey F-35 or Morrison Bros 9095A. (includes adapter), or OPW 61FSTOP.
      1. Drop tube as required.
      3. Cap: OPW 634-TT, EMCO Wheaton A97, or Morrison Bros. 305C.

F. Hose Drip Containment Chamber At Fill Port:
   1. Type: Minimum 5 gallon capacity with drain valve and water tight lid; Pomeco/OPW 221AST, or Morrison Bros. 518. Material shall be stainless steel.
   2. Provide a stainless steel constructed metal enclosure (lockable) containing dry break adaptor, check valve and gate valve for the fill station
   3. Lock: Master Lock 911-DKA.

G. Fill Station:
   1. Provide a stainless steel constructed metal enclosure (lockable) containing dry break adaptor, check valve and gate valve for the fill station. Provide color coding of fill station.
   2. Lock: Master Lock 911-DKA.

H. Stickport:
1. Provide a port for manually gaging the tank including a lockable vapor tight twist off cap; Morrison Bros. 178X, or OPW 83-0066.
2. All tanks shall be provided with a stick gage.

I. Support Saddles:
1. Provide UL-listed welded-on saddles to support the tank from concrete piers above the concrete foundation. The sizes and location of saddles shall be as required by the tank manufacturer. Coordinate the seismic supports with tank supports.

### 2.03 TANK GAGING, LEAK AND OVERFILL MONITOR SYSTEM

A. Acceptable Companies:
   2. Veeder Root Inc., Simsbury, CT, (800) 873-3313.
   3. OPW, Hotchkins, IL, (708) 465-4200.
   5. Intelligent Controls Inc., Saco, ME, (800) 872-3455 or (207) 283-0156.

B. Type: Continuous operation tank gaging, leak detection and overfill monitor system for double wall storage tanks, double wall product piping, and containment sumps.
   1. Systems shall have system test capability, and shall be UL listed and/or FM approved.
   2. System shall be tied into HVAC DDC control system and electrical PLC controls.

C. Alarm Monitor Panels: Locate panel inside nearest appropriate building as directed by Director’s Representative.
   1. The alarm panel shall visually indicate the following:
      a. Status of each tank’s interstitial space (dry, water, or hydrocarbon condition).
      b. Status of each containment system (dry, water, or hydrocarbon condition).
      c. Status of high level sensor set at 95 percent of tank operating capacity (on or off). When sensor is tripped, audio alarm shall be activated and be audible at fill port location.

D. Leak Sensors:
   1. Detects leaks in the following:
      a. Interstitial space between tank walls.
      b. Piping system which drains into containment sump.
   2. Sensors: Non distinguishing type not sensitive to condensation forming on the sensor surface, or dripping across the sensor surface.

E. Instrumentation Control Cable: Connect probe and sensor to alarm monitor panel, as recommended by manufacturer of leak and overfill monitor system.

F. Audible Overfill Alarm Device: Weatherproof, surface mounted basic grille type, 120 V ac as manufactured by tank gaging, leak detection and overfill monitor system manufacturer.
G. Overfill Alarm Device Sign: Constructed of 1/8 inch thick two color laminated plastic engravers stock, with the words “OVERFILL ALARM DEVICE” engraved in white on red background. Size sign and lettering for easy reading from ground level.

2.04 TYPE C INSTALLATION PACKAGE

A. Provide all accessories below for installation of the above ground tanks for No. 2 Fuel Oil.
1. Manual Shutoff Valve: Steel ball valve, 1 1/2 inch size, Jomar T-2000, or Morrison Bros. 619BSS (stainless steel).
2. Explosion Proof Solenoid Valve: Brass, 1-1/2 inch size; ASCO 8210, or Morrison Bros. 710.
3. Pressure Relief Valve: Steel, 1/4 inch size, Morrison Bros. 77.
4. Check Valve: Bronze body and disc; Crane 37, Nibco T413, or Morrison Bros. 246.
5. Foot Valve: Double poppet with strainer, OPW 86, or Morrison Bros. 335A.
6. Extractor Fitting: OPW 233-E
7. Foot Valve Wrench: OPW 52.
11. Termination Plug: Total Containment Inc. Model TP3000
12. Termination Compression Seal: Total Containment Inc. Model EF5036
13. Provide pump out fittings for primary and overfill chamber for each tank.

2.05 TANK HEATERS

A. Provide tank heaters to maintain the temperature of No. 2 fuel oil within each tank above 32 degree F whenever the ambient temperature is below 32 degree F.
1. Acceptable Manufacturers:
   a. Watlow Industries, Lockport, NY.
   b. Chromalox, Pittsburgh, PA.
2. O Shaped Heater: two (2) 5,000 watt heater assembly, 2 inch size, requiring manhole for mounting.
   a. Element Sheath: (6) incoloy elements attached to 18 inch manway cover.
   b. Thermocouple: (2) Type J thermocouples, one attached to element sheath for over temperature sensing, and the other immersed for process temperature sensing.
   c. Control Panel (Remote): NEMA 4, with series 935 temperature controller for controlling process temperature, series 935 controller for high limit protection, (2) mercury displacement relays, silicone rubber heater with integral thermostat for freeze protection, red strobe light for high limit alarm, control circuit fusing, and reset switch for limit control mounted on door.
   d. Electrical Requirements: 12 watts/sq. inch element watt density, 460 volts, three phases.
2.06 FUEL FOR TESTING

A. Coordinate with the Facility thru the Director’s Representative for the delivery of a full tank of each appropriate fuel type for testing to verify that fuel transfer equipment and instrumentation is operating properly.

2.07 FUEL MANAGEMENT SYSTEM

A. Stand alone, magnetic stripe card activated, self contained, island mounted type capable of 24 hour monitoring, and simultaneous control of maximum of 10 hoses; EJ Ward Fuel Control Terminal FCT-RT.
   1. Conforming to requirements of NYS Department of Transportation.
   2. The system shall be tied into HVAC DDC control system and electrical PLC controls.

B. Features:
   1. Microprocessor:
      a. Capable of reprogramming without changing hardware, and communicates with communication controller by internal network or by dial-up phone lines.
      b. Memory: 2 MEG.
   2. Keypad: Heavy duty, alpha-numeric membrane type with separate key for each letter (no shift or function keys required).
   3. Display: Backlit LCD with contrast adjustment that is highly visible and easy to read in total darkness or direct sunlight.
   4. Dispenser selection controlled thru system logic by vehicle and/or operator card data.
   5. Programmable to limit delivery by card or vehicle identification.
   7. Capable of recording and storing transaction data including operator vehicle, quantities, day and time, odometer reading; and printing this information on demand.
   8. Interfaces with fuel dispensers, tank monitoring equipment, and capable of data transfer via modem to facility computers.
   9. Storage capacity with battery backup for minimum 500 transactions.
  10. Transient protection on AC power input and modem communication.
  12. Weatherproof Cabinet and Stand: Stainless steel construction.

2.08 FASTENERS

A. Vandal Resistant Fasteners: Stainless steel, allen or torx head, both with center post.

PART 3 EXECUTION

3.01 PREPARATION

A. Testing Prior to Installation:
   1. Before placing the tank in place, plug all openings and pressure test tank in accordance with manufacturer’s printed test instructions, unless otherwise specified. Tests shall be in accordance with API Standard No. 650.
2. Tanks should not be pressurized beyond manufacturer’s specified limits.
3. The tank must hold the test pressure for 30 minutes.
4. Check fitting connections, and seams in tank by applying a soap suds solution.
5. Reject any leaking tanks.

3.02 INSTALLATION
A. Install the Work of this section in accordance with the item manufacturer’s printed installation instructions, unless otherwise shown or specified.

3.03 TANK ACCESSORIES
A. Fuel Identification: Attach laminated plastic nameplate to each tank fill pipe to identify the fuel in the tank.
B. Tank Identification: Affix tank identification label, or plate permanently to tanks and fill ports.
C. Install padlocks on all lockable caps on fill and vapor recovery piping.
D. Terminate vent lines with vent caps.
E. Overfill Alarm Device Sign: Mount sign adjacent to alarm horn in a location easily readable from ground level.

3.04 FIELD QUALITY CONTROL
A. Testing: After installation of tank and piping, test the system in the presence of the Director’s Representative, as follows:
1. Piping: Before painting or backfilling, plug ends and test with air at 5 psi and hold for two hours without leaking.
2. Tanks: Pressure test tank in accordance with manufacturer’s printed test instructions, unless otherwise specified.
   a. Tanks should not be pressurized beyond manufacturer’s specified limits.
   b. The tank must hold the test pressure for 30 minutes.
   c. Check fitting connections, and seams in outermost tank by applying a soap suds solution.
3. Product Level and Overfill Protection:
   a. The Facility through the Director’s Representative will arrange for delivery of product as needed to test high level alarm, and fill limiting valve.
   b. During the filling process the Director’s Representative will monitor and record the low level alarm, quantity of product as compared to reading on the Control Panel, the overfill alarm, and will test the overfill valve.
   c. Make required repairs and final adjustments.
4. Fuel System for No. 2 Fuel Oil:
   a. After reconnecting all piping, burning apparatus and tanks, and when directed, perform a system acceptance test in the presence of the Director’s Representative to demonstrate that the fuel system is operating properly.
   b. Make required repairs and final adjustments.
5. Motor Fuel Dispensing System:
   a. After reconnecting all piping, dispensers, and tanks, and when directed, perform a system acceptance test in the presence of the Director’s Representative to demonstrate that the fuel dispensing system is operating properly.
   b. Make required repairs and final adjustments.
   c. Minimum flow rate for diesel or gasoline systems without Stage II vapor recovery is 11.0 gpm, and 7.5 gpm with Stage II vapor recovery.

6. Fuel System for Diesel-Generators:
   a. After reconnecting all piping, diesel-generator, and tanks, and when directed, perform a system acceptance test in the presence of the Director’s Representative to demonstrate that the fuel system is operating properly.
   b. Make required repairs and final adjustments.

   END OF SECTION
SECTION 232003
THERMOMETERS AND GAUGES

PART 1   GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A.  Valves:  Section 230523.
B.  Pumps:  Section 232123.

1.02 SUBMITTALS

A.  Product Data:  Manufacturer’s catalog sheets, specifications and installation
    instructions for each item specified.

1.03 QUALITY ASSURANCE

A.  Regulatory Requirements:  Where Federal, NSF, ASME or other standards are
    indicated or required, products shall meet or exceed the standards established for
    material, quality, manufacture and performance.

PART 2   PRODUCTS

2.01 MANUFACTURERS/COMPANIES

A.  Dresser Instruments.
B.  Marsh Bellofram.
C.  Moeller Instrument Co.
D.  Taylor Precision Products.
E.  H.O. Trerice Co.
F.  Weksler Instruments Corp.

2.02 THERMOMETERS

A.  General Design Features:
1.  Scale Ranges:  1-1/2 times actual working temperature required for the
    particular application, as approved.
   a.  Maximum of two degrees between graduations and ten degrees
       between numerals.
   b.  When scale ranges are in excess of 100 degrees, maximum range
       between numerals may be 20 degrees, or as otherwise approved
       for the particular application.
2.  Direct Reading Thermometers:  Bimetallic actuated, dial type, straight
    pattern, angle pattern, or adjustable angle pattern as required.
3. Remote Reading Thermometers: Vapor tension actuated, or gas actuated type, with extension capillary tube of length as required for the particular application.
   a. Case type as required for the particular mounting application.
   a. Sockets for Use in Insulated Piping, Insulated Tanks or Similar Equipment: Extension lagging neck type, of length as required to compensate for insulation thickness, and proper immersion.

2.03 THERMOMETERS FOR MEASURING LIQUID TEMPERATURE

A. Bimetallic Actuated Thermometers: Comply with ASME B40.3, Accuracy Grade A.
   1. Construction: Type 304 stainless steel, all welded construction, with clear acrylic plastic or shatterproof glass crystal.
   2. Dial: White enamel background with bold black figures and graduations.
   3. Head Size:
      a. Installation in Piping: 3 inch diameter.
      b. Installation in Tanks and Similar Equipment: 5 inch diameter.
   4. Stem: Length as required for proper immersion, and to compensate for insulation thickness, with threaded connection for socket.
   5. External Calibration Device.
   6. Separable Socket:
      a. Water Service: Brass or bronze.
      b. Steam Service: Stainless steel.

B. Vapor Tension or Gas Actuated Capillary Thermometers: Adjustable type, with micrometer type pointer or external calibration device, of design and materials as follows:
   1. Case and Ring: Stainless steel or non-ferrous material as approved, with clear acrylic or shatterproof glass lens. Provide case of type as required for the particular mounting application. Case adjustable, allowing rotation of 360°, and stem adjustment of at least 180°. Provide set screw for locking case in desired position.
   3. Dial: White enamel background, with bold black graduations, numerals and pointer; 3-1/2 inch diameter.
   5. Bulb: Copper with union well connection.
   6. Separable Socket:
      a. Water Service: Brass or bronze.
      b. Steam Service: Stainless steel.

2.04 THERMOMETERS FOR MEASURING AIR TEMPERATURE

A. Bimetallic Actuated Thermometers: Comply with ASME B40.3, Accuracy Grade A.
   1. Construction: Type 304 stainless steel, all welded construction, with clear acrylic plastic or shatterproof glass crystal.
   2. Dial: White enamel background with bold black figures and graduations.
   3. Head Size: 5 inch diameter.
   4. Stem: Length as required for average duct cross sectional sensing of air temperature, and to compensate for insulation thickness.
   5. External calibration device.
B. Vapor Tension or Gas Actuated Capillary Thermometers: Adjustable 3-1/2 inch dial type, with micrometer type pointer or external calibration device, of design and materials as follows:
   1. Case and Ring: Stainless steel or non-ferrous material as approved, with clear acrylic or shatterproof glass lens. Case adjustable allowing rotation of 360°, and stem adjustment of at least 180°. Provide set screw for locking case in desired position.
   3. Dial: White enamel background, with bold black graduations, numerals and pointer; 3-1/2 inch diameter.
   5. Bulb: Copper air sensing bulb with split flange mounting device.

2.05 PRESSURE AND COMPOUND GAUGES

A. Type: Adjustable dial type with micrometer type pointer, or external calibration device, bronze bourdon tube, and bronze bushed rotary movement.

B. Dial: White enameled background, and bold black graduations, numerals and pointer; 3-1/2 inch diameter.
   1. Scale Range:
      b. Compound Gauges: From 30" Hg vacuum to double normal operating pressure.

C. Case: Cast aluminum, brass, or black finished phenolic.

D. Accuracy: Guaranteed of within 1 percent in middle third of dial range.

2.06 PRESSURE SNUBBERS AND IMPULSE DAMPERS

A. Pressure Snubbers: H.O. Trerice Co. Model 872.


PART 3 EXECUTION

3.01 INSTALLATION

A. Thermometers:
   1. Install in accordance with the manufacturer's printed installation instructions.
   2. Install direct reading thermometers, when the application requires installation 6 feet or less above the floor or bottom of space in which installed, and remote reading type when the installation is over 6 feet.
B. Pressure and Vacuum Gauges:
   1. Install in accordance with the manufacturer's printed installation instructions.
   2. For measuring steam pressure, install gauges complete with needle valves, drain cocks and syphons.
   3. For measuring liquid pressure, install gauges complete with stop cocks and drain cocks.

C. Pressure Snubbers and Impulse dampers:
   1. Install pressure snubbers in the piping connections to gauges installed in suction and discharge piping connections to close coupled and base mounted circulating pumps driven by motors under 10 HP, and install impulse dampers for pumps 10 HP and over.

END OF SECTION
SECTION 232005

PIPING AND ACCESSORIES FOR DIESEL ALTERNATORS

PART 1   GENERAL

1.02 QUALITY ASSURANCE

A. Identify materials with markings in accordance with standards specified.

1.03 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each item specified.

PART 2   PRODUCTS

2.01 PIPE, FITTINGS, GASKETS, SEALANTS, AND SLEEVES

A. Black Steel Pipe: Schedule 40, ASTM A-120, or A-53.

B. Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.


E. Unions: Malleable iron, ASME B16.39, Class 250, with brass to iron, or brass to brass seats.

F. Couplings: Same material and pressure rating as adjoining pipe, conforming to standards for fittings in such pipe. Taper tapped type.

G. Nipples: ASTM A-120, FS WW-N-351B, standard weight, except when length is less than one inch between threads, provide extra heavy.

H. Thread Sealant: Arno C-950 Thread-Seal; Lake Chemical Slic-Tite; Locktite Sealant with Teflon.

I. Flange Gasket: Teflon or Viton, designed for the temperature and pressure of the coolant piping system.

J. Anti-Seize Lubricant: Never Seez Corp., Broadview, IL.

K. Pipe Sleeves, Packing, and Sealant:
   1. Sleeves: Schedule 40 steel pipe.
   3. Sealant: One component, mildew resistant silicone, by Dow Corning or General Electric.
2.02 ENGINE EXHAUST PIPING

A. Black Steel Pipe: Schedule 40, ASTM A-120, or A-53, Grade A

B. Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.

2.03 FLEXIBLE VIBRATION ELIMINATORS FOR CONNECTION OTHER THAN ENGINE EXHAUST

A. Type 321 stainless steel hose and braid; Flexonics PCS.

2.04 FLEXIBLE CONNECTORS AND EXPANSION JOINTS FOR ENGINE EXHAUST

A. Flexible connectors and expansion joints shall be provided at each engine and at each silencer. Flexible sections and expansion joints shall have flanged connections (150 psi). Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at 750 F continuous exhaust temperature. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction for a minimum of 3 inches.

2.05 PIPE HANGERS, SUPPORTS, AND ACCESSORIES

A. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.

B. Trapeze Hangers: Hanger assembly for multiple parallel piping runs. Construct trapeze assembly to have a load safety factor of 5.

C. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with 2 nuts at each end for positioning rod and hanger, and locking each in place.

D. Self Drilling Anchors (Group III, Type 1): Ramset’s RD Series, or Red Head/Phillips Series S-14.

E. Single Unit and Double Unit Expansion Shields: Diamond’s Keystone.

F. Bolts, Nuts, Washers, Lags and Screws: Medium carbon steel; type, size, and grade required for proper installation of the Work.

PART 3 EXECUTION

3.01 INSTALLATION
A. Piping: Install black steel pipe with malleable iron fittings and threaded joints, except use threaded flanges or flanged fittings for final connections to equipment, and for pipe sizes 5 inches and up.
   1. Allow for expansion and contraction.
   2. Maintain one inch minimum air-space around pipe or pipe covering.
   3. Install vertical piping plumb, and maintain a constant pitch on horizontal piping without sags or humps.
   4. Cut pipe square, ream, and thread to ASME B1.20.1 taper pipe thread standards.
   5. Make up threaded joints with thread sealant.
   6. Make up flanged joints with gaskets; coat flange bolts and nuts with anti-seize lubricant prior to assembly.

C. Flexible Vibration Eliminators: Install in accordance with the manufacturer’s printed instructions.

D. Pipe Hangers, Supports, and Accessories: Support, size, and space hangers in accordance with the American Society of Mechanical Engineer’s Code for Pressure Piping, ASME B31.1, Power Piping.

END OF SECTION
PREFUNCTIONAL CHECKLIST

ELMIRA CORRECTIONAL FACILITY - EMERGENCY GENERATOR

PC-M-[   ] - FUEL OIL PUMPS

Components Included:

Rotary Pumps
Base
Valves and Gauges
Spare Parts

TEFC Motor
Lead/Lag Controller
Starters

Associated Checklists:

Diesel Fuel Filtration System

1. Submittal/Approvals:

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

☐ List attached.

<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Date</th>
<th>Controls</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>Date</td>
<td>General Contractor</td>
<td>Date</td>
</tr>
<tr>
<td>Manufacturer/Vendor</td>
<td>Date</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prefunctional checklist items are to be completed as part of startup and initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor, subcontractor, trade or vendor responsible to verify completion of this item. A/E = Architect/Engineer, All = All Contractors, CA = Commissioning Agent, CC = Controls Contractor, EC = Electrical Contractor, GC = General Contractor, MC = Mechanical Contractor, SC = Sheet Metal Contractor, TAB = Test and Balance Contractor, M/V = Manufacturer/Vendor.

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted.

| Commissioning Agent | Date | Owner's Representative | Date |

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(New 09/01/10)
2. **Requested Documentation Submitted:**

<table>
<thead>
<tr>
<th>Check</th>
<th>Equip Tag-&gt;</th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer's cut sheets.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance data (pump curves, flow rates, etc.).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation and startup manual and plan.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sequences and control strategies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O&amp;M manuals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spare parts.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Documentation complete as per contract documents for given trade.*

Yes  No

3. **Model Verification:**

1 = As Specified, 2 = As Submitted, 3 = As Installed. Check if Okay. Enter note number if deficient.

<table>
<thead>
<tr>
<th>Equip Tag---&gt;</th>
<th></th>
<th></th>
<th></th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manuf.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Serial #</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volts/phase</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>RPM</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GPH</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Motor Hp</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Motor Effic</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

*The equipment installed matches the specifications for given trade.*

Yes  No

4. **Installation Checks:**

<table>
<thead>
<tr>
<th>Check</th>
<th>Equip Tag-&gt;</th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials, equipment and installation methods in accordance with all applicable codes and standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Label permanently affixed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check</td>
<td>Equip Tag-&gt;</td>
<td>Contr.</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>Installation in accordance with manufacturer's field representative.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pumps in place and properly grouted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration isolation devices installed and functional.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factory alignment appears correct.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field alignment if required, completed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seismic anchoring installed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure and flow gages and sensors installed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump lubricated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe fittings complete and pipes properly supported.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipes properly labeled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strainers in place and clean.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piping system properly tested.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valves properly tagged.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensors calibrated.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Electrical and Controls

<table>
<thead>
<tr>
<th>Check</th>
<th>Equip Tag-&gt;</th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power disconnects in place and labeled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All electrical connections tight.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proper grounding installed for components and unit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor safeties in place and operable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control system interlocks hooked up and functional.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All control devices and wiring complete.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Final

<table>
<thead>
<tr>
<th>Check</th>
<th>Equip Tag-&gt;</th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Startup report complete with this checklist attached.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safeties installed and safe operating ranges for this equipment provided to the commissioning agent.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The checklist items of Part 4 are all successfully completed for given trade.       Yes     No

5. **Operational Checks:** (These augment mfr's list. This is not the functional performance testing.)

<table>
<thead>
<tr>
<th>Check</th>
<th>Equip Tag-&gt;</th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The HOA switch properly activates and deactivates the unit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump rotation verified correct.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No unusual noise or vibration.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No leaking apparent around fittings.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measure line to line voltage phase imbalance for each pump: (% imbalance = 100x (avg. - lowest /avg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record imbalance of each pump in cell. Imbalance less than 2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Record full load running amps for each fan.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>_____ rated FL amps x _____ svc factor = (Max amps). Running less than max?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specified sequences of operation and operating schedules have been implemented with all variations documented.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead/lag controller operation verified.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Check

<table>
<thead>
<tr>
<th>Check</th>
<th>Equip Tag-&gt;</th>
<th></th>
<th></th>
<th></th>
<th>Contr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified point-to-point checks have been completed and documentation record submitted for this system.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6. Sensor Calibration:

All field-installed sensors and gages on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

**Notes:**

END OF CHECKLIST
# Functional Test Procedure

**Elmira Correctional Facility - Emergency Generator**

**FTP-M-[ ] - Fuel Oil Pumps**

**Associate Equipment:**  
- **Pumps**
- **Tanks**

**Associated Checklists:**  
- **Filtration System**

## 1. Participants:

<table>
<thead>
<tr>
<th>Party</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Party filling out this form and witnessing testing: ____________________________________________

Date of Test: ____________________________

## 2. Prerequisite Checklist:

a. The following have been started up and startup reports and pre-functional checklists submitted and approved ready for functional testing:

- **Generators**
- **Fuel Oil Filtration System**

b. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

<table>
<thead>
<tr>
<th>Controls Contractor Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| c. | All A/E punch list items for this equipment corrected. |
| d. | Test complete and approved for the fuel oil system. |
| e. | The functional test procedures reviewed and approved by installing contractor. |
| f. | Safeties and operating ranges reviewed. |
| g. | Test requirements and sequences of operation attached. |
| h. | Schedules and setpoints attached. |
| i. | Have all energy savings control strategies, setpoints and schedules been incorporated that this equipment and control system are capable of? If not, list recommendations below. |

---

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(New 09/01/10)
j. O&M manuals provided.

k. Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays, Lockouts, Schedules, Etc. Changed to Accommodate Testing.

l. Spare parts provided.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pre-Test Values</th>
<th>Returned to Pre-Test Values Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge Pressure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Functional Testing Record:

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Test Procedure</th>
<th>Expected and Actual Response</th>
<th>Pass Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HOA Operation</td>
<td>Pumps operate and indicator run lamp illuminated in HAND position.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pumps operate via controller command and indicator run lamp illuminated in AUTO position</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pumps remain off in OFF position indicator lamp not illuminated</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Simulate Lead/Lag/Failure operation</td>
<td>Witnessed Lead/Lag Rotation and verify lag pump operates with lead pump failure and alarm is noted.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Pump operation</td>
<td>Pumps run without excessive vibration or noise.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Pump operation</td>
<td>Pressure readings shall be consistent with predetermined values</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Pump strainers</td>
<td>Strainers can be disassembled for cleaning.</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

END OF TEST PROCEDURE
SECTION 232123

PUMPS

PART 1   GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Vibration Isolation:  Section 230550.
B. Seismic Restraints:  Section 230550.
C. Wiring for Motors and Motor Controllers:  Section 260523.
D. Motors:  Section 260221.

1.02 PERFORMANCE REQUIREMENTS

A. Design pump and pump supports to withstand all seismic loads.  Refer to seismic loading criteria on the Contract Drawings.
B. Seismic Performance:  Design and install pumps to assure continued performance of their intended function when subjected to the specified seismic forces.
C. Seismic Performance:  Design and install pumps to assure that they remain in place with no separation of any parts when subjected to the specified seismic forces.
D. The design of the pump and pump supports shall be performed by a professional engineer experienced in the seismic design of pumps.

1.03 SUBMITTALS

A. Product Data:  Catalog sheets and installation instructions for each type or size pump.
B. Schedule:  Pump schedule showing pump specifications and application.
C. Quality Control Submittals:
   1. Performance curves for each pump, showing gpm, brake HP and efficiency from free delivery to shut-off.  Chart curves on manufacturer’s factory tests shall be conducted in accordance with the recommended procedures of the Hydraulic Institute, and certified thereto by the manufacturer.
   2. Certificates:  Affidavit required under QUALITY ASSURANCE Article.
   3. Company Field Advisor Data:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
c. Services and each product for which authorization is given by the Company, listed specifically for this project.

4. Copy of Seismic Qualifications Certificate.

D. Contract Close Out Submittals:
   1. Operation, Maintenance Data, and Parts Lists: Deliver 2 copies, for each type of pump or pumping apparatus, to the Director’s Representative.

1.04 QUALITY ASSURANCE

A. Company Field Advisor: Secure the services of a Company Field Advisor from pump manufacturer for a minimum of 8 working hours for the following:
   a. Render advice regarding installation and final adjustment of the system.
   b. Render advice on the suitability of each item for this particular application.
   c. Witness final system acceptance test, then certify with an affidavit that the system is installed in accordance with the Contract Documents and is operating properly.
   d. Train facility personnel on the operation and or maintenance of the system (Minimum of two 4-hour sessions). Two training sections shall be separated by a minimum of 15 days.
   e. Explain available service programs to facility supervisory personnel for their consideration.

B. Seismic Qualification Certificate: Certificate from pump manufacturer covering pumps, accessories, supports, and components; and consisting of the following:
   1. Basis for Certification: Indicate whether Withstand Certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions, and loads transmitted to structure at each attachment point.
   3. Detailed description of equipment anchorage devices on which the certification is based including installation requirements.
   4. Comprehensive seismic engineering analysis of pump and pump supports.

1.05 MAINTENANCE

A. Spare Parts: Deliver one spare set of mechanical seals for each size and type of pump equipped with mechanical seals, to the Director’s Representative, who will sign receipt for same. Furnish seals of type as required for the particular pump application and the chemical water treatment being utilized. Suitably box and label spare seals as to their usage.
PART 2 PRODUCTS

2.01 PUMPS - GENERAL

A. Design pumps to operate continuously without overheating bearings or motors at every condition of operation on the pump curve, or produce noise audible outside the room or space in which installed.

B. Equip pumps complete with electric motor and drive assembly, unless otherwise indicated. Design pump casings for the indicated working pressure and factory test at 1-1/2 times the designed pressure.

C. Provide condensate pumping, boiler return pumping and vacuum pumping apparatus as complete factory assembled and prewired packaged units, each complete with integral pump controls and electric control panel.

D. Manufacture domestic hot water pumps of all-bronze construction.

E. Design pumps for ethylene glycol usage as specified for water, of type as indicated.

F. Pumps of the same type, shall be the product of a single manufacturer, with pump parts of the same size and type interchangeable.

G. Provide oil lubricated pumps with constant level oilers, with the exception of in-line circulating and close coupled pumps.

H. Equip base mounted pumps with OSHA compliant metal guards over the moving drive assembly. Fabricate from expanded galvanized metal or galvanized sheet metal. Secure guards as required and approved.

2.02 FUEL OIL PUMPS

A. Main Fuel Oil Pumps: Constant displacement, internal gear type designed for pumping No. 2 fuel oil.
   1. The pumps are bi-rotational, positive displacement, internal gear types with cast iron housings and Buna-N self-adjusting mechanical seals. Pump motors shall be base-mounted and Total Enclosed Fan Cooled (TEFC). Pump shall be suitable for outdoor installation. Provide weatherproof enclosure for outdoor use.

   2. Oil pump and motor assemblies shall be factory assembled on a structural steel channel base and shall include a base mounted motor directly connected by a flexible coupling to a bi-rotational, internal gear pump, having self-adjusting mechanical seals and cast iron housing. Rotating parts shall have a steel OSHA guard. The sets shall be prime coated and finished with an oil, water and solvent resistant, polyurethane enamel.

   3. Pump shall be Model LO, by Preferred Utilities Manufacturing Corp., Danbury, CT, or approved equal, complete with pressure relief valve.
2.03 CHARTS AND DIAGRAMS

A. Lubrication Charts: Card holder with aluminum or stainless steel frame, clear acrylic front, and sheet aluminum card backing plate. Minimum size card 8 x 10 inches. Illustrate or type the manufacturer’s recommendations for lubrication of each type pump.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install close-coupled, base mounted and all floor supported pumps or pumping apparatus on concrete pump foundations, or vibration isolating bases, or both, all as noted on drawings or specified. Level, align and true the equipment utilizing steel shims. Bolt to construction and grout, when grouting holes are provided in bases.

3.02 FIELD QUALITY CONTROL

A. Preliminary System Tests:
   1. Preparation: Have the Company Field Advisor adjust the completed system and then operate it long enough to assure that it is performing properly.
   2. Run a preliminary test for the purpose of:
      a. Determining whether the system is in a suitable condition to conduct the acceptance test.
      b. Checking control equipment.
      c. Training Facility personnel.

B. System Acceptance Test:
   1. Preparation: Notify the Director’s Representative at least 3 working days prior to the test so arrangements can be made to have a Facility Representative witness the test.
   2. Make the following tests:
      a. Individually test control devices.
      b. Test alarm indicating devices.
      c. Test each system function step by step.
   3. Supply equipment necessary for system adjustment and testing.
   4. Submit a typewritten report of the test results, signed by the Company Field Advisor and the Director’s Representative. Enclose a copy of the report in a metal frame covered with clear acrylic glazing and mount it adjacent to the pump control panel.

END OF SECTION
SECTION 233113

METAL DUCTWORK

PART 1  GENERAL

1.01 REFERENCES

A. American Conference of Governmental Industrial Hygienists (ACGIH).
B. National Fire Protection Association (NFPA).
C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

1.02 SUBMITTALS

A. Shop Drawings:
   1. Layouts for areas in which it may be necessary to deviate substantially from layout shown on the Drawings. Show major relocation of ductwork and major changes in size of ducts. Minor transitions in ductwork, if required due to job conditions, need not be submitted as long as the duct area is maintained.
   2. Layout and fabrication details for cooking equipment exhaust ductwork.
   3. Layouts of mechanical equipment rooms and penthouses.
   4. Details of intermediate structural steel members required to span main structural steel for the support of ductwork.
   5. Method of attachment of duct hangers to building construction.
   6. Coordinate shop drawings with related contracts prior to submission.

B. Product Data: Material, gage, type of joints, sealing materials, and reinforcing for each duct size range, including sketches or SMACNA plate numbers for joints, method of fabrication and reinforcing. Include ACGIH figure numbers for hoods if applicable.

1.03 QUALITY ASSURANCE

A. SMACNA: Gages of materials, fabrication, reinforcement, sealing requirements, installation, and method of supporting ductwork shall be in accordance with the following SMACNA manuals, unless otherwise shown or specified:
   1. HVAC Duct Construction Standards.
   2. Round Industrial Duct Construction Standard.

B. Conform to the applicable requirements of NFPA 90A, 90B, 91, 96, and 101.
PART 2  PRODUCTS

2.01  MATERIALS

A.  Sheet Metal:
2.  Copper:  ASTM B-370.
5.  Stainless Steel:  AISI Types 302, 304 and 316, as specified.

B.  Duct Hangers:
1.  Strap Hangers:  Same material as ducts, except that hangers for stainless steel ducts in unfinished spaces may be galvanized steel.
2.  Rod Type Hangers:  Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with 2 removable nuts each end for positioning and locking rod in place.  Unless stainless steel, galvanized or cadmium plated; shop coat with metal primer.

C.  Miscellaneous Fasteners and Upper Hanger Attachments:
1.  Sheet Metal Screws, Machine Bolts and Nuts:  Same material as duct, unless otherwise specified.
2.  Concrete Inserts:  Steel or malleable iron, galvanized; continuously slotted or individual inserts conforming with MSS SP-58, Types 18 & 19, Class A-B.
4.  Metal Deck Ceiling Bolts:  B-Line Systems, Inc.’s Fig. B3019.
7.  Stainless Steel Shapes and Plates:  ASTM A276 and ASTM A666.
8.  Machine Bolt Expansion Anchors:
   a.  Non-caulking single unit type:  FS FF-S-325, Group II, Type 2, Class 2, Style 1.
   b.  Non-caulking double unit type:  FS FF-S-325, Group II, Type 2, Class 2, Style 2.
   c.  Self-drilling type:  FS FF-S-325, Group III, Types 1 and 2.

2.02  FABRICATION - GENERAL

A.  Fabricate ductwork from galvanized sheet metal.

B.  Dissimilar Metals:  Separate dissimilar metals used for ductwork with 12 oz vinyl coated woven fiberglass duct connector fabric, such as Duro Dyne’s Glasseal.  No separation is required between screws or rivets and the materials in which they are inserted.
PART 3  EXECUTION

3.01 INSTALLATION - GENERAL

A. Install ductwork to allow maximum headroom. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved, if cross sectional area is maintained.

B. Pitch horizontal ducts connected to hoods downward toward hood not less than 1 inch in 10 feet.

C. Provide necessary transformation pieces, and flexible fabric connections for ductwork connected to air handling equipment or air inlet and outlet devices.

3.02 HANGERS FOR DUCTS, UNDER 2 INCHES W.G.

A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:
   1. Rectangular ducts up to 42 inches wide, not having welded or soldered seams, and supported from overhead construction; extend strap hangers down over each side of the duct and turn under bottom of duct a minimum of 2 inches. Secure hanger to duct with 3 full thread sheet metal screws, one in the bottom and 2 in the side of the duct.
   2. Rectangular ducts 43 inches wide and over, and all sizes of duct with welded or soldered seams, and supported from overhead construction; use trapeze hangers.
   3. Prime coat plain steel rods threaded at the site immediately after installation with metal primer.

3.03 UPPER HANGER ATTACHMENTS

A. General:
   1. Secure upper hanger attachments to structural steel or steel bar joists wherever possible.
   2. Do not use drive-on beam clamps, flat bars or bent rods, as upper hanger attachments.
   3. Do not attach hangers to steel decks which are not to receive concrete fill.
   4. Do not attach hangers to precast concrete planks less than 2-3/4 inches thick.
   5. Avoid damage to reinforcing members in concrete construction.
   6. Metallic fasteners installed with electrically operated or powder driven tools may be used as upper hanger attachments, in accordance with the SMACNA Manual, with the following exceptions:
      a. Do not use powder driven drive pins or expansion nails.
      b. Do not attach powder driven or welded studs to structural steel less than 3/16 inch thick.
      c. Do not support a load, in excess of 250 lbs from any single welded or powder driven stud.
      d. Do not use powder driven fasteners in precast concrete.
B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by ductwork support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of 5.
   1. Secure upper hanger attachments to steel bar joists at panel points of joists.
   2. Do not drill holes in main structural steel members.

3.04 DUCT RISER SUPPORTS, UNDER 2 INCHES W.G.

A. Support vertical round ducts by means of double-ended split steel pipe riser clamps bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.

B. Unless otherwise specified or shown on the drawings, support vertical rectangular ducts by means of two steel angles, secured to duct and resting on floor slab or adjacent structural steel member, at every other floor through which the duct passes. Size supports as follows:

<table>
<thead>
<tr>
<th>MAX. SIDE DIMENSION (inches)</th>
<th>SUPPORT ANGLE (inches)</th>
<th>SECURE TO DUCT WITH</th>
<th>MIN BEARING AT EACH END (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>1 x 1 x 1/8</td>
<td>Screws</td>
<td>2</td>
</tr>
<tr>
<td>48</td>
<td>1-1/2 x 1-1/2 x 1/8</td>
<td>Bolts</td>
<td>3</td>
</tr>
<tr>
<td>60</td>
<td>2 x 2 x 1/8</td>
<td>Bolts</td>
<td>3</td>
</tr>
<tr>
<td>61 - up</td>
<td>2-1/2 x 2-1/2 x 3/16</td>
<td>Bolts</td>
<td>4</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1  GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Metal Ductwork: Section 233113.

1.02 REFERENCES

A. ACGIH: American Conference of Governmental Industrial Hygienists.
D. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
E. UL: Underwriters Laboratories, Inc.

1.03 SUBMITTALS

A. Product Data: Catalog sheets, diagrams, standard schematic drawings, and installation instructions for each manufactured product. Submit SMACNA Figure Numbers for each shop fabricated item.
B. Samples: When directed, submit one complete unit for each type of proposed air inlet and outlet device. Approved samples will be delivered to the job site for installation.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Unless otherwise shown or specified, comply with the applicable requirements of the following:
      a. SMACNA: Gages of materials, fabrication, sealing, and installation shall be in accordance with the SMACNA Manuals.
         1) HVAC Duct Construction Standards.
         2) Round Industrial Duct Construction Standard.
         3) Rectangular Industrial Duct Construction Standard.
      c. AMCA: Certify damper and/or louver ratings in accordance with AMCA 511.
1.05 MAINTENANCE

A. Special Tools:
   1. One bar deflection key for every five supply grilles and/or every five return grilles.
   2. One operator key for every five supply registers and/or every 5 return or exhaust registers.
   3. Two keys or socket wrenches for each type of damper adjustment screw or device on manual damper regulators.
   4. One tool for each type and size security fastener.

PART 2 PRODUCTS

2.01 GRILLES AND REGISTERS

A. Unless otherwise specified, fabricate grille and register faces, and frames of steel with factory applied white baked-on enamel.

B. Exhaust or Return Grilles: Fixed, single deflection type.
   1. Grille Face: 20 gage construction of same material as bars/vanes.
   2. Face Bars/Vanes: Installed in grille face.
      a. Deflection Angle: 20 to 55 degrees.
      b. Nominal Bar/Vane Spacing: 0.66 inch or 0.75 inch on center.
      c. Sidewall grilles shall have horizontal face bars/vanes.

C. Mounting Frames for Registers and Grilles:
   1. Fabricated from a minimum of No. 20 USS gage stamped or rolled steel, or extruded aluminum, to match material and finish of mating grille or register face.
      a. Weld exposed joints and ground flush.
      b. Completely close corner joints with neatly welded backtrim.
      c. Furnish frames complete with felt or sponge rubber gaskets on all four sides, except when frames are used as plaster stops.

2.02 DAMPERS

A. Manual Damper Regulators:
   1. For Dampers Installed in Exposed, or Accessible Concealed Ductwork: Indicating quadrant with heavy metal handle, end bearing, and means for locking damper in all positions.
   2. For Dampers Installed in Inaccessible Concealed Ductwork: Concealed type with indicating regulator in cast metal box with cover plate. Furnish assembly complete with duct end bearing, adjustment coupling, and damper extension rods.
2.03 LOUVERS

A. Louvers meeting the following specifications shall be furnished and installed where shown on the plans and/or as described in schedules. Louvers shall be stationary type with K style blades in a 4" louver frame. The head member shall incorporate an integral gutter and each jamb shall incorporate an integral downspout so water drains to the head end, then down the downspouts and out at the louver sill. Each factory-assembled louver section shall be designed to withstand wind loadings of 25 pounds per square foot (100 mph wind equivalent). Louvers too large for complete factory assembly shall be built up by the installing contractor from factory-assembled louver sections. Louver frames, mullions, and section joints shall be adequately supported from the building structure to withstand this same wind loading. Louver performance data shall be licensed under the AMCA Certified Ratings Program and shall bear the AMCA Certified Ratings Seal. This certified performance data shall include airflow pressure loss and water penetration, and shall demonstrate performance equal to or better than the Greenheck model specified. Basis of Design: Louvers shall be Greenheck Model EDK-430 stationary type fabricated from 6063T5 aluminum extrusions of .081" nominal wall thickness. Blades shall be positioned at 30° angles approximately on 3" centers. Each louver shall be equipped with a framed, removable, rear-mounted screen of 3/4" x .051" expanded, flattened aluminum. Provide aluminum wire mesh bird screen. Louvers shall be supplied with a Kynar finish applied following a thorough cleaning and pretreatment of the metal surface. Dry film thickness of the Kynar shall be approximately 1.2 mls after baking at 450°F. Color shall be selected by architect from standard color chart.

2.04 GASKET MATERIAL

A. Registers, Grilles, and Diffusers Installed in Exposed, Uninsulated Ductwork: 1/4 inch thick felt or sponge rubber material, of width as required by flange.

B. Flanged Joints in Ducts: 1/8 inch thick reinforced inert plastic of the self-conforming type, of same width as flange.
   1. Exception: Where flanged connections in cooking equipment exhaust ductwork is allowed by NFPA 96, make up joints with Fibrefrax Grade 110 Paper by Carborundum Co.

2.05 SEALANTS


B. U.L. Listed adhesives (liquid or mastic), scrim, tapes, or combinations thereof, as required for pressure class; suitable for system operating temperatures; compatible with media conveyed within, insulation (if any), and ambient conditions.
PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Unless otherwise shown or specified, install the Work of this Section in accordance with the manufacturer’s printed installation instructions and the SMACNA Manual.

END OF SECTION
SECTION 233418
CENTRIFUGAL WALL EXHAUSTERS

PART 1   GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Wiring for Motors and Motor Controllers: Section 260523.

B. Motors: Section 260221.

1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications, standard schematic drawings, and installation instructions for each fan specified.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Exhausters, with wheels 12 inches in size and larger, shall be licensed to bear the AMCA seal.
   2. Electrical components shall be UL listed.

PART 2   PRODUCTS

2.01 WALL EXHAUSTER

A. General Design: Quiet operating, direct drive centrifugal fan, with an aluminum, backward curved, non-overloading wheel, dynamically balanced with motor and enclosed in a fan housing of spun aluminum. Fan shall have single point power connection.

B. Components:
   1. Fan Housing: Fabricated from heavy gage spun aluminum, with flanges for anchoring to exterior wall surfaces. Power assembly shall be isolated from housing, with stainless steel springs, or equivalent means as approved. Fan housing shall be easily removable for access to motor and servicing.
   2. Motor: Speed or speeds of motors shall be as noted on drawings. Single phase fractional horse power motors shall be of the capacitor, split phase or shaded pole type, with ball or lifetime lubricated bearings and built-in thermal overload protection.
   3. Shutters: Aluminum self-opening type. Frame and blades shall be fabricated of aluminum; bearings shall be bronze or nylon. Damper blades shall be coupled together with tie rods at each end and edges of blades shall be felled.
4. Bird Guards: Fabricate from heavy gage polished steel wire on maximum 1/2-inch spacings and install in discharge openings of fan assembly.
5. Disconnect Switch: Factory mounted, UL approved, moisture tight, unfused disconnect switch, located inside the motor compartment next to the motor terminal box.

C. Exhausters, bird guards and shutters shall be the product of the same manufacturer.

D. Exposed fastening devices shall be aluminum or stainless steel.

E. Provide all other accessories as shown on the schedule.

2.02 SEALANT

A. Acrylic Type: FS TT-S-00230.

PART 3 EXECUTION

3.01 INSTALLATION

A. Set exhauster wall mounting flanges in a heavy bead of acrylic sealant.

B. Secure units in accordance with manufacturer’s printed instructions and approved shop drawings.

END OF SECTION
SECTION 233421
POWER ROOF VENTILATORS

PART 1   GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Wiring for Motors and Motor Controllers:  Section 260523.

B. Motors:  Section 260221.

1.02 SUBMITTALS

A. Product Data:  Manufacturer’s catalog sheets, standard schematic drawings, specifications and installation instruction for each size unit and curb.

B. Detailed Dimensional Data:  If roof curb is not the product of the ventilator manufacturer, provide detailed dimensional data confirming the ventilator and curb match exactly.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Ventilators shall be licensed to bear the AMCA seal.
   2. All electrical components shall be UL listed.

PART 2   PRODUCTS

2.01 VENTILATORS

A. General:  Ventilators shall be of the electric motor, V-belt driven centrifugal fan type, enclosed in a storm proof aluminum housing, properly braced and stiffened to form a rigid unit, which will withstand a horizontal pressure of 30 lbs. per square foot of projected area.

B. Housing:  Fabricate from spun aluminum, with heavy duty corrosion resistant metal hinges and friction catches, to permit access to motor and fan assembly. Provide structural reinforcing members to support fan wheel, motor and bearings, and vibration elimination devices to prevent transmission of vibration to housing. Discharge openings shall be provided with aluminum bird screens.

C. Fan Assembly:
   1. Fan Wheel:  Non-overloading centrifugal type, fabricated of aluminum or steel, balanced at factory. Provide grease packed wheel bearings of the self-aligning, ball bearing, pillow block type.
2. Drive Assembly: Electric motor driven V belt drive, with cast iron or steel pulleys. Provide motor pulley of the variable pitch type, to permit adjustment of fan speed 10% above or below speed indicated.

3. Motor: Speed or speeds as indicated, suitable for operation with the shaft vertical.

4. Assembly shall be complete with an Underwriters’ Laboratory approved for the use, non-fused safety type disconnect switch, located under the fan housing. Factory installed wiring shall be in flexible metal conduit.

D. Damper: 24 VAC internally mounted motorized damper.

E. Accessories: Provide all accessories as shown on schedule.

2.02 VENTILATOR CURBS

A. Fabrication: Factory fabricated, double shell, aluminum, a minimum of 1 inches thick, insulated with mineral wool, or thermally equivalent insulation as approved. Fabricate curbs from minimum No. 18 gage aluminum, properly braced and stiffened to form a rigid weatherproof unit.

B. For ventilators with formed steel housings, fabricate curbs as specified for aluminum with the exception that the curb be of galvanized sheet steel, minimum of 20 gage. Finish all surfaces of curbs with a minimum 2-coat baked enamel finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Preliminary Work: Deliver ventilator curbs to Construction Contractor for installation. Coordinate with the Construction Contractor in the locating and sizing of roof openings required.

B. Install roof curbs in complete accordance with the manufacturer’s printed installation instructions and approved shop drawings (if any).

C. Install ventilators on roof curbs, with approved fastening devices, in accordance with manufacturer’s printed installation instructions.

END OF SECTION
SECTION 235733
PREFABRICATED CHIMNEYS

PART 1   GENERAL

1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Roof support, roof flashing and storm collar.

B. Furnish Construction Contractor with two sets of approved drawings showing exact location and dimensions of roof opening required for chimney pipe.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Seismic Restraints for Ductwork: Section 233113.

1.03 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each item specified.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Factory built chimneys shall be designed and installed in accordance with the requirements of the NFPA and all components shall be UL listed and labeled.

PART 2   PRODUCTS

2.01 MANUFACTURERS/COMPANIES

A. Dura-Vent Corporation.

B. Hart & Cooley Manufacturing Co.

C. Selkirk Metalbestos, Division of the Wallace Murray Company.

2.02 ALL FUEL INSULATED CHIMNEY

A. Furnish a factory fabricated, round sectional, double walled, stainless steel insulated chimney, with twist lock end joints. Insulation between the inner and outer wall shall be a low k value rigid thermal insulation, a minimum of 1 inch thick. Chimney fittings, supports, anchor plates, roof flashing, storm collar, storm cap, and other miscellaneous items shall be of the same manufacture as the chimney. Termination cap shall be of the round dome type with upper and lower skirt.
B. Furnish a factory fabricated, round sectional, multi-wall chimney, with a stainless steel inner liner; an aluminized steel intermediate liner and a galvanized steel outer liner, with twist lock end joints. Chimney fittings, supports, anchor plates, roof flashing, storm collar, storm cap and other miscellaneous items shall be of the same manufacture as the chimney. Termination cap shall be of the round dome type with upper and lower skirts.

2.03 MULTI-WALL CHIMNEY

A. Furnish a factory fabricated, round sectional, double walled chimney, with an aluminum inner liner, a galvanized steel outer casing with twist lock end joints. Chimney fittings, supports, anchor plates, roof flashing, storm collar, storm cap and other miscellaneous items shall be of the same manufacture as the chimney. Termination cap shall be of the bird proof type.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install chimney in accordance with the manufacturer’s printed installation instructions.

END OF SECTION
PART 1   GENERAL

1.01  PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Deliver the following products to the Electric Contractor for installation and connection to power wiring:
   1. Line voltage thermostats.

B. Deliver the following products to the Construction Contractor for installation:
   1. Outside air vent assembly including detailed dimensional data.

1.02  RELATED WORK SPECIFIED ELSEWHERE

A. Vibration Isolation: Section 230550.

B. Pipe Hangers and Supports: Section 230529.

C. Wiring for Motors and Motor Controllers: Section 260523.

D. Motors: Section 260221.

1.03  SUBMITTALS

A. Product Data: Catalog cuts, specifications, installation and maintenance instructions for each type of heater specified.

B. Shop Drawings: Detailed dimensional data for outside air intake box assembly.

C. Schedule: List manufacturer, unit type, model number, and performance data for each unit heater.

D. Quality Control Submittals:
   1. Copy of Seismic Qualifications Certificate.

1.04  QUALITY ASSURANCE

A. Regulatory Requirements: Unit heaters shall be UL listed.

B. Seismic Qualification Certificate: Certificate from unit heater manufacturer covering unit heaters, accessories, supports, and components; and consisting of the following:
   1. Basis for Certification: Indicate whether Withstand Certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions, and loads transmitted to structure at each attachment point.
3. Detailed description of equipment anchorage devices on which the certification is based including installation requirements.
4. Comprehensive seismic engineering analysis of unit heaters and supports.

PART 2 PRODUCTS

2.01 GAS FIRED TYPE UNIT HEATER

A. Type: Hot Dawg Series, Model HDS By Modine Manufacturing Company, 1500 DeKoven Avenue, Racine, WI, 53403, (800)828-4328

B. Gas Vent: 3 inches

C. Service Voltage: 115V

D. Control: 24V thermostat.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer’s printed installation instructions, unless otherwise specified.

END OF SECTION