SECTION 22 0529
PLUMBING PIPING AND EQUIPMENT SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 22 0548 - Plumbing Seismic Anchorage and Restraints

B. Section 22 0700 - Plumbing Systems Insulation

C. Section 23 0550 - Vibration Isolation (Spring Hangers and Mounts)

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Provide all supporting devices not provided as part of building structure or indicated on structural drawings or structural details, as specified and as required for proper supporting, anchoring, and guiding of piping, equipment, materials and systems.

B. Support for all conditions of operation, including variations in installed and operating weight of equipment, piping and ductwork, to prevent excess stress and allow for proper expansion and contraction.

C. Support of fire protection pipe shall comply with NFPA 13 Standard for the Installation of Sprinkler Systems, _____ Edition.

1.04 SUBMITTALS

A. Product Data for each piping system for all pipe sizes and all applicable equipment including the following:
   1. Manufacturer's name
   2. Model numbers
   3. Materials of construction and load ratings lbs.
   4. Schedule of hangers and support devices with pipe support spacing
   5. Insulated pipe supports along with application chart or table including pipe support spacing.
   6. Insulation protection saddles and weight bearing insulation table
   7. Details and calculations for sizing supplementary steel utilized for trapeze or specially designed supports
   8. Structural attachments, inserts, and concrete anchors. Submit ICC-ES Evaluation Report for each type of anchor.
   9. Calculations and drawings for concrete inserts and anchors for each application
   10. Drawings showing specific locations of any weld attachments to structure, including weight supported by such attachments
   11. Drawings showing specific locations of any suspended loads which exceed 100 lbs within joist chord panel to be attached to open web steel joist structural members. Include weight supported by such attachments. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord.)
   12. Equipment mounting devices
   13. Pipe guides and anchors
   14. All other appropriate data

B. Submittals in PDF format shall be organized using PDF bookmarks per detailed instructions on assembling submittal packages identified under Submittal Requirements section of 22 0000 - General Plumbing Requirements.

1.05 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall conform to the latest requirements of ANSI B31/ASME B31.1 Code for Pressure Piping and MSS Standard Practice SP-58-2018 (Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation), except as supplemented or modified herein.

B. Support materials shall be steel or stainless steel unless specifically indicated.

C. Support devices shall be factory fabricated and have published load ratings.

D. Unless otherwise indicated, design supports, anchors, and related components with safety factor in accordance with AISC Manual of Steel Construction, but not less than 2.0.

E. Determine maximum deflection using the following equation.

F. Maximum deflection of support members, including trapeze supports, shall be in accordance with the following equation, but shall not exceed 0.3":

D = L/240

Where D = Max deflection in "

L = Support member length in "

G. Unless otherwise indicated, hangers, support devices and hardware shall be steel and shall have factory standard black, primed, galvanized or electroplated finish for indoor application, and hot-dipped galvanized finish for outdoor application and corrosive atmospheres. Coat cut edges, welds or any damaged finish with galvanized paint.

1. Corrosive atmospheres include the following locations:
   a. Exterior locations
   b. Chemical storage and hazardous waste storage rooms
   c. Food service/kitchen areas
   d. Locker/shower rooms
   e. Meter pits
   f. Utility tunnels
   g. Cage wash room (dirty and clean)
   h. Sterilizer/autoclave room

H. Materials in contact with pipe shall be galvanically compatible with piping material to eliminate conductive path for galvanic corrosion. Where piping and support materials have galvanic potential, Provide galvanic separation, such as nonmetallic coating or inserts between piping and metallic supports. Pipe insulation is acceptable galvanic separation. Materials in contact with pipe shall be galvanically compatible with piping material to eliminate conductive path for galvanic corrosion. Where piping and support materials have galvanic potential, provide galvanic separation, such as nonmetallic coating or inserts between piping and metallic supports. Pipe insulation is acceptable galvanic separation. Galvanic potential shall be determined by table below:

	Galvanized Steel	**Carbon Steel**	**Stainless Steel (Type 304 or 316)**	**Copper Brass Bronze**
Copper, Brass, Bronze	Yes	Yes	No	NA
Stainless Steel (Type 304 or 316)	Yes Note (1)	Yes Note (1)	NA	

Carbon Steel	No	NA		
Galvanized Steel	NA			

(1) Required where stainless steel surface area near interface is equal or greater than steel surface area

I. Unless otherwise indicated, steel support devices exposed to ventilation air stream shall be stainless steel or steel with either galvanized finish or paint finish. Paint type shall be approved by Architect/Engineer.

J. This Contractor is responsible for proper placement and sizing of supporting devices to accommodate insulation thickness and pitching of pipe. Coordinate with Contractor performing work specified in Section 22 0700 - Plumbing Systems Insulation.

K. In addition to hangers specified in this Section, piping connected to pumps, compressors, and similar rotating or reciprocating equipment shall have vibration isolation hangers or supports for specified distance from such equipment. Refer to Section 23 0550 - Vibration Isolation for required distance.

L. Where piping can be conveniently grouped to allow trapeze type supports, supporting steel shall be by means of standard structural shapes.

M. Hangers and rods shall be plumb when pipelines are at their normal operating temperatures.

N. Unless otherwise indicated, continuous insert channels are not allowed.

O. Punching, drilling, or welding of building structural steel is not allowed unless approved by Structural Engineer.

P. Refer to Structural Documents and ICC-ES Evaluation Report for application of concrete inserts and concrete anchors.

Q. Lateral braces shall be designed and detailed to apply loads as directly as possible to structural floor slabs, roof decks, or other building lateral elements. Braces shall not be applied to bottom flanges of steel beams or bottom chords of open web steel joists.

R. Coordinate with Contractor for any proposed weld attachments to building structure. This may result in use of welding codes or standards, which may apply to "structural work". and may necessitate repair of fireproofing and/or extension of fireproofing to support members. Execution of this work may be assigned to General Trades responsible for building structural steel. Cost for this work, however, will remain the responsibility of this Contractor.

S. Top or bottom chords of open web steel joists may be used to support loads, provided total load within panel does not exceed 100 lbs and load is placed concentric to joist. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord).

T. Where fire rated fiberglass products are used for channel and support devices, the following properties shall apply:
   1. Flame Spread Properties
      a. Polyester Fiberglass (PF) Class 1 ASTM E84
      b. Vinylester Fiberglass (VF) Class 1 ASTM E84

U. Fasteners including concrete anchors for seismic application shall have ICC Evaluation Service Report (ESR) and meet requirements of local authorities.

PART 2 - PRODUCTS

2.01 STRUCTURAL SUPPORTS

A. Unless specifically indicated on structural drawings, design and provide all supporting devices including miscellaneous steel (angles, channels, beams, etc.), required for proper support of piping, equipment and materials.

B. Supporting steel in _____ shall be stainless steel.

2.02 PIPE HANGERS AND SUPPORTS (METALLIC)

A. Manufacturers: Anvil, Erico, Tolco, PHD, National Pipe Hanger Corporation, or B-Line, equal to Anvil figures listed. Corresponding MSS Type is indicated where applicable.

B. Clevis and Roller Type Hangers:

System	Pipe Size	Clevis	Roller
Hot Pipes with Insulation (105°F and above)	and 2" and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2" to 6"	---	171 (MSS Type-41), 181 (MSS Type-43)
	8" and larger	---	171 (MSS Type-41)
Ambient Bare Pipes (61°F to 104°F)	2" and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2" and larger	260 (MSS Type-1), 216 (MSS Type-4)	---
Cold Pipes with Insulation (33°F to 60°F)	2" and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2" and larger	260 (MSS Type-1), 295 (MSS Type-1)	---
Cold Pipes with Insulation 32°F and below)	2" and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2" to 6"	260 (MSS Type-1)	171 (MSS Type-41), 181 (MSS Type-43)
	8" and larger	---	171 (MSS Type-41)

1. For pipe size 2-1/2" and larger, where there is transverse movement at support points due to thermal expansion/contraction, clevis type hangers similar to Anvil Figure 260 (MSS Type-1) may be used if vertical angle of hanger rod is less than 4°.

C. Flat Surfaces (Trapeze, Rack Type):

1. Use structural steel members such as struts, angles, channels and beams to support pipes as required. Select members properly for pipe support types and loading conditions. Refer to Part 1 for design criteria. Submit support details with type of members selected and load calculations. Provide straps, clamps, rollers or slides indicated below at each support point.

System	Pipe Size	Straps or Clamps	Rollers	Slides

Hot Pipes with Insulation (105°F and above)	2" and smaller	Anvil Klo-Shure	---	
	2-1/2" and larger	---	171 or 177(MSS Type-41), 271 (MSS Type-45), 274 (MSS Type-46)	257 or 436 with 212 or 432 clamps, Type 1, 2 or 3 for longitudinal movement only. Type 4, 5 or 6 for both longitudinal and transverse movement
Ambient Bare Steel Pipes (61°F to 104°F)	6" and smaller 8" and larger	B-Line BVT Unistrut Cush-a-Clamp	---	---
Ambient Bare (Copper) pipes (61°F to104°F)	all sizes	B-Line BVT Unistrut Cush-a – Clump		
Cold Pipes with Insulation (33°F to 60°F)	10" and smaller	137 (MSS Type-24)	---	---
	12" and larger	432	171 or 177 (MSS Type-41), 271 (MSS Type-45), 274 (MSS Type-46)	257 or 436 with 212 or 432 clamps, Type 1, 2 or 3 for longitudinal movement only and Type 4, 5 or 6 for both longitudinal and transverse movement.
Cold Pipes with Insulation (32°F to 59°F) and below)	2" and smaller	243, 244	---	---
	2-1/2" and larger	---	171 or 177 (MSS Type-41), 271 (MSS Type-45), 274 (MSS Type-46)	257 or 436 with 212 or 432 clamps, Type 1, 2 or 3 for longitudinal movement only and Type 4, 5 or 6 for both longitudinal and transverse movement.

D. Vertical Pipe within Wall Cavities
   1. Use clamps, straps, inserts or channels to support pipes concealed in wall cavity. Select members for pipe support types and loading conditions. Refer to Part 1 for design criteria.
   2. Provide clamps, strut channels, insulated supports, or brackets and inserts equal to manufacturer indicated below:

System	Pipe Size	Supports	Clamps, Brackets/Inserts	Pre-insulated Inserts
Hot and Cold Pipes with Insulation	All sizes	Anvil 137	HoldRite 260 series with SBIS bracket, Anvil 262	Anvil Klo-Sure, Pipe Shields A2000
Ambient Bare Pipes (61°F to 104° F	All sizes	Anvil 137, 138-R	Anvil 262	---
Ambient Bare Copper Pipes (61°F to 104°F)	All sizes	Anvil CT-138R	HoldRite 260 series with SBIS bracket	---

2.03 PIPE HANGERS AND SUPPORTS (NON-METALLIC)

A. Manufacturers: Aickinstrut, B-Line, Strut-Tech, Unistrut, Litchfield International, equal to B-Line figures listed

B. Clevis Type Hangers:

System	Pipe Size	Clevis	
____	4" and smaller	B-Line No. BFP22 SH series	
____	____" and smaller	B-Line No. BFP22 SH series	
Bare Pipe	4" and smaller	B-Line No. BFP22 SH series	

C. Clamp Type Hangers:

System	Pipe Size	Clamp	Cushions
Iron Pipe	____" and smaller	B-Line No. BFP-2000 Series	--
Steel Pipe	____" and smaller	B-Line No. BFP-2000 Series	--
Copper Tubing	____" and smaller	B-Line No. BFP-2000 Series	--

2.04 INSULATION PROTECTION SHIELDS

A. Anvil Fig. 167 (MSS Type-40) constructed of galvanized carbon steel. Per the latest edition of Standard MSS SP-58, select shield to accommodate outer diameter of insulation. Shield length and gauge for insulation compression strength not less than 15 psi, shall be as follows:

Pipe Size	Length	Gauge
1/4" thru 3"	12"	18
4"	12"	16
5" and 6"	18"	16
8" thru 14"	24"	14
16" thru 24"	24"	12

2.05 INSULATED PIPE SUPPORTS

A. Description:
   1. Products designed specifically for weight-bearing support of insulated pipes. Apply products in accordance with manufacturer's recommendations and requirements indicated below:
   2. Refer to PART 3 – EXECUTION for application of Type A, Type B, and Type C Insulated Pipe Supports specified below.

B. General:
   1. Supports shall be designed and rated for applied load, including weight of pipe, fluid, insulation, and any other imposed loads, with minimum 1.5 safety factor. Ratings shall be published by manufacturer and included in submittals.
   2. Load ratings shall be established by pipe support manufacturer based upon testing and analysis conforming to the latest editions of ASME B31.1 and MSS SP-58.
   3. High compressive strength inserts utilized to support loads shall encircle circumference of pipe. Block-style inserts are not allowed.
   4. Supports shall be suitable for hot or cold pipe service as applicable.
   5. Submit chart or table indicating selected model along with pipe sizes, rated loads, support device types and support spacing for each piping system.
   6. Pipe support spacing shall be in accordance with manufacturer's recommendations but shall not exceed maximum spacing indicated under Hanger and Support Spacing in Part 3 of this Section.
   7. Testing of insulation for compressive strength properties shall comply with ASTM D1621.
   8. Insulation thickness shall match adjacent pipe insulation thickness.
   9. Integrity of vapor barrier jacket shall be maintained continuously through support assembly.
   10. Insulated pipe support style shall be specifically selected for the application and shall consider the following criteria at minimum:
      a. Vertical, lateral and axial support design load limits.
      b. Vertical, lateral, and axial support design travel limits
      c. Temperature of support, at pipe surface, and ambient conditions
      d. Test or pre-operational loads that may exceed normal operating conditions
      e. Material for any items that will be welded directly to the pipe
      f. Loading and displacements caused by seismic, hydraulic surge, or other forces
      g. Temperature at support steel
   11. All steel components shall have corrosion protection coating consisting of hot-dip galvanizing or zinc-rich primer coating.

C. Type A Insulated Pipe Supports (Light Duty)
   1. Description:
      a. Pipe insulation specified in Section 22 0700 - Plumbing Systems Insulation with insulation protection shields specified in this Section. Weight-bearing inserts are not required.
      b. Type B or Type C supports may be utilized in lieu of Type A supports.

D. Type B Insulated Pipe Supports (Standard Duty):
   1. Manufacturers:
      a. SNAPP ITZ insulation inserts by KB Enterprise, Tru-Balance Insulated Saddles by Buckaroos, Inc., Value Engineered Products, or approved equal.
      b. Klo-Shure insulation couplings may be used for cold pipes insulated with elastomeric insulation. Mount shall be 7 Series Strup Mount with metal clamps or Clevis System for clevis hangers.
      c. Type C supports may be utilized in lieu of Type B supports"

d. Contractor may propose to utilize contractor-fabricated insulated pipe supports in lieu of manufactured Type B Supports. Use of contractor-fabricated assemblies is subject to approval of appropriate submittal data. Submit detail drawings of assemblies and product data showing equivalency to specified manufactured products for approval.

2. Description:
   a. Load-rated assembly consisting of high compressive strength insulation material completely encompassing circumference of pipe, vapor barrier jacket, and insulation protection shield.
   b. Insulation protection shield shall conform to ANSI/MSS SP-58. Shield shall be G90 galvanized steel and shall span full circumference of pipe insulation. Half-shields spanning lower 180° degrees arc of insulation outer circumference will be acceptable when used with clevis hangers.
   c. Axial length of insulation material shall be not less than 9" or 2" longer than insulation protection shields (1" minimum on each end), whichever is longer.
3. Insulation Materials:
   a. Hot Pipes 105°F to 250°F:
      1) Rigid closed cell, polyisocyanurate or phenolic insulation by ITW, Resolco, or Kingspan. Minimum compressive strength shall be 100 psi.
   b. Hot Pipes 251°F to 1200°F:
      1) High-density calcium silicate insulation similar to Johns Manville Thermo-12 Gold. Minimum compressive strength shall be 100 psi.
   c. Cold Pipes 60°F and below:
      1) Rigid closed cell, polyisocyanurate, phenolic insulation similar to ITW, Resolco, Kingspan, or cellular glass insulation similar to Pittsburgh Corning Foamglas.

E. Type C Insulated Pipe Supports (Heavy Duty):
1. Manufacturers:
   a. Pipe Shields, Inc., Bergen Pipe Supports, or Rilco equal to Pipe Shields models listed.
   b. Unless otherwise indicated, pre-insulated pipe supports shall be as indicated in the following schedule. Model numbers are based on Pipe Shields, Inc.
      1) Pipe supported on hangers: Model “A” Series and Model “D” Series
      2) Pipe supported on flat surfaces and pipe rollers: Models “A” Series
      3) Pipe supported on slides: Model "B" Series with lateral guide or restraint
      4) Pipe anchors: Model “C” Series
      5) Riser clamps: Model “E” Series with thrust plates. Select proper model for restraint for downward load or upward load.
   c. Contractor may propose to utilize contractor-fabricated insulated pipe supports in lieu of manufactured Type C Supports. Use of contractor-fabricated assemblies is subject to approval of appropriate submittal data. Submit detail drawings of assemblies and product data showing equivalency to specified manufactured products for approval.
2. Description:
   a. Load-rated assembly consisting of high compressive strength insulation material completely encircling circumference of pipe, vapor barrier jacket system incorporating structural inserts and insulation protection shield/casing where applicable.
3. Insulation Material:
   a. Structural Inserts:

1) Structural inserts used by manufacturer to reinforce between pipe and insulation jacket for clamping devices shall be water-resistant high compressive strength inorganic materials selected by manufacturer for desired combination of structural strength and insulating properties. Structural inserts shall have minimum compressive strength of 600 psi. Thermal conductivity shall be not more than 0.084 W/m°C at 24°C(0.58 Btu·in/(hr·ft^2°F) at 75°F.

b. Jacket:

1) Jacket shall consist of G90 galvanized steel conforming to ASTM A653/A653M and shall provide complete vapor barrier around insulation and bearing surface for protection of insulation.

2) When recommended by manufacturer, use reinforced insulation protection shield at support bearing surface. Insulation shall extend 1" beyond insulation protection shield to maintain vapor barrier integrity.

2.06 HANGER RODS (METALLIC)

A. Rods shall conform to the latest MSS Standards except as modified herein. Furnish rods complete with adjusting and lock nuts.

B. Rods shall have electroplated zinc or hot dip galvanized finish.

C. Unless otherwise indicated, size rods for individual hangers and trapeze support as indicated in the following schedule. Rod size may be reduced one size for double rod hangers. Total weight of equipment, including valves, fittings, pipe, pipe content and insulation, shall not exceed limits indicated.

Max. Pipe Size With Single Rigid Rod	Rod Diameter (inches)	Max Load (lbs) of Hanger Rod (Not exceeding 650 °F Service Temp.)
2"	3/8	730
3"	1/2	1350
5"	5/8	2160
8"	3/4	3230
12"	7/8	4480
18"	1	5900
30"	1-1/4	9500

D. Threaded rods are not allowed in clean rooms.

2.07 HANGER RODS (NON-METALLIC)

A. Rods shall conform to the latest MSS Standards except as modified herein. Furnish rods complete with adjusting and lock nuts.

B. Unless otherwise indicated, size rods for individual hangers and trapeze support as indicated in the following schedule.

C. Total weight of equipment, including valves, fittings, pipe, pipe content and insulation, shall not exceed limits indicated.

Max. Pipe Size With Single Rod	Rod Diameter (")	Max Load (lbs) of Hanger Rod (Not exceeding 200°F Service Temp.)
"	"	_____

2.08 BOLTS, NUTS, STUDS AND WASHERS

A. ASTM A307, electroplated zinc finish

2.09 ROD ATTACHMENTS

A. Anvil Fig. 290 (MSS Type-17), galvanized finish

2.10 U-BOLTS

A. Anvil Fig. 137 (MSS Type-24), galvanized finish

2.11 BEAM CLAMPS

A. Beam Clamps: Anvil Fig. 133/134 (MSS Type-21), 218 (MSS Type-30), 228 (MSS Type-28 or 29) and 292 (MSS Type-28 or 29)

B. Top Beam Clamps: Anvil Fig. 227 (MSS Type-25)

C. C-Clamps: Anvil Fig. 86, 92 or 93 (MSS Type-19 or 23) with set screw and lock nut

2.12 ADJUSTABLE PIPE SADDLE SUPPORTS

A. Anvil Fig. 264 (MSS Type-38), galvanized finish. Provide Anvil Fig. 63 Type T stanchion with base, galvanized finish, where applicable.

2.13 RISER CLAMPS (BARE PIPE)

A. Anvil Fig. 261 (MSS Type-8), galvanized finish

B. B-Line B3373C, PVC coated carbon steel, in area at pipe contact, for bare copper tubing

C. Proset system, proseal plug and fire-fill for sleeved and cored holes.

2.14 RISER CLAMPS (INSULATED PIPE)

A. Unless otherwise indicated, insulated pipe riser clamps shall be Type C insulated pipe supports. Refer to Insulated Pipe Supports in Part 2.

B. Contractor may propose to utilize contractor-fabricated riser supports. Use of contractor-fabricated riser supports is subject to approval of appropriate submittal data. Submit support detail drawings, bearing stamp of Structural Engineer registered in project jurisdiction, for approval. Supports shall be engineered to withstand static and dynamic forces with minimum safety factor of 2.0. Submit insulation details addressing thermal break from building structure and vapor barriers.

2.15 CONCRETE INSERTS (WOODEN FORMED CONCRETE)

A. Anvil Fig. 281 or 282, or Hilti HCI-WF (MSS Type-18), suitable for rod diameter and weight supported.

2.16 CONCRETE INSERTS (METAL DECK FORMED CONCRETE)

A. Anvil Fig. 284, Tolco No. 109DD, B-Line Fig. B3019, DeWalt/Powers "Bang-It+", Hilti HCI-MD, or MSCO No. MX34.

2.17 CONCRETE ANCHORS

A. Manufacturers: Hilti, DeWalt/Powers or Red Head

B. Anchors shall be selected, sized, and detailed by Contractor’s structural engineer registered in project’s jurisdiction, based on project conditions and in accordance with project building code. Calculations and drawings shall be submitted.

C. Anchors shall meet ICC Acceptance Criteria, and ICC-ES Evaluation Reports (ESRs) shall specifically list the current applicable codes.

D. Anchors installed in hardened concrete for purpose of transmitting structural loads from one connected element to another, or for safety related elements such as sprinkler pipes, heavy suspended pipes, and barrier rails shall have ICC-ES report demonstrating anchors have met requirements of AC 193 for mechanical anchors in concrete elements.

E. Post-installed expansion anchors and undercut anchors installed in hardened concrete shall be qualified for strength design and tested according to ACI 355.2. Designs shall be per the requirements of ACI 318, Appendix D.

F. Anchors for seismic load application shall be approved by ICC-ES Evaluation Reports to resist seismic loads and selected to meet project seismic design requirements. Refer to Section 22 0548 - Plumbing Seismic Anchorage and Restraints and Structural drawings.

G. Anchors shall be zinc plated in accordance with ASTM B633.

H. Select anchors with load ratings based on cracked concrete conditions.

2.18 CONTINUOUS INSERT CHANNELS

A. Manufacturers: Unistrut, Anvil, B-Line, Michigan, Halfen, Hilti or Kindorf. Brackets inserts and accessories shall be suitable for channel insert selected.

B. Length and support capabilities to be suitable for supporting plumbing piping in vicinity.

2.19 METAL FRAMING SUPPORT SYSTEM (STRUT SYSTEM)

A. Manufacturers: Unistrut, B-Line Strut Systems, Anvil-Strut, Power-Strut, Erico, Superstrut, Kindorf, Hilti, and Hydra-Zorb

B. Channels shall have epoxy paint or electroplated zinc finish.

C. Channels shall not be lighter than 12 ga.

2.20 PIPE MOUNTING PEDESTALS

A. Equal to Roof Products & System Corporation consisting of equipment rail, "U" shaped mounting brackets, galvanized threaded rod and cast iron pipe rollers. Rail shall have built-in raised cant to match roof deck insulation.

2.21 EQUIPMENT RAILS

A. Manufacturers: Roof Products & Systems, ThyCurb, Custom Curb, Inc. or Vent Products equal to Roof Products & Systems Model ER-4 with raised cant style. Mounting rails shall be galvanized steel with integral base plate, continuous welded corner seams, factory installed 2" x 4" wood nailer and 18 ga galvanized steel counter flashing.

B. Mounting rail gauge shall be selected to support equipment adequately but shall be not less than 18 ga.

C. Height shall be as detailed, but not less than 8" above finished roof.

D. Equipment rails shall span minimum of 2 joists and not cantilever more than 6") where joists are used. Rails shall be level at top with pitch built in when deck slopes 1/4" per foot or greater.

2.22 PIPE ROOF PENETRATION PROTECTIONS

A. Manufacturers: Roof Products & Systems, ThyCurb or Vent Products equal to Roof Products & Systems "RPS-Pipe Portals" consisting of 12" OD prefabricated roof curb, laminated acrylic coated ABS plastic curb cover with EPDM protective rubber cap and stainless steel clamp.

2.23 PIPE GUIDES

A. Unless otherwise indicated, guides shall be equal to Pipe Shields "B" Series, selected by load and movement. Refer to Insulated Pipe Supports in Part 2.

2.24 PIPE ANCHORS

A. Unless otherwise indicated, anchors shall be Type C Insulated Pipe Supports. Refer to Insulated Pipe Supports in Part 2.

B. Contractor may propose to utilize contractor-fabricated anchors. Use of contractor-fabricated anchors is subject to approval of appropriate submittal data. Submit anchor system detail drawings, bearing stamp of Structural Engineer registered in project jurisdiction, for approval. Anchors shall be engineered to withstand static and dynamic forces with minimum safety factor of 3.0. Submit insulation details addressing thermal break from building structure and vapor barriers.

2.25 CASEWORK PIPE SUPPORTS

A. Hinged pipe clamp and Strutcatcher, nylon 12 Grilamid, Clic by Litchfield International.

B. Vibration isolation pipe clamp, yellow zinc chromate finish, B-Line BVT Series Vibraclamp or Kwik-Clip by B-Line.

2.26 FIXTURE SUPPLY SUPPORT

A. Acceptable manufacturers: Erico, Holdrite, Siou

B. Vertical Pipe Support:
   1. Galvanized steel stud support bracket, pre-drilled tube support mounting holes, adjustable stud width, _____ or equal.
   2. UV resistant nylon tube support, rated for (0-130°F through 0-130°F, resealable locking mechanism, _____ or equal.
   3. Support bracket and tube support to be from same manufacturer.

C. Through Stud Support:
   1. Polypropylene stud insert for isolation of water tubing through metal wall studs, rated for maximum water temperature of ([130°F] ([54°C]), ____or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install supports to allow for free expansion of piping. Support piping from building structural members using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. At no time shall hangers and supports overload building structural members. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.

B. Select and size building attachments properly in accordance with MSS Standards and manufacturer's published load rating information.

C. Coordinate hanger and support installation to properly group piping of all trades.

D. Suspend piping hangers by means of hanger rods. Perforated band iron and flat wire (strap iron) are not allowed.

E. Piping and ductwork shall be supported independently from other piping or ductwork.

F. Pipe hangers and supports shall not penetrate vapor barrier of pipe insulation.

G. Do not support equipment, or piping from metal roof decking or ceiling grid.

H. Install adequate supports so as not to over stress either piping or equipment to which piping is connected.

I. Refer to Section 22 0000 - General Plumbing Requirements for requirements of personnel injury protection guards for supporting devices.

3.02 HANGER AND SUPPORT SPACING

A. Space pipe hangers and supports for horizontal pipe accordance with the following schedule, with exceptions as indicated herein:

B. Steel Pipe (Standard Weight and Extra Strong):

Pipe Size	Max Spacing
1-1/4" and smaller	7 ft-0"
1-1/2"	9 ft-0"
2"	10 ft-0"
2-1/"	11 ft-0"
3"	12 ft-0"
4"	14 ft-0"
6"	17 ft-0"
8"	19 ft-0"
10" and larger	20 ft-0"

C. Steel Pipe (Standard Weight and Extra Strong):

Pipe Size	Max Spacing
1-1/4" and smaller	7 ft-0"
1-1/2"	9 ft-0"
2"	10 ft-0"
2-1/2"	11 ft-0"
3" and larger	12 ft-0"

D. Copper Tube (Unless Otherwise Noted):

Pipe Size	Max Spacing
3/4" and smaller	5 ft-0"
1" to 1-1/4"	6 ft-0"
1-1/2" to 2-1/2"	8 ft-0"
3" and larger	10 ft-0"

E. Copper Tube (Domestic Water, Laboratory Water, Non-potable Water):

Pipe Size	Max Spacing
1-1/4" and smaller	6 ft-0"
1-1/2" and larger	10 ft-0"

F. Copper Tube (Domestic Water, Laboratory Water, Non Potable Water):

Pipe Size	Max Spacing
1-1/2" and smaller	6 ft-0"
2" and larger	10 ft-0"

G. Copper Tube (Medical Gases):

Pipe Size	Max Spacing
1/4"	5 ft-0"
3/8" and 1/2"	6 ft-0"
3/4"	7 ft-0"
1"	8 ft-0"
1-1/4"	9 ft-0"
1-1/2" and larger	10 ft-0"

H. Plastic Pipe

1. PVC Pipe:

Pipe Size	Max Spacing
All sizes	4 ft-0"

2. CPVC Pipe:

Pipe Size	Max Spacing
1" and smaller	3 ft-0"
1-1/4" and larger	4 ft-0"

3. PVDF Pipe (Waste and Vent):

Pipe Size	Max Spacing
2" and smaller	3 ft-0"
3" and larger	4 ft-0"

4. PP Pipe (Waste and Vent):

Pipe Size	Max Spacing
2" and smaller	3 ft-0"
3"	4 ft-0"
4"	4 ft-6"

5. PP Pipe (High Purity Water):

Pipe Size	Max Spacing
All sizes	Continuous sheet metal trough

6. PP-R Pipe (Potable and Nonpotable Water):

Pipe Size	Max Spacing
2" and smaller	4 ft-0"
3"	6 ft-0"

7. PEX-a Pipe (Potable and Nonpotable Water):

Pipe Size	Max Spacing
3" and smaller	2 ft-8"

   a. Pipe can be supported with PEX-a Pipe Channel as an alternate. Spacing for supports with pipe channel shall be 6 ft) for pipes 3/4" and smaller and 8 ft for pipes 1") and larger.
   b. Provide copper tube size riser clamps at base of each floor and at top of every other floor with mid-floor guides for hot water systems.
   c. Provide copper tube size riser clamps at base of each floor and top of every 4 floors with mid-floor guides for cold water systems.

8. Support plastic pipe at all changes of direction. Adequate consideration shall be given to piping expansion.

I. Cast Iron Pipe:
   1. Maximum hanger and support spacing shall be 10 ft for all pipe sizes. Provide minimum of one hanger per pipe section close to joint on barrel, at each pipe fitting, at change of direction and branch connections.
   2. Support Cast Iron No-Hub pipe as recommended in CISPI Publication "Cast Iron Soil Pipe and Fittings Handbook, Chapter IV - Installation of Cast Iron Soil Pipe and Fittings."

J. Borosilicate Glass:
   1. Maximum hanger and support spacing for borosilicate glass piping shall be 10 ft.
   2. Support borosilicate glass pipe with padded hangers.

K. Maximum spacing shown above may be restricted by strength of attachment to building structure. Submit data with calculations with published load ratings showing attachment to be utilized and maximum spacing allowable for that type of attachment and pipe size.

L. Spacing less than indicated above may be required to conform to building structure design or loading limitations.

M. Spacing less than indicated may be required depending on compressive strength of pipe insulation and insulated pipe supports.

N. If pipe size changes between support points, maximum spacing shall be based on the smaller pipe size.

O. If trapeze hangers are used to support multiple services, spacing shall be based on the most restrictive pipe size and material on trapeze hanger.

P. For non-metallic pipe, follow manufacturer's installation recommendations in addition to requirements noted herein.

Q. Install supports for vertical piping and anchors as recommended by pipe manufacturer.

R. Place hangers and supports to meet requirements of Section 23 2116 - Pipe and Pipe Fittings or specific pipe system sections, with regard to pitch for drainage and venting and clearance between services.

S. Hangers and supports shall bear on outside of insulation when pipes are to be insulated.

T. Place hangers and supports within 1 ft of each fitting, such as elbows and tees, and at each valve, strainer, and other piping specialty for piping 4" and larger.

U. Place hanger or support at first elbow upstream of pump inlet and first elbow downstream of pump outlet.

3.03 RISER SUPPORTS

A. Insulated Piping:
   1. Unless otherwise indicated, support vertical piping as indicated below:
   2. Support vertical piping at _____ of riser, secured and anchored to building structure. Provide guides on vertical piping. Use spring hangers at _____ of riser and at take offs from riser at each floor. Use spring hangers for minimum 3 hangers away from top and bottom elbows and from each take off at riser.
   3. Guide vertical piping 2-1/2" and smaller at every floor. Guide 2-1/2" and larger at every other floor. Spring hangers (Type 6) and guides (Type VSG) are specified in Section 23 0550 - Vibration Isolation.

B. Bare Piping:
   1. Unless otherwise indicated, maximum vertical support spacing for ambient bare steel and cast iron pipes shall be 15 ft.
   2. Maximum vertical support spacing for other piping including copper tubing and plastic piping shall be 10 ft.
   3. Install riser clamps and intermediate supports as required.
   4. Rest riser clamps on floor or on pipe sleeve.
   5. Bare piping above 120°F such as steam vents shall be supported per insulated piping requirements.

3.04 INSULATED PIPE SUPPORTS APPLICATION

A. Install insulated pipe support at each support point of insulated pipe.

B. Pipe Size 1-1/2" and Smaller:
   1. Use Type A insulated pipe support. Pipe insulation specified in Section 22 0700 - Plumbing Systems Insulation shall be continuous through support points.
   2. Use one shield (bottom) for clevis hanger.
   3. Use 2 shields (top and bottom) for roller hanger/support or strap/clamp support. Apply 2 metal straps to hold top and bottom shields onto insulation jacket.
   4. Type B or Type C insulated pipe supports may be used in lieu of Type A support.

C. Pipe Size 2" through 5":
   1. Use Type B insulated pipe supports. Refer to Part 2 for acceptable products.
   2. Type C insulated pipe supports may be used in lieu of Type B supports.

D. Pipe Size 6" and Larger:
   1. Use Type C insulated pipe supports. Refer to Part 2 for applicable products.

3.05 PIPE FLOOR SUPPORTS

A. Unless specifically shown otherwise, use adjustable pipe saddle supports with associated stanchion similar to Anvil Fig. 264/63. Select supports properly for weight and height of pipe stand.

3.06 CONCRETE INSERTS

A. Concrete insert application, size, loading, and placement shall be this Contractor's responsibility.

B. Coordinate with General Contractor for placement of inserts before concrete pour. Minimize use of inserts and anchors after concrete pour.

3.07 CONTINUOUS INSERT CHANNELS

A. Mount continuous insert channels when used for pipe support on 8 ft-0" maximum centers and 8 ft-0" from corners.

3.08 BEAM CLAMPS

A. Provide locknut for hanging rod at clamp.

B. C-clamps are allowed for rod size 3/8" or smaller and only for static loading such as air piping, cold water piping, fire protection piping and, other similar piping. C-clamps are not allowed for hot water piping and steam and steam condensate piping, except hot water runouts to terminal heating devices.

C. C-clamps are not allowed for open web steel joist application.

D. C-clamps are not allowed for seismic application.

3.09 TRAPEZE SUPPORTS

A. Construct trapeze supports with struts, angles, or channels and hang them by inserts or welded beam attachments and rods.

B. Determine trapeze supports spacing by the smallest pipe on trapeze.

C. If trapeze supports are used to support multiple services, support spacing shall be based on the most restrictive pipe size and material on trapeze supports.

D. Refer to Part 1, Design Criteria for maximum deflection allowed for trapeze supports.

3.10 PIPE MOUNTING PEDESTALS

A. Use for all piping on roof. Install bottom of pedestal flat on roof deck, insulate exterior of pedestal, flash and counter flash.

3.11 EQUIPMENT RAILS

A. Use for all roof-mounted equipment, which is not curb mounted. Install bottom of equipment rail flat on roof deck. Insulate exterior of equipment rail.

B. Flashing will be by General Contractor. Provide counter flashing as specified and secure to wood nailer with stainless steel truss head screws.

3.12 CONCRETE ANCHORS

A. Anchor application, size, and placement shall be this Contractor's responsibility.

3.13 PIPE ROOF PENETRATION PROTECTIONS

A. Install at points where pipes are penetrating roof. Install as shown and according to manufacturer's installation instructions.

3.14 PIPE GUIDES

A. Install where shown on drawings.

B. For manufactured expansion devices, install minimum of 2 pipe guides at each side of manufactured pipe expansion device. Locate first guide no more than 4 pipe diameters from expansion device and second guide at 14 pipe diameters from first guide. Install intermediate guides in accordance with guide spacing data recommended by manufacturer or the following table, whichever is more stringent.

MAXIMUM DISTANCE BETWEEN INTERMEDIATE GUIDES (FT)				
	Pipe Operating Pressure			
Pipe Size (inches)	0-50 psig	51-100 psig	101-150 psig	151-200 psig
3	21	19	17	16
4	35	29	25	22
6	57	44	37	32
8	66	52	45	40
10	91	69	58	51
12	107	79	66	58
14	115	85	71	62
16	127	94	78	68

C. If anchor is located within 4 pipe diameters from expansion joints, guides need not be installed on anchor side.

3.15 PIPE ANCHORS

A. Install anchors where shown on drawings or in conjunction with expansion joints, loops and swing joints as required to allow proper expansion and contraction of piping without damage to structure, equipment or piping.

B. Do not anchor piping to concrete block walls, wood, or partition walls.

END OF SECTION

SECTION 22 0553
PLUMBING SYSTEMS IDENTIFICATION

PART 1 - GENERAL

1.01 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents, including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 SUBMITTALS

A. Product Data: For identification materials and devices

B. Valve Schedules: For each piping system

C. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

PART 2 - PRODUCTS

2.01 IDENTIFYING DEVICES

A. Stencil Paint:
   1. Oil-based, alkyd enamel, black color

B. Marker System:
   1. Manufacturers: Brady USA, Marking Services Inc. (MSI), Kolbi, or Seton
   2. Manufacturer's standard, preprinted with color coding, lettering size, and length of color field according to ASME A13.1.
   3. Use pressure-sensitive type or “snap-on” type.
   4. “Strap-on” type may be used for piping over 6” size, including insulation.

C. Valve Tags:
   1. Minimum 1-1/2” diameter, 0.032" thick, polished brass or 316 stainless steel.

D. Laminated Plastic Nameplates:
   1. Nameplates shall be approximately 1-1/2” x 4“, 1/16” thick, and have 1/2" high lettering. Face of plastic nameplates shall be black with white letters.
   2. Fasteners shall be self-tapping, stainless steel screws or contact type with permanent adhesive.

E. Underground Warning Tape:
   1. Manufacturers: Brady USA, Marking Services Inc. (MSI), Kolbi, or Seton
   2. Underground warning tape, 5.0 mil overall thickness, 2” width minimum, aluminum foil core where required to be detectable, bonded polyethylene jacket. Brady “Identoline” or equal.
   3. Following services shall be provided with warning tape with colors and trace wire as indicated:
      a. Natural Gas: Yellow with black letters, detectable
      b. Fuel Oil: Yellow with black letters, detectable
      c. Water Lines: Blue with black letters, (non) detectable
      d. Sanitary Sewer: Green with black letters, (non) detectable
      e. Storm Sewer: Green with black letters, (non) detectable

PART 3 - EXECUTION

3.01 GENERAL

A. After painting and/or covering is completed, identify equipment and piping as indicated. Locate identification as conspicuously as possible except where such would distract from finished area.

B. Where markers are used in high heat applications or exposed to harsh chemical or acid environments, specifically select marker materials for those applications.

C. Coordinate, obtain and confirm mechanical systems identification criteria and requirements from Owner.

3.02 PIPING SYSTEM IDENTIFICATION

A. Install pipe identification on each system.

B. Place flow directional arrows at each pipe identification location.

C. Identify all piping (except medical gas) not less than once every 25 ft, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

D. Identify medical gas piping systems identified in Section 22 6316 in accordance with NFPA 99.
   1. Medical gas piping system labels shall be located as follows:
      a. At intervals of not more than 20 ft
      b. At least once in every room
      c. On both sides of walls or partitions penetrated by piping
      d. At least once every story transversed by risers
   2. Medical gas piping shall be labeled by stenciling or adhesive markers that identify patient medical gas, support gas, or vacuum system and include:
      a. Gas/Vacuum system name or chemical symbol per NFPA 99 Table 5.1.11
      b. Gas/Vacuum color code per NFPA 99 Table 5.1.11
      c. Operating pressure in addition to gas name where positive pressure piping systems operate at pressures other than standard pressures defined by NFPA 99 Table 5.1.11.
   3. Medical gas piping shall not be painted.

E. Identify piping by stenciling. Height of lettering shall be same as pipe diameter up to maximum of 1” in height. When finished color of piping is dark, stenciling shall be on white background.

F. Identify piping with marker system.
   1. For “strap-on” type, ensure marker is fitted snugly to pipe or pipe insulation surface with sufficient straps.

3.03 VALVE IDENTIFICATION

A. Identify valves with brass tags bearing system identification and valve sequence number in 1/2” black characters. Attach tag to valve body with brass jack chain and “S“ hook for brass tag and SS jack chain or SS braided wires with swag sleeves and “S“ hook for stainless steel tag. Non-metallic fasteners are not allowed.

B. Valve numbers shall be prefixed with corresponding piping system identification in 1/4” black letters.

C. Furnish typewritten valve schedule indicating valve number, fixtures, equipment or areas served by each numbered valve and incorporate in O&M Manuals.

3.04 EQUIPMENT IDENTIFICATION

A. Identify major equipment, including heat exchangers, pumps, water heaters, tanks, compressors, etc.

B. Identify equipment by stenciling equipment number and service in 2” high letters.

C. Identify equipment with marker system.

D. Identify equipment with laminated plastic nameplates.

E. Identify control equipment and panels with laminated plastic nameplates.

F. Nameplate Markings:
   1. Identify model number, size, capacity, electrical characteristics, serial number, along with other items scheduled for equipment on drawings.
   2. Indicate motor horsepower, voltage, phase, cycles, RPM, full load amps, locked motor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency, minimum circuit amps, minimum feeder conductor size, disconnect or fuse size, refrigerant, and other pertinent information.

G. Locate motor nameplates for easy reading. Relocate or provide new nameplates on motors if original nameplates are not located for easy reading.

3.05 ACCESS PANEL IDENTIFICATION

A. Identify each service opening or access opening with minimum 1/2" high letters indicating type of damper.

B. Furnish typewritten charts with identification and location of all access panels serving equipment and valves and incorporate in O&M Manuals.

3.06 SPRINKLER ZONE CONTROL VALVE IDENTIFICATION

A. Identify sprinkler zone control valves with laminated plastic nameplates. Nameplate shall include name of sprinkler zone served and description of area served.

B. Identify inspector's test valve with laminated plastic nameplate if valve is located remote from sprinkler control valve. Nameplate shall include name of sprinkler zone served.

3.07 UNDERGROUND WARNING TAPE

A. Install detectable warning tape 4" to 6" below grade to allow for accurate above surface detection.

B. Install non-detectable warning tape 6" to 12" below grade.

C. Repair and replace existing underground warning tape where disturbed by excavation.

END OF SECTION

SECTION 22 0700
PLUMBING SYSTEMS INSULATION

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 22 0529 - Plumbing Piping and Equipment Supporting Devices

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Provide insulating materials and accessories as required for mechanical systems as specified below.

B. Insulating products delivered to construction site shall be labeled with manufacturer's name and description of materials.

1.04 DEFINITIONS

A. Concealed areas, where indicated in this Section, shall apply to shafts, furred spaces and space above finished ceilings, inaccessible tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

B. Unless otherwise indicated, unit of thermal conductivity is Btu in/(h ft² °F).

C. Interstitial spaces are considered as concealed areas.

1.05 SUBMITTALS

A. Product Data for each piping system for all pipe sizes, each ductwork system but not limited to, the following:
   1. Manufacturer's name
   2. Schedule of insulating materials
   3. Insulation material and thickness
   4. Jacket
   5. Adhesives
   6. Fastening methods
   7. Fitting materials
   8. Intended use of each material
   9. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings
   10. Insulation installation details (manufacturer's installation instruction/details, Contractor's installation details, MICA plates where applicable)
   11. Literature data sheet from sealants and adhesive manufacturers stating VOC compliance with USGBC LEED IEQ 4.1.
   12. Literature data sheet from coatings and mastics (including lagging adhesives) manufacturers stating VOC compliance with USGBC LEED IEQ 4.2.
   13. All other appropriate data

1.06 DELIVERY, STORAGE AND HANDLING

A. Insulation material shall be delivered to project site in original, unbroken factory packaging labeled with product designation and thickness. Shipment of materials from manufacturer to installation location shall be in weather-tight transportation. Protect insulation materials from moisture and weather during storage and installation. Protect insulation material against long exposure to UV light from sun.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Insulation:
   1. Owens Corning, Johns Manville, Manson, Knauf or CertainTeed similar to product indicated except where product of manufacturers not listed above is specifically identified for special type of insulation.

B. Coatings, Mastics, Sealants and Adhesives:
   1. Foster, Childers, Design Polymerics, Vimasco, Miracle or Pittsburgh Corning

2.02 MATERIALS

A. Products used for or related to air conditioning and ventilating systems shall conform to NFPA 90A possessing flame spread index of not over 25 and smoke developed index no higher than 50.

B. Unless otherwise indicated, all products, material itself or on composite basis, shall have flame spread index not more than 25 and smoke developed index not more than 50, when tested in accordance with ASTM E84 or UL 723.

C. Pipe insulation installed outdoors may have smoke developed index not exceeding 450.

D. Insulation shall not contain formaldehyde

E. Foam insulation materials shall not use CFC or HCFC blowing agents in manufacturing process.

F. Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36.

2.03 INSULATION

A. Insulation materials shall be fire retardant, moisture and mildew resistant, vermin proof, and suitable to receive jackets, adhesives and coatings as indicated.

B. Glass fiber insulation shall be of inert inorganic material, non-corrosive to mechanical surfaces.

C. Insulating cement shall be Quick-Cote by PK Insulation MFG Co. or Ryder GP, with dry density of no more than 38 lb/ft³ thermal conductivity of 0.96 at 400°F mean temperature, and service temperature to 1200°F.

D. Filling and finishing cement shall be Super-Stik by PK Insulation MFG Co., or Ryder MW, with dry density of no more than 24 lb/ft³, thermal conductivity of 0.74 at 500°F mean temperature, and service temperature to 1900°F.

E. Type A Insulation (Flexible Elastomeric):
   1. Flexible, closed-cell, elastomeric cellular insulation.
      a. ASTM Standard: ASTM C534/C534M, Type I (tube form) or Type II (sheet form), Grade I
      b. Thermal Conductivity: Maximum 0.28 at 75°F mean temperature
      c. Water Vapor Permeability: Maximum 0.08 perm-"
      d. Water Absorption: Maximum 0.2 % by volume
      e. Service Temperature: -297 to 220°F
   2. Manufacturers/Products:
      a. Armacell, AP Armaflex FS
      b. Aeroflex, Aerocel
      c. K-Flex, Insul-Tube

F. Type F Insulation (Flexible Fiberglass Blanket):
   1. Flexible fiberglass blanket insulation, faced with specified jacket.
      a. ASTM Standard: ASTM C1290
      b. Density: Minimum 0.75 lb/ft³

c. Thermal Conductivity: Maximum 0.30 at 75°F mean temperature
d. Service Temperature: Maximum 250°F.

2. Manufacturers/Products:
   a. Johns Manville, Microlite EQ FSK
   b. Owens Corning, All Service Duct Wrap
   c. Knauf, Atmosphere Duct Wrap.

G. Type H Insulation (Calcium Silicate Block or Pipe):
1. Hydrous calcium silicate block and pipe insulation with non-asbestos fibrous reinforcement.
   a. ASTM Standard: ASTM C533, Type I
   b. Density: Minimum dry 13 lb/ft³
   c. Thermal Conductivity: Maximum 0.49 at 400°F
   d. Compressive Strength: Minimum 100 psi at 5% compression
   e. Service Temperature: 80 to 1200°F
2. Manufacturers/Products:
   a. Industrial Insulation Group (IIG), Thermo-12 Gold.

H. Type PP Insulation (Phenolic):
1. Rigid cellular phenolic insulation faced with specified jacket.
   a. ASTM Standard: ASTM C1126, Type III
   b. Density: Minimum 2.5 lb/ft³
   c. Thermal Conductivity: Maximum 0.18 at 75°F mean temperature
   d. Compressive Strength: Minimum 30 psi .
   e. Water Vapor Permeability: [2.14 perm-"] (3.10 ng/s m Pa)
   f. Water Absorption: Maximum 0.9% by volume
   g. Service Temperature: -290°F to -250°F
2. Manufacturers/Products:
   a. ITW, Trymer Supercel Phenolic
   b. Resolco, Insul-phen
   c. Polyguard, PolyPhen

I. Type R Insulation (Rigid Mineral Fiber Pipe Insulation):
1. Mineral fiber (fiberglass) preformed pipe insulation faced with specified jacket.
   a. ASTM Standard: ASTM C547, Type I
   b. Density: Minimum nominal 3 lb/ft³
      1) Thermal Conductivity: Maximum 0.23 at 75°F and 0.29 at 200°F
      2) 0.29 at 200°F mean temperature
   c. Service Temperature: To 850°F
2. Manufacturers/Products:
   a. Johns Manville, Micro-Lok HP
   b. Owens Corning, ASJ Max Fiberglas Pipe Insulation
   c. Knauf, Earthwool 1000° Pipe Insulation

J. Type R Insulation (Rigid Mineral Fiber Board Insulation):
1. Mineral fiber (fiberglass) duct and equipment insulation faced with specified jacket.
   a. ASTM Standard: ASTM C612, Type IA and IB
   b. Density: Minimum nominal 3 lb/ft³
   c. Thermal Conductivity: Maximum 0.23 at 75°F mean temperature
   d. Service Temperature: To 450°F
2. Manufacturers/Products:
   a. Johns Manville, 800 Series Spin-Glas, Type 814

b. Owens Corning, Fiberglas Fiberglass 700 Series, Type 703
c. Knauf, Earthwool Insulation Board

2.04 JACKETS

A. Jacket puncture resistances shall be based on ASTM D781 test methods. Vapor barrier permeance ratings shall be based on ASTM E96/E96M Procedure A.

B. Type A-1 Jacket (Aluminum Roll Jacketing):
1. Factory fabricated 0.016" thick, ASTM B209/B209M, Type 3003 or 3105, stucco embossed aluminum jacket with integrally bonded moisture barrier/retarder consisting of 3 layers of polymer films with total thickness of 3 mil.
2. Fitting covers shall be factory fabricated from not lighter than thick, Type 3003 or 1100 aluminum. For large pipes, where factory fabricated fitting covers are not available, Contractor shall fabricate fitting covers from like sheet materials.
3. Manufacturers/Products:
a. Johns Manville, Aluminum Jacketing
b. RPR Products, Insul-Mate

C. Type D-1 Jacket:
1. Heavy-duty, fire retardant material with glass fiber reinforcing. Jackets shall have neat, white Kraft finish suitable for painting, with beach puncture resistance of 50 units minimum. Vapor barrier shall be adhered to inner surface of jacket. Permeance shall not exceed 0.02 perm.
2. Manufacturers/Products:
a. Owens Corning, ASJ Max
b. Johns Manville, ASJ-4535
c. Knauf, ASJ+

D. Type P-1 Jackets:
1. Heavy-duty, fire retardant material with glass fiber reinforcing and self-sealing lap. Jacket shall have neat, white Kraft finish suitable for painting, with burst strength of 1.5 Joules(50 beach units) minimum and tensile strength 45 lbs/in minimum. Vapor barrier shall be adhered to inner surface of jacket. Permeance shall not exceed 0.02 perm.
2. Manufacturer/Products:
a. Owens Corning: ASJ-SSL
b. Johns Manville, ASJ
c. Knauf, ASJ+

E. Type V-1 Jacket:
1. Fire retardant and UV resistant PVC in minimum_____ mil thickness consisting of preformed fitting covers, preformed end terminations, and sheet material for straight runs of pipe. Jacketing system shall be suitable for indoor and outdoor application in temperature range of -35°F to 150°F. Material when installed according to manufacturer's instructions shall provide complete vapor barrier and readily cleanable surface while meeting Federal CGMP requirements.
2. Manufacturers/Products:
a. Johns Manville, Zeston
b. Speedline, Smoke Safe
c. Proto, LoSmoke

2.05 ADHESIVES, MASTIC, COATINGS, SEALANTS, AND REINFORCING MATERIALS

A. Adhesives and sealants shall comply with the South Coast Air Quality Management District SCAQMD 1168; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.1.

B. Coatings and mastics shall comply with VOC limits set forth by Green Seal BS-11 and comply with the South Coast Air Quality Management District SCAQMD 11133; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.2.

C. Products shall be compatible with surfaces and materials on which they are applied and shall be suitable for use at operating temperatures of systems to which they are applied.

D. Products shall be fire retardant, moisture resistant and mildew resistant and vermin proof.

E. Vapor Barrier Mastic: Below ambient insulation. Water vapor permeance shall be less than 0.08 perms at 45 mils dry film thickness per ASTM F1249.
   1. Foster 30-33
   2. Childers CP-33
   3. Vimasco 749

F. Weather Barrier Breather Mastic: Above ambient insulation. Permeance shall be greater than 1.0 perms at 1/16" dry film thickness per ASTM E96/E96M.
   1. Foster 46-50 Weatherite
   2. Childers CP-10/CP-11 Vi Cryl
   3. Vimasco WC-5

G. Lagging Adhesive/Coatings: Indoors applications used in conjunction with canvas/glass cloth.
   1. Foster 30-36
   2. Childers CP-50 AMV1
   3. Vimasco 713

H. Metal jacketing sealant for aluminum jacketing:
   1. Foster 95-44 Elastolar
   2. Childers CP-76 Chil Byl
   3. Pittsburgh Corning 727

I. Insulation joint sealant for Type P, Type PP, and Type G insulation:
   1. Foster 95-50 Flextra
   2. Childers CP-76 Chil Byl
   3. Pittsburgh Corning CW Sealant

J. Glass fiber fabric reinforcing shall be 10 x 10 mesh similar to Childers Chil Glas #10 or Foster Mast A Fab.

K. Wire mesh reinforcing shall be 22 ga, 1" galvanized.

L. Insulation cement shall be ANSI/ASTM C195, hydraulic setting mineral wool.

M. Finishing cement shall be ASTM C449.

N. Butt joint and longitudinal joint adhesive for Type A insulation shall be Armstrong 520, Rubatex 373, Childers CP-82 or Foster 85-75.

O. Weather-resistant protective finish for Type A insulation shall be equal to Armstrong WB Armaflex finish or Foster 30-64 elastomeric coating.

2.06 METAL BANDS AND WIRES

A. Aluminum bands shall be 0.5 x 0.20" up to 48" diameter and 0.75 x 0.020" over 48" diameter.

B. Stainless steel bands shall be 0.5 x 0.015" or 0.75 x 0.015".

C. Stainless steel wires shall be 16 ga.

2.07 REMOVABLE INSULATING BLANKETS

A. Custom designed removable, reusable, flexible, blanket thermal insulation system.

B. Acceptable Manufacturers: Thermal Energy Products, Inc., Advanced Thermal Corp., Temptec and Remco Technology, Inc.

C. Removable insulation system shall be custom designed for each individual item to provide close contour fit. Overlapping seams and gaps are not acceptable.

D. Removable insulation shall be designed to overlap adjoining pipe insulation by .

E. Insulation: Minimum 2" thick, 2.4 lb/ft³ density, 1000°F continuous service temperature thermal insulating wool; Owens Corning Fiberglass or equal.

F. Interior and Exterior Fabric: Minimum weight 0.59 kg/m² silicone rubber coated fiberglass cloth.

G. Securement: Blanket seams shall be closed with buckle and strap assembly (D ring closure).

H. Identification/Tagging: Label each removable insulation device with plastic or 304 stainless steel tag with raised letters. Tag as directed by Owner.

2.08 ACOUSTICAL BARRIER MATERIALS

A. Acoustical barrier material shall be combination of absorber and barrier, similar to Sound Seal Model B-10 LAG/QFA-3. Absorber/Barrier material shall have acoustic ratings of STC-29, .

B. Minimum sound transmission loss at each octave band shall be as follows:

Sound Transmission Loss (dB)					
Octave Band Center Frequency (Hz)					
125	250	500	1000	2000	4000
18	18	23	30	39	46

PART 3 - EXECUTION

3.01 APPLICATION

A. Provide insulation and jackets with minimum insulation thickness as indicated in the following schedule. The schedule applies to both exposed and concealed applications unless noted otherwise:

Piping System							
		Minimum Insulation Thickness According to Pipe Size					
Service	Jacket Type	Insulation Type	3/4" and Smaller	1" - 1-1/4"	1-1/2" - 3"	4" - 6"	8" and Larger
_____ Cold Water	P-1	R	1"	1"	1"	1"	1"
	---	A	3/4"	3/4"	3/4"	3/4"	3/4"
(Type A Insulation is an option)							
_____ Hot Water and Hot Water Return 105-140°F	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
	---	A	1"	1"	1-1/2"	1-1/2"	NA
(Type A Insulation is an option)							
_____ Hot Water and Hot Water Return 141-200°F	P-1	R	1-1/2"	1-1/2"	1-1/2"	1-1/2"	1-1/2"
Tempered Water	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
_____ Cold Water	P-1	R	1"	1"	1"	1"	1"
	---	A	3/4"	3/4"	3/4"	3/4"	3/4"

(Type A insulation is an option.)							
____ Hot Water and Hot Water Return 105-140°F	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
	---	A	1"	1"	1-1/2"	1-1/2""	NA
Storm_____ piping including roof drain body	P-1	R	NA	1"	1"	1"	1"
	---	A	NA	3/4"	3/4"	3/4"	NA
(Type A insulation is an option.)							
Sanitary waste piping downstream of cooling coil condensate connection	P-1	NA	1"	1"	1-1/2"	1-1/2"	1-1/2"
	P-1	A	3/4"	3/4"	3/4"	3/4"	NA
(Type A insulation is an option.)							
Clearwater Waste	P-1 ---	R A	1" 3/4"	1" 3/4"	1" 3/4"	1" 3/4"	1" NA
(Type A insulation is an option.)							
Purified Water - exposed	V-1	R	1"	1"	1"	1"	1"
Purified Water - concealed	P-1	R	1"	1"	1"	1"	1"
Piping Provided with Heat Tracing	P-1	R	1"	1-1/2"	2"	2"	2"
Insulation thickness shall be the greater thickness specified for piping system or thickness specified above.							
Insulated Exterior Piping	Unless otherwise indicated, provide protective insulation shield (Type A-1 jacket) in addition to pipe insulation and jacket specified in this schedule.						
Insulated Piping Subject to Abuse as Indicated on Drawings	Provide Type H insulation for hot piping and Type PP insulation for cold piping with V-1 jacket in lieu of specified insulation/jacket with same insulation thickness.						

Equipment & Systems			
Service	Jacket Type	Insulation Type	Insulation Thickness
OA Intake Pipes (Medical air, lab air intake, etc.)	---	A	1"
Heat Exchangers (Shell and Tube Type)	P-1	R	2-1/2"
Heat Exchangers (Plate and Frame Type)	---	A	1"
Water Softener Mineral Tanks		A	1"

3.02 INSTALLATION - GENERAL

A. All insulation installation methods shall be performed in accordance with the latest edition of National Commercial and Industrial Insulation Standards published by MICA (Midwest Insulation Contractors Association) and manufacturer's installation instructions, except as modified in this Section of specifications.

B. Install products with good workmanship, with smooth and even surfaces. Use full-length factory-furnished material where possible. Do not use scrap pieces.

C. Apply insulation only on clean, dry surfaces, after all rust and scale have been removed and testing of systems has been completed. Do not insulate any section of system that must be pressure tested until after it has been successfully tested. Any removal and reinstallation to correct system defects prior to end of guarantee period shall be accomplished at no expense to Owner.

D. Install insulating materials with necessary joints and terminations, to permit easy access and removal of equipment sections where inspection, service or repair is required, and to allow for expansion.

E. Where possible longitudinal joints in jackets shall face toward wall or ceiling.

F. Apply insulation to each pipe or duct individually. Common insulation applied to adjacent pipes or ducts will not be accepted.

G. Unless otherwise indicated, pipe and duct insulation shall be continuous through walls and floors.

H. Where multiple layers of insulation are used, stagger and secure each layer with metal bands.

I. Where penetrations occur through fire-rated walls, partitions, or floors, provide fire seal as specified in Section 22 0000 - General Plumbing Requirements and Section 07 8400 - Firestopping.

J. Insulate water piping within casework up to penetration of casework pipe chase at fixture stop. Insulate water piping within walls up to pipe penetration through the wall at fixture stop when serving wall-mounted fixtures. Termination of insulation shall be in neat and workman like manner with insulation jacket cap.

K. Insulate the following systems for complete vapor barrier protection:
   1. Storm
   2. Clearwater Waste
   3. Cold Water
   4. All equipment with surface temperature below 1 60°F

L. Apply Type A insulation for insulation and jackets requiring vapor barrier protection where specified insulations are cut for mounting sensors, control devices, parts of valves, devices or components which extend out from specified insulation to prevent condensation.

3.03 PIPING, VALVE AND FITTING INSULATION

A. Apply insulation to pipe, unions, flanges, fittings, valves and piping specialties with butt joints and longitudinal seams closed tightly. Valve insulation shall cover entire valve body including bonnets and packing nuts.

B. Laps on factory-applied jackets shall be 2" minimum width firmly cemented with lap adhesive, or shall be pressure sealing type lap.

C. Cover joints with factory furnished tape 3" minimum width) to match jacket. Cement firmly with lap adhesive. On systems requiring a vapor barrier (ASJ), vaporseal all longitudinal and butt joints ASJ/Saran seams with 4" wide coat of vapor barrier mastic or 3" minimum tape.

D. Where staples are used, they shall be on 6" maximum centers. When used for systems requiring vapor barrier, cover lap and staples with finish coat of vapor barrier mastic or 3" minimum tape.

E. For finishing of insulated pipe fittings and valves where surface temperature of insulation is not higher than 125°F, use one piece PVC fitting covers, minimum thickness of 0.05 mm(20 mil), Fitting cover shall be Johns Manville Zeston 2000 PVC, PROTO Fitting Covers, or similar by other manufacturers listed. Where fitting and valve insulation requires vapor barrier, seal joints of PVC covers with vapor barrier adhesives. Insulation type, R-value and density of insulation used at fittings shall match insulation of adjacent piping. Install insulation at pipe fittings and valves completely prior to applying PVC covers.
   1. For Type R (Rigid glass fiber) pipe insulation, PVC fitting covers with flexible mineral fiber blanket insulation inserts are acceptable, except those located in mechanical rooms within 6' above floor. For fitting covers located in mechanical room within 6' above floor, insulation inserts shall be pre-molded rigid fiber glass type wrapped around elbows.

F. Stove pipe style insulation on elbows (Detail A on Plate 2-200 of MICA 8th Edition) is not allowed. It may be used for closed cell elastomeric insulation.

G. Where terminations of pipe insulation are required, insulation shall have tapered ends, built up and finished as specified for fittings.

H. For pipes 1" and smaller, install specified pipe insulation and jacket continuous through hanger or support locations. Install insulation protection shields to protect insulation from compressing.

I. For pipes 1-1/2" and larger, where manufactured pre-insulated pipe supports are used at hanger or support locations, extend insulation to insulated pipe supports. Where vapor barrier is required, this Contractor shall be responsible for continuity of vapor barrier at insulated pipe supports. 3" wide vapor barrier tape on hot and cold systems at pipe supports.

J. For pre-insulated pipe supports and insulation protection shields, refer to Section 22 0529 - Plumbing Piping and Equipment Supporting Devices.

K. For Contractor-fabricated anchors, secure insulation directly to pipe surface and extend insulation up anchor for distance of 4 times insulation thickness. For pre-insulated anchors, cover entire surface of anchors with Type A insulation. Where applicable, take special care to assure vapor seal at anchor.

L. Where mechanical grooved pipe connections are used in piping system, insulate couplings as specified for pipe.

M. Piping, fittings and valves not to be insulated:
   1. Valves furnished with removable insulation/jacket

3.04 EQUIPMENT INSULATION

A. Where multiple layers of insulation are required, stagger and secure each layer with stainless steel bands.

B. Install removable insulation where access is required for cleaning, repair and inspection. Construct removable insulation with Type A insulation for cold equipment and Type R insulation with V-1 jacket for hot equipment. Do not apply bonding adhesive to equipment surface.

C. Provide removable insulating blankets on expansion joints.

D. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these locations.

E. Equipment not to be insulated:
   1. Equipment furnished with factory insulation.

3.05 EQUIPMENT AND COMPONENTS

A. Acoustical Barrier Materials:
   1. Provide 2" thick Type R insulation with Type D-1 jacket as inner layer. Over insulation install acoustical barrier materials as outer layer in accordance with manufacturer's installation instruction.
   2. Refer to plans for equipment requiring acoustical barrier materials.

3.06 PROTECTIVE INSULATION SHIELD (A-1 JACKET) FOR PIPE JACKETS EXTERIOR TO BUILDING

A. Unless otherwise indicated, install shields (A-1 jacket) around insulated pipe and fittings exterior to building. Seal water and vapor tight at terminations.

B. Longitudinal overlap shall be at least 2" wide with vapor barrier sealant.

C. Secure jacketing with 3/4" wide .015" stainless steel or 3/4" wide .020" aluminum bands and wing seals on maximum 18" centers.

END OF SECTION

SECTION 22 1118
WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section covers interior domestic cold water, domestic hot water (120°F), domestic hot water return, nonpotable cold water and trap filler lines to a point of connection inside the building.

B. All components shall comply with NSF 61 and NSF 372 to be compliant with requirement for lead content of ≤0.25% maximum weighted average.

1.02 RELATED WORK

A. Section 22 0529 - Plumbing Piping and Equipment Supporting Devices

B. Section 22 0553 - Plumbing Systems Identification

C. Section 22 0700 - Plumbing Systems Insulation

D. Section 22 2114 - Plumbing Specialties

1.03 QUALITY ASSURANCE

A. Order pipe with each length marked with manufacturer`s name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier`s name.

B. Installed material not meeting specification requirements must be replaced with material that meets these Specifications without additional cost to Owner.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

E. Before shipping, piping shall be cleaned, free of rust and scale, and chemically treated to protect inside of pipe from rusting and furnished with end caps.

1.05 SUBMITTALS

A. Manufacturer`s technical data for the following:
   1. Pipe
   2. Fittings
   3. Joints
   4. Valves
   5. Unions and Flanges
   6. Dielectric fittings
   7. Water hammer arrestors

B. Shop Drawings on items specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

B. Materials shall be provided from list of approved manufacturers. Home Market, Generic Broker, or Wholesaler's house brands are not acceptable.

2.02 PIPE, FITTINGS, AND JOINTS

A. Above Ground:
   1. Copper (1/2" and Smaller):
      a. Pipe: Copper tube, _____, hard drawn, ASTM B88
      b. Fittings:
         1) Cast copper alloy, solder joint, pressure rated, ANSI/ASME B16.18
         2) Wrought copper, solder joint, pressure rated, ANSI/ASME B16.22
      c. Joints:
         1) Lead free (<0.2%) solder, ASTM B32, flux, ASTM B813
      d. Nipples: Red brass pipe, threaded
      e. Exposed tubing and fittings in kitchen and areas subject to chemical cleaning shall have chrome plated finish.
   2. Copper [3" thru 8"]:
      a. Pipe: Copper tube, _____, hard drawn, ASTM B88
      b. Fittings:
         1) Cast copper alloy, solder joint, pressure rated, ANSI/ASME B16.18
         2) Wrought copper, solder joint, pressure rated, ANSI/ASME B16.22
      c. Joints: Brazed, BCuP-3 or BCuP-5 type, AWS A5.8M/A5.8, 1250°F minimum melting point
   3. Copper (3" and Larger):
      a. Pipe: Copper tube, _____, hard drawn, ASTM B88
      b. Fittings:
         1) Wrought copper, ASTM B75/B75M or ASTM B152/B152M and ASME B16.22, roll grooved
         2) Copper alloy CDA 836(85-5-5-5), sand cast per ASTM B584 and ASME B16.18, roll grooved
         3) Manufactured to copper tube dimensions with factory grooved ends. Flaring of tube and fitting ends to IPS dimensions is not permitted.
      c. Joints: Roll grooved with ductile iron couplings, ASTM A536. Coupling housing shall be cast with off-setting, angle-pattern bolt pads. Heat-treated carbon steel bolts, ASTM A449 and ASTM A183, pressure responsive _____ gasket UL Classified in accordance with NSF 61, and enamel coated. Victaulic Style 607.

B. Mechanically Formed Tee Connections and Couplings:
   1. Contractor may use mechanically formed tee connections in lieu of wrought copper tee fittings, for branch takeoffs up to one half (1/2) diameter of main. Mechanically formed tees shall be formed by use of T-Drill machine in accordance with ASME B31 and T-Drill manufacturer`s installation recommendation. Forming method shall be UL Listed.
   2. Mechanically formed tee connections shall be made by workers trained and certified by T-Drill manufacturer. Connections shall comply with American Welding Society lap joint weld, and joints shall be brazed in accordance with Copper Development Association Copper Tube Handbook using BCuP series filler metal.
   3. Owner reserves right to require destructive testing on 3 joints to ensure quality of joints. Contractor shall repair with new materials without any cost to Owner.
   4. Submit a formed tee sample made by each worker for approval. Sample shall be 1" main with 1/2" branch connection.

2.03 UNIONS AND FLANGES

A. General:
   1. Unions, flanges and gasket materials to have pressure rating of not less than 150 psi at 180°F**.**

B. Copper (3" and Smaller):
   1. Wrought copper union, Nibco Figure 633-W. Mueller Brass equal.

C. Copper (3" and Larger):
   1. Ductile iron flange adapters, ASTM A536, coated with copper-colored enamel for use with grooved end pipe and fittings, flat face, manufactured for engaging directly into roll grooved copper tube and fittings and bolting directly to flanged components with ANSI Class 125 and 150 bolt hole patterns, EPDM gasket. Victaulic Style 641.

2.04 VALVES

A. Shutoff Valves:
   1. Ball Valves (____ and smaller):
      a. Acceptable manufacturers: Apollo, Hammond, Milwaukee, Nibco, Stockham and Watts with indicated features and equal to model listed. Note that not all manufacturers make all sizes. _____
      b. Full Port, 2 Piece: Bronze body, ASTM B584, stainless steel ball and stem, teflon seats, stem extension with length according to installed system insulation thickness, 600 psi CWP pressure rating, _____.
      c. Full Port, 3 Piece: Bronze body, ASTM B584, stainless steel ball and stem, teflon seats, stem extension with length according to installed system insulation thickness, 600 psi CWP pressure rating, _____.
      d. Standard Port, 2 Piece: Bronze body, stainless steel ball and stem, teflon seats, stem extension with length according to installed system insulation thickness, 600 psi CWP pressure rating, _____.
      e. Insulated Handle: For insulated systems to prevent condensation on valve body with thermal and vapor seal, equal to _____.
   2. Butterfly Valves (_____ and larger):
      a. Acceptable Manufacturers: Apollo, Hammond, Kitz, Milwaukee, Nibco, and Stockham with indicated features and equal to model listed. Note that not all manufacturers make all sizes or styles.
      b. Threaded or Solder Ends: Bronze body, stainless steel disc and stem, viton disk seal, Milwaukee Series BB2
      c. Lug Type: Ductile iron body, 316 stainless steel disc mounted without pins or bolts, EPDM liner, stainless steel stem, copper or glass reinforced epoxy resin bushings (lower, upper and collar), 200 psi CWP pressure rating, 10 position lever handle through 6", gear operator 8" and larger, _____
      d. Wafer Type: Ductile iron body, 316 stainless steel disc mounted without pins or bolts, EPDM liner, stainless steel stem, copper or glass reinforced epoxy resin bushings (lower, upper and collar), 200 psi CWP pressure rating, 10 position lever handle through 6", gear operator 8" and larger, _____
      e. Grooved Type:
         1) Cast brass body, aluminum-bronze disc, stainless steel stem. Disc shall be offset from stem centerline to provide full 360 degree seating. Elastomeric seal, copper tubing sized grooved ends, 300 psi CWP pressure rating, manual level or gear operator with handwheel for 3" to 6", Victaulic Series 608N.

2) Stainless steel body and disc, ASTM A351/A351M Grade CF8M, stainless steel stem. Disc shall be offset from stem centerline to provide full 360 degree seating. Seat and seal material shall be EPDM, grooved ends, 300 psi CWP pressure rating, manual lever lock handle or gear operator with handwheel, 3" to 8", Victaulic Series 861.

3. Gate Valves:
   a. Acceptable Manufacturers: Apollo, Crane, Hammond, Kennedy, Milwaukee, Nibco, and Stockham with indicated features and equal to model listed. Note that not all manufacturers make all sizes.
   b. Size 2-1/2" and Smaller: Lead-free bronze body, bronze trim, 150 psi steam pressure rating, union bonnet, rising stem, _____.
   c. Size 3" and Larger: Nickel iron body and wedge, stainless steel trim, outside screw and yoke (OS&Y), 125 psi steam pressure rating, bolted bonnet, flanged pipe ends, _____.

B. Swing Check Valves:
   1. Size 2" and Smaller:
      a. Bronze body, ASTM B62, Y pattern, PTFE resilient disc, horizontal swing, 200 psi CWP rating, _____
   2. Valves 2-1/2" and Larger:
      a. Nickle iron body, horizontal swing, stainless steel or nickel iron disc, stainless steel replaceable seat, 200 psi CWP rating, _____.

C. Spring Check Valves:
   1. Valves 2" and Smaller:
      a. Bronze body, ASTM B584, in-line lift type with spring, Buna-N or PTFE disc, 250 psi CWP rating, _____
   2. Valves 2-1/2" and Larger:
      a. Cast iron body, wafer type, Buna-N seat, aluminum bronze disc, in-line type with stainless steel spring, 250 psi CWP rating, _____
      b. Stainless steel body and disc, stainless steel spring and shaft, _____ seat, vertical or horizontal installation, grooved ends, 300 psi CWP rating, Victaulic Series 816.
   3. Size [1/2" thru 2"]:
      a. Stainless steel body, in-line pattern, stainless steel seats, spring and valve disc. DFT, Inc. Basic Check, Model BSS, rated for 300 psi WSP.
      b. Manufacturers: Nibco, Watts, Mission, DFT, Inc., Circle Seal, Milwaukee, Stockham

D. Balancing Valves:
   1. Circuit Setter:
      a. Acceptable Manufacturers: Bell and Gossett, Victaulic, Watts or approved equal
      b. 2" and Smaller: Shall be of lead-free brass or bronze construction with glass and carbon-filled TFE seat rings and have differential pressure read-out ports across valve seat area. Read-out ports to be filled with internal EPT insert and better connection with check valve. Valve bodies to have 1/4" NPT tapped drain/purge port. Valves to have memory stop feature and calibrated nameplate to assure specific valve setting. Valve to be leak-tight at full-rated working pressure and temperature 300 psi/250°F. B&G _____, or approved equal.
   2. Globe Style Balancing Valve:
      a. Acceptable Manufacturers: Armstrong, Caleffi, Nibco, or Red-White Valve

b. Size 2" and Smaller: Valve shall be for precise regulation and control and rated 240 psi/250°F. Valve shall be constructed of dezincification resistant, lead-free brass (DZR) or bronze alloy. Valve shall be Straight Pattern Glove having 2 metering/test ports with internal check valves. Two 1/4" drain plugs and protective caps. Valve must be quipped with visual position readout and concealed memory stops for repeatable regulation and control. _____ or approved equal.

3. Constant Flow Balancing Device:
   a. Acceptable Manufacturers: IMI Flow Design, Caleffi; Eaton, or Victaulic
   b. 1/1" thru 1": Nickel plated brass or 316 stainless steel body, flexible Buna-N insert that acts as variable orifice. Flow rates to be maintained to within ± 15% up to pressure drops of 125 psi. _____ or approved equal.
4. Constant Flow Balancing Device:
   a. Acceptable Manufacturers: Griswold, Hayes Fluid Controls or approved equal
   b. 1/1" thru 1": Lead-free brass or 316 stainless steel wye pattern body, replaceable pressure independent flow control cartridge. Flow rates to be maintained to within ± 15% with pressure drops of 2 - 80 psig. Valve shall be factory marked with design flow rate. _____ or approved equal.
   c. 1-1/4" thru 2-1/2": Lead free brass or stainless steel wye pattern body, replaceable pressure independent flow control cartridge. Flow rates to be maintained to within ± 15% with pressure drops of 2 - 80 psig. Valve shall be factory marked with design flow rate. _____

2.05 DIELECTRIC FITTINGS

A. Insulating nipple, metal casing, inert thermoplastic lining; Anvil Figure 7090, Clearflow dielectric fitting by Perfection Corporation or Victaulic Style 47.

B. Dielectric unions 2" and smaller; dielectric flanges 2-1/2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psi at 180°F. Watts Regulator Company, Lochinvar, Wilkins or Epco Sales, Inc.

C. Copper-silicon casting, UNS C87850, threaded or grooved end. UL classified in accordance with NSF 61 for potable water service. Victaulic Style 647

2.06 WATER HAMMER ARRESTORS

A. Mechanical Water Hammer Arrestors:
   1. Piston-compressed air column type, with sealed air chamber.
   2. Manufacturers: Watts, Sioux-Chief, and Precision Plumbing Products (PPP), Inc., equal to size shown. Provide access panels when mechanical shockstops are installed in non-accessible concealed locations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install pipe and fittings in accordance with reference standards, manufacturer`s recommendations and recognized industry practices.

B. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.

C. Include connections to plumbing fixtures, to equipment by others, and to equipment requiring water. Provide proper backflow and back siphonage protection to safeguard potable water system from contamination.

D. Lay out water system so as to conform to intent of drawings. Coordinate piping with building features and work of other trades. Install water piping plumb and square with building. Plans indicate, general routing, provide additional offsets as required. Install piping with necessary swing joints and offsets to allow for expansion.

E. Install shut-off valves on branch lines near mains to avoid long dead-leg branches when valves are closed.

F. Install shut-off valves where indicated and at base of risers to allow isolation of portions of system for repair.

G. Do not install water piping within exterior walls.

H. Provide drain valves at base of risers and at low points of trapped piping 2" and larger where trapped water volume exceeds 5 gallons.

I. Install pressure reducing valves where indicated on drawings. Provide pressure gauges on both inlet and outlet sides of valve. Flush strainer and adjust to outlet pressure as scheduled.

J. Provide protective sleeve covering of elastomeric pipe insulation where copper or steel piping is embedded in masonry or concrete.

K. Provide dielectric fittings between dissimilar piping materials.

L. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

M. Install valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to equipment, fixtures and systems installed by others where same requires piping services indicated in this Section.

N. In-line pumps 3 hp and larger shall be independently supported from building structure.

O. Install water pipe using proper pipe and fittings. Use reducing fittings for changes in pipe size.

P. Install trap filler lines to slope to drain tailpiece without trapping.

3.02 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Soldered Copper Joints:
   1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
   2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves.
   5. Follow manufacturer`s recommendations when heating valves and equipment for soldered connections.

C. Brazed Copper Joints:
   1. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   2. Joints shall be cleaned and polished before brazing.
   3. Flux of any type shall not be used.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves. Disassemble valves where possible to prevent damage to seats during brazing.

D. Press Fit Copper Joint:
   1. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   2. Tubing shall be clean and dry before inserting into fittings.
   3. Insert pipe fully into fitting and mark on pipe at shoulder of fitting.
   4. Check fitting alignment against mark on pipe to ensure pipe is fully engaged.
   5. Crimp joint with pressing tool approved by fitting manufacturer. Mark crimped joints with permanent marker after each joint has been pressed.
   6. Provide initial joint leak test at 45 psig prior to performing final pressure test as defined later in this Section.

E. Grooved Copper Joints:
   1. All grooved end piping products shall be supplied by single manufacturer. Grooving tools shall be supplied by same manufacturer as grooved fittings and components.
   2. Install rolled groove copper pipe and fittings using equipment specifically for copper tube by mechanical coupling manufacturer.
   3. Use only those couplings and gaskets so designated for copper tube.
      a. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
      b. Gaskets shall be supplied by the grooved coupling manufacturer.
   4. Flaring of tube and fitting ends to IPS dimensions is not permitted.
   5. Grooved end shall be clean and free from indentations, projections, and roll marks in area from pipe end to groove for proper gasket sealing.
   6. Factory-trained field representative shall provide on-site training for Contractor’s field personnel in proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review product installation. Contractor shall remove and replace any improperly installed products.

F. Mechanically Formed Tee Fittings:
   1. Form mechanically extracted collars in continuous operation consisting of drilling pilot hole and drawing out tube surface to form collar, having height of not less than 3 times thickness of tube wall. Use adjustable collaring device. Notch and dimple branch tube.
   2. To form couplings, anneal end of tubing to be expanded - insert expander and reform tube to accept size OD. Socket expansion shall be at least 3 times base tube wall thickness in depth.
   3. Braze joints and couplings in accordance with American Welding Society "lap-joint" weld, and Copper Development Association copper tube handbook using BCuP filler metal. (Note: soft soldered joints will not be permitted.)

3.03 SPRING LOADED CHECK VALVES

A. Provide spring loaded check valve in each pump discharge line.

3.04 WATER HAMMER ARRESTORS

A. Use water hammer arrestors to control water hammer. Installed devices shall be sized and located according to manufacturer`s recommendations, PDI Standards, or as shown on drawings.

B. Use water hammer arrestors with flush valves and quick-closing valves. Provide access panels when water hammer arrestors are installed in non-accessible concealed locations.

3.05 DIELECTRIC UNIONS AND FLANGES

A. Install dielectric unions or flanges at points where copper-to-steel pipe connection is required in domestic water systems.

B. Install unions on equipment side of shutoff valves for items such as: water heaters, water softeners, pumps, filters, and similar equipment requiring periodic replacement.

3.06 CLEANING

A. Flush and clean piping prior to testing. Remove corrosion by mechanical or chemical means. Use chemicals that are non-toxic.

3.07 TESTING

A. Refer to Testing paragraph of Section 22 0000 - General Plumbing Requirements.

B. Water test system may be applied to system in its entirety or in sections. Test piping with water to pressure of 100 psi] for 2 h. No decrease in pressure allowed. Provide pressure gauge with shutoff and bleeder valve at highest point of system tested. Inspect joints in system under test.

C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

D. Do not conceal pipe until satisfactorily tested.

E. Testing with air will not be allowed.

3.08 BALANCING

A. Balance water distribution system. Adjust control valves for proper operation. Set balancing valves to maintain hot water in hot water system.

B. Balance flush valves, flow control valves and mixing valves for adequate flow and temperature to plumbing fixtures and equipment.

3.09 DISINFECTION

A. Disinfect water piping in the following manner:
   1. Clean and flush water pipe with water until water at remote tap is clear.
   2. Fill water systems with solution containing 50 ppm of chlorine (minimum concentration). Allow solution to stay in water system for 24 h. Alternately use solution of 200 ppm of chlorine (minimum concentration) for 3 h.
   3. Flush water system of chlorine solution.
   4. Allow clean water to stand in system for 24 h. Take sample from remote tap for bacteriological test.

B. Do not use water system for potable water supply until safe bacteriological test is obtained. Repeat steps 1 through 4 until safe water system is obtained.

3.10 BACTERIOLOGICAL TESTS

A. Take representative water samples and test to ensure bacteriologically safe water supply system. Include HPC (Heterotrophic Plate Count) test and test for presence of Pseudomonas aeruginosa as well as regular coliform bacteria test. HPC test maximum containment level of 500 organisms/ml. Perform bacteriological tests shortly before Owner`s acceptance of building. If tests fail, make corrections and retest.

B. When connecting to existing water supply of unknown quality, sample for analysis and comparison with finished water system analysis shall be taken prior to making new connection. This will allow isolating source of contamination from within scope of work or pre-existing water supply. Final conditions shall meet criteria specified above for areas within scope of work.

END OF SECTION

SECTION 22 1314
SANITARY WASTE AND STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes materials and methods for sanitary waste and vent, clearwater waste and vent, storm drainage, and overflow storm drainage piping systems within and including piping to 5 ft outside building wall.

1.02 RELATED WORK

A. Section 22 0529 - Plumbing Piping and Equipment Supporting Devices

B. Section 22 0553 - Plumbing Systems Identification

C. Section 22 2114 - Plumbing Specialties

D. Section 22 4000 - Plumbing Fixtures

1.03 QUALITY ASSURANCE

A. Order piping with each length marked with manufacturer`s name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier`s name.

B. Installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure material is undamaged and complies with Specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.05 SUBMITTALS

A. Manufacturer`s technical data for the following:
   1. Pipe and fittings
   2. Joints
   3. Cleanouts
   4. Floor drains and floor sinks
   5. Air gap fittings
   6. Discharge check valves
   7. Discharge isolation valves
   8. Traps

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials herein specified shall be new, unless otherwise noted.

2.02 PIPE, FITTINGS, AND JOINTS

A. Interior Above Ground:
   1. Cast Iron:

a. Pipe: Hubless cast iron pipe, ASTM A888, CISPI 301, NSF certified with material test reports from _____.
b. Fittings: Hubless cast iron fittings, ASTM A888, CISPI 301, NSF certified with material test reports from _____.
c. Joints: _____

2. Cast Iron
a. Pipe: Hub and spigot pipe, service weight, ASTM A74, NSF certified with material test reports from _____
b. Fittings: Hub and spigot fittings, service weight, ASTM A74, NSF certified with material test reports from _____
c. Joints: _____

3. Polyvinyl Chloride (PVC):
a. Pipe: Schedule 40, Class 12454 (PVC 1120), ASTM D1785
b. Fittings: Drain, waste and vent (DWV) pattern fittings, ASTM D2665; socket fitting patterns, ASTM D3311. Fabricated fittings 10" and larger shall be per ASTM F1866.
c. Joints: Primer, low VOC, ASTM F656; solvent cement, low VOC, ASTM D2564

4. Galvanized Steel:
a. Pipe: Schedule 40, Type F, Grade A, ASTM A53/A53M
b. Fittings: Cast iron threaded drainage fittings, ASME B16.12

B. Pressurized Interior Above Ground:
1. Copper (2" and smaller):
a. Pipe: Type L copper tube, hard drawn temper, ASTM B88
b. Fittings:
1) Cast copper drainage fittings (DWV), ANSI/ASME B16.23
2) Wrought copper drainage fittings (DWV), ANSI/ASME B16.29
c. Joints: Lead free (<0.2%) solder, ASTM B32; flux, ASTM B813

2. PVC (3" and smaller):
a. Pipe: Schedule 40, Class 12454 (PVC 1120), ASTM D1785
b. Fittings: Socket pattern pressure fittings, ASTM D2466
c. Joints: Primer, low VOC, ASTM F656; solvent cement, low VOC, ASTM D2564

C. Adapter Couplings for Joining Dissimilar Pipe Materials:
1. Acceptable Manufacturers: Fernco, Mission, _____
2. 1" through 6" diameter: Fernco Proflex 3000 Series shielded coupling with neoprene gasket, stainless steel shield, and stainless steel clamping bands. Adapter couplings shall be specifically designed for pipe materials being joined.
3. 8" through 27" diameter: Fernco 1000 Series flexible coupling with elastomeric PVC or neoprene gasket and stainless steel clamping bands. Adapter couplings shall be specifically designed for pipe materials being joined.

2.03 VALVES

A. Pump Discharge Check Valves:
1. Acceptable Manufacturers: Hammond, Milwaukee, Nibco and Stockham with indicated features and equal to model listed
2. Size 2" to 4", Horizontal Installation:
a. Cast iron body, swing check, bronze disc and ring, brass pin, Class 125, threaded ends, Nibco T-918-B
3. Size 2-1/2" and Larger, Vertical Installation:
a. Cast iron body, swing check, bronze disc to 4" and cast iron disc with bronze disc face rings or bronze disc for 5" and up, lever and spring operator, brass pin, Class 125, flanged ends, Nibco F-918-BLS

4. Size 4" and smaller:
    a. Acceptable manufacturers: Chemtrol, Ipex, Spears, or approved equal
    b. PVC body, swing check, EPDM seals, flanged ends. Spears 4423-(size)

B. Pump Discharge Isolation Valves:
1. Ball Valves:
    a. Acceptable Manufacturers: Apollo, Hammond and Nibco with indicated features and equal to model listed
    b. Size 2" to 3":
        1) Full Port, 2 Piece: Bronze body, ASTM B584, stainless steel ball, teflon seats, stem extension, 600 psi CWP pressure rating, _____.
2. Butterfly Valves:
    a. Acceptable Manufacturers: Crane or Nibco with indicated features and equal to model listed
    b. Size 4" and larger:
        1) Wafer Type: Ductile iron body, aluminum bronze disc, EPDM liner, 316 4106 stainless steel stem, brass collar bushings, copper upper and lower bushings, (lower, upper and collar), 200 psi CWP pressure rating, lever handle through 6", gear operator 8" and larger, _____.
3. Gate Valves
    a. Acceptable Manufacturers: Nibco or Apollo with indicated features and equal to model listed
    b. Size 2" and larger:
    c. Cast iron body, ASTM A126, Class 125/150 flanges, 200 psi CWP pressure rating, MSS SP-70, ASME B16.10, full port OS&Y gate valve. _____
4. Discharge valve assembly:
    a. Grooved pipe, Victaulic 318 Series that includes Victaulic 365 plug valve, 317 check valve and couplings. For sizes 3" and larger.
5. Size 2" and smaller:
    a. Acceptable manufacturers: Chemtrol, Ipex, Spears, or approved equal
    b. True union, full port ball valve, CPVC body, ASTM D1784, EPDM o-rings, Teflon seats, socket ends. Ipex VX series

2.04 CLEANOUTS

A. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to number listed in Drains and Cleanout Schedule.

B. Provide recessed, solid brass, cleanout plugs where fittings are used as cleanouts. Provide taper-thread plug with Teflon tape thread wrap.

C. Floor Cleanouts: Cleanout with cast iron ferrule, adjustable top, nickel-bronze scoriated cover and frame, bronze taper-thread plug, equal to J.R. Smith 4033L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4033L-F-C.

D. Floor Cleanouts, Carpeted Areas: Cleanout with cast iron ferrule, adjustable round top, nickel-bronze scoriated cover and frame, bronze taper-thread plug, and small stainless steel carpet marker, equal to J.R. Smith 4033L-Y. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4033L-F-C-Y.

E. Floor Cleanouts, Tiled Areas: Cleanout with cast iron ferrule, adjustable square tile top, nickel-bronze scoriated cover and frame, and bronze taper-thread plug, equal to J.R. Smith 4053L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4053L-F-C.

F. Floor Cleanouts, Unfinished Floors and Areas Outside Building: Cleanout with cast iron ferrule, adjustable round top, scoriated cast iron tractor cover, and bronze taper-thread plug, equal to J.R. Smith 4239L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4239L-F-C.

G. Floor Cleanouts, Areas with Heavy Traffic: Cleanout with cast iron ferrule, adjustable housing, heavy-duty ductile iron scoriated top, and brass taper-thread plug, equal to J.R. Smith 4233L-M. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4233L-M-F-C

H. Wall Cleanouts: Cleanout with cast iron counter sunk ferrule, bronze or brass taper-thread plug, secured stainless steel access cover, equal to J.R. Smith 4472T.

2.05 FLOOR DRAINS

A. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to number listed herein or in Drains and Cleanout Schedule.

B. Floor drains shall be in accordance with ANSI/ASME A112.21.1M. Provide with caulked or no-hub connection. Floor drains shall have internal seepage collar for embedding in floor construction and weep holes to provide adequate drainage to drain pipe. Include trap _____ where indicated on drawings.

C. FD-1: Cast iron body with round 8" diameter satin nickel bronze strainer. Include trap primer connection where indicated on drawings. J.R. Smith 2005Y-A.

D. FD-2: Cast iron body with round 8" diameter satin nickel bronze strainer. Funnel shall be 4" diameter by 3" high constructed of satin nickel bronze and secured to strainer. Include trap primer connection where indicated on drawings. J.R. Smith 2005Y-A with funnel 3580-NB.

E. FD-3: Cast iron body with 4" square adjustable satin nickel-bronze strainer, integral flange, flashing clamp, and weep holes. J.R. Smith 2005Y-B.

F. FD-4: Cast iron body with 8" diameter cast iron strainer, integral flange, and 4" diameter cast iron funnel secured to strainer. Include trap primer connection where indicated on drawings. J.R. Smith 2120Y with 3580-CI funnel.

G. FD-5: Cast iron body with 6" deep sump, acid resisting enameled interior, 8" square satin nickel-bronze top, and aluminum dome secondary strainer. J.R. Smith 3100Y.

H. FD-6: Cast iron body with 17" deep sump, acid resisting enameled interior, 24 by 16" rectangular acid resisting enameled grate, 1/2" square grate openings, and aluminum sediment bucket. J.R. Smith 3483Y-12.

I. FD-8: Type 304 stainless steel, 14 ga, with #4 satin finish interior, 6" deep, 1/2" trap primer tapping, and with medium duty stainless steel "heelproof" grate, 1/4" square openings, for medium traffic areas. J.R. Smith 9692Y-P050-61.

J. FD-9: Type 304 stainless steel, 14 ga, with #4 satin finish interior, 8" deep for automatic equipment discharge. _____.

K. FD-10: Type 316 stainless steel, 14 ga, with #4 satin finish interior, 6" deep, 1/2" trap primer tapping, and with medium duty 316 stainless steel grate with 1/4" square openings, for corrosive conditions surface drainage. J.R. Smith 9692-Y-P050-61-316.

2.06 AIR GAP FITTINGS

A. Air gap fittings constructed of cast iron with integral air gap having free area of at least twice the inlet area. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to J.R. Smith 3950 or 3951.

2.07 TRAPS

A. Same material as pipe or fittings unless specified with fixtures. Refer to Section 22 4000 - Plumbing Fixtures. Provide 17 ga brass, chrome plated traps for exposed traps.

2.08 UNDERCOUNTER SUMP PUMP

A. Acceptable Manufacturers: Hydromatic, Liberty, Little Grant, Zoeller

B. Undercounter sump pump shall be packaged system consisting of collection basin, sump pump and controls. Package shall be shipped pre-assembled and factory tested.

C. Sump basin shall be polypropylene or polyethylene with connections for inlet, discharge, and vent pipes. Sump cover shall be removable for pump replacement.

D. Pump shall be submersible type constructed of epoxy coated cast iron shell, two vane enclosed semi-open non-clog nylon or thermoplastic impeller, stainless steel fasteners, upper and lower sintered sleeve bearings. Motors shall be NEMA B, submersible, filled with non-toxic dielectric oil.

E. Pump controls shall include single on/off float or single diaphragm pressure switch with factory set on and off levels.

F. Package shall be wired for single 120V, 1 phase cord-and-plug power connection.

G. Refer to Schedule on drawings for pump capacities. Basis of design is _____ gal basin and pump cable of _____ gpm at ft head.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturer`s recommendations and recognized industry practices.

B. Connect piping to fixtures, each piece of equipment, and drains. Install required piping as shown on drawings.

C. Grade horizontal lines with minimum of 1/8" per ft, except piping 2" diameter or smaller which shall be run at 1/4" per ft (21 mm per m) slope.

D. Grade horizontal lines with minimum of 1/4" per ft, except piping 4" diameter or larger which may be run at 1/8" per ft slope with approval of local authority.

E. Install piping parallel with building lines and at heights, which do not obstruct any portion of window, doorway, stairway, or passageway, except, as may be shown on plans. Install overhead piping as high as possible.

F. Grade vent pipe for complete drainage by gravity to soil or waste pipes. Vent terminations shall be set true and level. Locate vent piping at least 10 ft away from window, door or intake openings. Coordinate closely with roofing Contractor to prevent damage to roofing membrane. Flashing shall be in accordance with requirements of roofing manufacturer.

G. Where interferences develop, offset or reroute piping as required to clear interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

H. Provide protective sleeve covering of elastomeric pipe insulation, where piping and/or fittings are embedded in masonry or concrete.

I. Maintain piping in clean condition internally during construction.

J. Mitered ells, notched tees, and orange peel reducers are not allowed. Bushings are not allowed on threaded piping.

K. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

L. Set cleanouts true and level and protect properly throughout construction.

M. Set floor drains true and level and protect properly throughout construction. Weep holes shall be filled with removable material and kept free from concrete and other debris during construction. Weep holes shall be cleaned out for final working order. Provide safing for floor drains installed in elevated slabs.

N. Trap each fixture and piece of equipment requiring sanitary drainage connections. Trap seals shall be standard depth, except when deep seals are required by code. Traps shall be set true and level and located within limits of code requirements. Traps shall not be used as separator, interceptor or other type of device to retain solids. Traps shall be provided with thread type approved cleanout plugs when specified. Protect traps during construction and seal off to prevent stones, debris and other foreign matter from entering before use. Locate running traps for full accessibility with double cleanout.

O. Provide plugs or caps for pipe openings during construction to prevent debris from entering pipe. Temporary plug shall be plastic cap or equivalent.

3.02 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Soldered Copper Joints:
   1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
   2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves.
   5. Follow manufacturer's recommendations when heating valves and equipment for soldered connections.

C. Grooved Copper Joints:
   1. All grooved end piping products shall be supplied by single manufacturer. Grooving tools shall be supplied by same manufacturer as grooved fittings and components.
   2. Install rolled groove copper pipe and fittings using equipment specifically for copper tube by mechanical coupling manufacturer.
   3. Use only those couplings and gaskets so designated for copper tube.
      a. The gasket style and elastomeric material (grade) shall be verified as suitable for intended service as specified.
      b. Gaskets shall be supplied by the grooved coupling manufacturer.
   4. Flaring of tube and fitting ends to IPS dimensions is not permitted.
   5. Grooved end shall be clean and free from indentations, projections, and roll marks in area from pipe end to groove for proper gasket sealing.
   6. Factory-trained field representative shall provide on-site training for Contractor's field personnel in proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review product installation. Contractor shall remove and replace any improperly installed products.

3.03 POLYVINYL CHLORIDE (PVC) PIPE

A. Pipe Joints:

1. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints with PVC pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if fitted with wheels designed for use with PVC pipe that do not leave raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Check dry fit of pipe and fittings. Reject materials, which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
2. Maintain pipe, fittings, primer and cement between 40°F - 100°F during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 size of pipe diameter. Apply primer to fitting socket and pipe surface with scrubbing motion. Check for penetration and reapply as needed to dissolve surface to depth of 4-5 thousandths (0.102 to 0.127 mm). Apply solvent cement to fitting socket and pipe in amount greater than needed to fill gap. While both surfaces are wet, insert pipe into socket fitting with quarter turn to bottom of socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set, whichever is longer. Reference manufacturer`s recommendations for initial set time before handling and for full curing time before pressure testing.

B. Install plastic pipe and fittings as recommended by manufacturer. Include adequate offsets or expansion joints to allow for pipe expansion.

C. Do not install plastic pipe in plenum space.

3.04 CAST IRON PIPE

A. No-hub Piping: Place gasket on end of one pipe of fitting and clamp assembly on end of other pipe or fitting. Firmly seat pipe or fittings ends against integrally molded shoulder inside neoprene gasket. Slide clamp assembly into position over gasket. Tighten fasteners to manufacturer`s recommended torque.

B. Install cast iron pipe and fittings as recommended by CISPI in their publication "Installation of Cast Iron Soil Pipe and Fittings".

C. Support piping at every coupling. Locate hanger within 18" of coupling.

D. Installations with multiple joints within a 4 ft developed length shall be supported at every second joint.

E. Secure base of risers with thrust restraints to prevent joint separation. Restraint shall be in accordance with CISPI recommendations.

F. _____ _____, horizontal piping 5" and larger to prevent horizontal movement. Install bracing at every branch connection and every change of direction in accordance with CISPI recommendations.

3.05 TESTING

A. Refer to Testing paragraph of Section 22 0000 - General Plumbing Requirements.

B. Gravity Systems:
1. Water test may be applied to system either in its entirety or in sections. Piping shall be tightly plugged and submitted to 10 ft head of water located at highest point. Provide separate standpipe above highest point being tested or extend system to obtain required 10 ft head of water. Head shall be maintained for at least 30 minutes before inspection starts.

C. Pressurized Systems:

1. Water test system may be applied to system in its entirety or in sections. Test piping with water to pressure of _____ for 2 h. No decrease in pressure allowed. Provide pressure gauge with shutoff and bleeder valve at highest point of system tested. Inspect joints in system under test.

D. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

E. Do not backfill pipe until successfully tested.

F. Testing with air will not be allowed.

END OF SECTION

SECTION 22 2114
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section covers material specialties for piping systems.

B. All components installed on water systems defined in Section 22 1118 - Water Distribution System shall comply with NSF 372 to be compliant with requirement for lead content of <0.25% maximum weighted average.

1.02 RELATED WORK

A. Section 22 1118 - Water Distribution System

B. Section 22 1314 - Sanitary Waste and Storm Drainage Systems

C. Section 22 6114 - Laboratory Compressed Air System

D. Section 22 6653 - Corrosion Resistant Waste And Vent System

1.03 SUBMITTALS

A. Manufacturer's technical data for the following:
   1. Thermometers
   2. Pressure gauges
   3. Pressure relief valves
   4. Strainers
   5. Backflow preventers
   6. Flexible connections
   7. Air vents
   8. Trap primers
   9. In-line check valves
   10. Flashings
   11. Safings

B. Shop drawings and product data on items specified herein.

C. Certificates: Submit performance testing certificates for reduced pressure backflow preventers and double check backflow preventers.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials herein specified shall be new unless otherwise noted.

2.02 THERMOMETERS

A. Manufacturers: Miljoco, Taylor, Trerice, Weksler, Winters and Weiss equal to Trerice number listed

B. Thermometers shall be 9” die cast aluminum case and frame, double strength glass window, adjustable angle stem, permanently stabilized glass tube with mercury free indicating fluid, readable scale with gradations from 30°F to 240°F. Provide brass extension neck sockets of appropriate length. Trerice Series No. A400 (old catalog number BX91400).

C. Thermometers shall be 5” round bi-metal type, stainless steel case, readable scale and gradations from 30°F to 240°F, external calibrator adjustment, back or bottom connection as appropriate. Provide brass extension neck sockets of appropriate length. Trerice Series No. B85200. Provide with minimum or maximum registering pointers.

2.03 THERMOMETER SOCKETS AND TEST WELLS

A. Brass construction with threaded connections suitable for thermometer stems or bulbs and control sensing devices, well length suitable for pipe diameter with extended neck as required to suit pipe insulation. Furnish with brass cap and short chain to secure cap to body for test well.

B. Test wells for stainless steel piping shall be same material as piping.

2.04 PRESSURE GAUGES

A. Manufacturers: Ashcroft, Marsh, Marshalltown, Miljoco, Taylor, Trerice, U.S. Gauge, Weiss, and Winters, equal to Trerice number listed

B. Pressure gauge shall be 4-1/2” die cast aluminum case, double strength glass window, readable dial scale with gradations from 0 to 200 psi, phosphor bronze bourdon tube, brass socket. Provide shutoff valve with pressure gauge, Trerice Series No. 600.

C. Gauge accuracy shall meet ASME B40.1 Grade 1A (1% full scale).

D. Pressure gauges shall be calibrated for the following pressure ranges:
   1. Domestic Water: 0 to 160 psi at 2 psi increments
   2. Medical Air: 0 to 100 psi at 1 psi increments
   3. Oxygen: 0 to 100 psi at 1 psi increments
   4. Medical Vacuum: 30” at 0.2” Hg increments

E. Pressure Snubbers:
   1. 1/4” or 1/2” size, matching gauge size, 1000 psig WP. Brass for copper or carbon steel pipe, stainless steel for stainless steel pipe.

2.05 PRESSURE RELIEF VALVE

A. Manufacturers: Apollo, Cash-Acme, Consolidated, Kunkle, Lonergan, and Watts

B. Bronze body, resilient seat/seal, ASME Section VIII, stainless steel spring

C. Refer to Schedules on drawings for performance requirements.

2.06 STRAINERS

A. Manufacturers: Apollo, Hoffman, Keckley, Metraflex, Mueller, Watts, Wheatley or Zurn

B. Strainers shall be comparable to regulator or control valve specified. Strainers shall be "Y" type for liquid service to 300 lbs WOG at 210°F, with 20 mesh stainless steel screen. Body material shall be compatible with installed piping, stainless steel, or FDA approved, heat fused, epoxy coated interior.

2.07 BACKFLOW PREVENTER

A. Reduced Pressure Zone Backflow Preventers:
   1. Manufacturers: Apollo, Cla-Val, Febco, Watts or Zurn, equal to model listed _____
   2. 3/4” through 2”: Bronze body, resilient check valve seats, shut-off valves, Y-pattern strainer with bronze body and stainless steel screen, drain line air-gap fitting, bronze test cocks, certified in accordance with ASSE 1013 and AWWA C511_____.
   3. 2-1/2” through 10”: Cast iron body, bronze trimmed check valves, shut-off valves, drain air-gap fitting, bronze test cocks, certified in accordance with ASSE 1013 and AWWA C511_____.
   4. 3/4” through 2”: Lead free cast copper silicon body, resilient check valve seats, shut-off valves, Y-pattern strainer with bronze body and stainless steel screen, drain line air-gap fitting, bronze test cocks, certified in accordance with ASSE 1013 and AWWA C511_____

5. 2-1/2” through 10”: Lead free body, stainless steel housing, EPDM elastomers, _____ isolation valves, drain air-gap fitting, bronze test cocks, certified in accordance with ASSE 1013 and AWWA C511_____

B. Double Check Valve Backflow Preventers:
   1. Manufacturers: Cla-Val, Febco, Apollo or Watts, equal to model listed
   2. 2-1/2” through 10”: Cast iron body, bronze trimmed check valves, OS&Y gate valves, bronze test cocks, certified in accordance with ASSE 1015 and AWWA C506, UL listed or FM approved_____.

C. Double Check with Vent (DCV) Backflow Preventers:
   1. All bronze construction with stainless steel trim, union connections, 175 psi pressure rating, 250°F temperature rating, and conforming to ASSE Standard 1012. Watts No. 9D.

2.08 TRAP PRIMERS

A. Manufacturers: Precision Plumbing Products, Portland, OR.

B. Trap primer body shall be of machined brass with air inlet ports and backflow valve. Trap primer shall be activated by water pressure variation of 10 psi or greater to deliver metered amounts of water. Model PR-500.

C. Distribution units shall be patented containers with 1 to 4 tube outlets. Two outlets maximum with model P-2, 3 to 4 outlets with model P-1.

D. Electronic trap primer manifold, cabinet mounted; with 24 h timer, vacuum breaker, solenoid valve and hydraulic shock arrestor. Control wiring shall be 120 V single phase 3 wire connection for 120 V solenoid and 24 h timer. Box includes manual on/off switch and 2 amp fuse. Provide assembly without factory installed valve. Plumbing Contractor shall install a 3/4” ball valve as specified in Section 22 1118 - Water Distribution System . Cabinet shall be 14” x 16” x 3-1/2” deep, 16 ga box with 14” x 16” hinged prime coated door. Model No. PT-4, PT-6, PT-8, PT-10 or PT-12.

E. Bronze body with atmospheric-vented drain chamber. 125 psig minimum working pressure. Outlet manifold with number of connections as indicated on drawings. Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
   1. Solenoid valve on inlet to be controlled by local timer. Timer to operate on 120 V power supply.
   2. Precision Plumbing Products – Model MP-500-115V.

F. Manufacturers: Jay R. Smith or Zurn

G. Brass or chrome plated brass dual disc drop primer valve with air gap equal to Jay R. Smith 2699.

2.09 IN-LINE TRAP SEALER

A. Manufacturers: Mi-Gard by Mifab, Quad Close Trap Seal by Jay R. Smith, Sure Seal by Rector Seal, Trap Guard by Proset, Green Drain by Green Drains Inc., or ZShield by Zurn

B. Inline trap sealer shall be ABS plastic housing and neoprene rubber diaphragm, silicone, or Elastomeric PVC material with self-closing bottom. In-line trap sealer shall conform to ASSE 1072.

2.10 FLEXIBLE CONNECTIONS

A. Bronze, braided flexible hose or neoprene twinsphere connectors by Mason Industries with 150 psi WOG working pressure rating.

B. Alternate manufacturers are Redflex, Resistoflex and Flexonics.

2.11 AIR VENTS

A. Manual Air Vents: Bell and Gossett Model 4V, 125 psi pressure at 210°F temperature, or approved equal. Use 1/2” ball valve for main pipes.

2.12 FLASHINGS

A. Elastomer Membrane Roofing:
   1. Pipe clamps, Fernco Series 1056 flex coupling with Series 300 stainless steel clamps.

B. Built-Up Roofing:
   1. 4 lb/ft² sheet lead, to 18” beyond drain perimeter.
   2. Preformed lead vent collar, 4 lb/ft2 sheet lead, to 18” beyond vent perimeter; 18” minimum square base flange.
   3. Nobleflex roof drain flashing of Chloraloy and 20 lb/ft2 asphalt saturated roofing felt bonded together.

2.13 SAFINGS

A. 4 lb/ft² sheet lead, to 18” beyond edge of drain on all sides.

B. Chlorinated polyethylene (CPE) as manufactured by Noble Company under trade name Chloraloy 240.

C. Polyvinyl Chloride (PVC) shower pan line, 40 mil thickness, ASTM D4551.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide thermometers where indicated on drawings. Thermometers shall be easily read from floor or maintenance platforms. Calibrate thermometers to ensure accuracy.

B. Install pressure gauges where indicated on drawings. Gauges shall be easily read from floor or maintenance platforms. Provide extensions as required to make gauges easily readable. Calibrate gauges to ensure accuracy.

C. Install backflow preventers as indicated on drawings. Flush debris from strainers. Certified tester shall test reduced pressure zone backflow preventers to verify that functions are operational. Route vent line to adjacent hub drain.

D. Install strainers for equipment including pumps, meters, backflow preventers, reducers and regulators, and as shown on drawings.

E. _____

F. Install in-line check valves where specified or as indicated on drawings.

G. Install flexible connections for base mounted pumps and other vibrating equipment.

H. Install air vents at high points in water systems where air may collect.

I. Safing:
   1. Install safing for floor drains. Extend safing to 18” from edge of drain. Safing shall be clamped to floor drain body and pitched to drain to weep holes. Floor drains installed in unexcavated areas do not require safing.
   2. Where core drilled floor drain installation into existing floor slab has been approved by A/E, drain strainer inlet shall be grouted in place with non-shrink epoxy concrete approved by Structural Engineer. Refer to detail Section 22 0690 - Plumbing Details.
   3. Install safings for showers. Concrete floor shall be smooth and free of dirt. Seal joints per manufacturer's recommendations and turn up sides minimum of 6” above curb or maximum water level. Safing shall clamp into drip pan of floor drain and be secured by flashing clamp to assure drainage into weep holes of drain body. Inside vertical corners of showers shall have 12” strips 6 ft above floor, extend 6” in each direction and bottom to overlap pan 3”.

4. Membrane roofing material, preformed elastomer pipe pots, and flashing seams are provided by Roofing Contractor for pipe penetrations and drain flashing. Plumbing Contractor shall provide drain flashing clamps and stainless steel strap clamps for piping penetrations. Coordinate with Contractor to facilitate sealing drain flashing and pipe penetrations.

J. Flashing:
   1. Coordinate flashings on roof closely with Roofing Contractor. Install flashings as required to ensure proper vapor barrier and as directed by Architect.
   2. Install flashing for roof drains and overflow drains. Flashing shall extend minimum of 18" beyond edge of drain and shall be clamped into drain body.
   3. Use premolded flashing assembly for roof penetration of medical air intake piping. Install 1" of insulation between flashing and outside of pipe.
   4. Use premolded flashing assembly with hood for roof penetrations of medical vacuum exhaust piping. Set bottom of hood at 24" above finished roof.
   5. Roof penetrations for corrosive or acid vent systems shall be preformed EPDM vent pot with flex coupling pipe clamp collar.

3.02 TESTING

A. Safings shall be subject to standing water test to detect leaks and proper drainage to weep holes of floor drain.

END OF SECTION

SECTION 22 4000
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section lists plumbing fixtures and accessories including method of installation.

1.02 RELATED WORK

A. Section 22 1118 - Water Distribution System

B. Section 22 1314 - Sanitary Waste and Storm Drainage Systems

C. Section 22 6114 - Laboratory Compressed Air System

D. Section 22 6653 - Corrosion Resistant Waste And Vent System

1.03 SUBMITTALS

A. One package of manufacturer's technical data for all items. Submittal shall be assembled brochure, showing cuts and full detailed descriptions for each item.

B. Shop drawings and product data on items specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

B. Vitreous china fixtures shall be of highest quality, non-absorbent, hard-burned, and vitrified throughout.

C. Enameled ware shall be quality cast iron of uniform thickness and density, glazed to uniform depth and high gloss rubbed smooth, without chips or flaws, craze, or cracks, and completely acid resisting.

D. Stainless steel fixtures shall be 302/304 types of non-corrosive steel, 18 ga self-rim for cabinet sinks, 14 ga for free standing compartment type sinks. Sink material shall have satin finish and coved corners, with faucet holes punched to match specified faucet fitting.

E. Precast receptors and shower basins shall be _____. Receptor and basin colors shall be standard colors unless otherwise noted. Assembly of drain to waste piping shall be made from floor level on which basin or receptor is installed.

F. Insulation for traps and supplies shall be molded closed cell vinyl insulation and shall meet ASTM E84 for flame and smoke spread. Insulation shall be vandal resistant and be color as listed.

2.02 MANUFACTURERS

A. Plumbing fixtures shall be provided from list of approved manufacturers. Home Market, Generic Broker, or Wholesaler’s house brands are not acceptable.

B. Water closets, urinals, and lavatories: American Standard, Kohler, or Zurn equal to number listed

C. Water Closet Seats: Bemis, Beneke, Centoco, Olsonite or Zurn equal to number listed

D. Waterless Urinals: Falcon, Kohler, or Sloan, equal to number listed

E. Flush Valves: Delaney, Hydrotek, Sloan or Zurn equal to number listed

F. Stainless Steel Sinks: Advance Tabco, Elkay or Just equal to number listed

G. Electric Water Coolers: Elkay, Halsey-Taylor, Haws, Oasis, or Sunroc equal to model listed

H. Service Sinks: American Standard, Eljer, or Kohler equal to number listed

I. Mop Basins (Janitor Sinks): Fiat, Mustee, Stern-Williams, or Zurn equal to number listed

J. Emergency Eyewashes and Showers: Acorn, Bradley, Encon, Guardian, Haws, or Speakman, equal to number listed

K. Manual Faucets: Chicago Faucet, T and S Brass, or Zurn equal to number listed

L. Manual Faucets: Chicago Faucet, Delta HDF, Kohler or Moen Commercial, equal to number listed

M. Sensor Activated Faucets: Bradley, Chicago Faucet, Kohler, Sloan, TOTO or Zurn equal to model listed

N. Fixture Traps: Engineered Brass Company, Kohler, McGuire, or Zurn equal to number listed

O. Insulated Traps and Supplies: McGuire or True-Bro equal to model listed

P. Supplies and Stops: Chicago Faucet, Kohler, McGuire or Zurn equal to number listed

Q. Supplies and Stops: Brasscraft, Engineered Brass Company, Kohler, LSP Aqua-Flo or McGuire equal to number listed

R. Shower Valves and Mixing Valves: Acorn, Leonard, Powers or Symmons equal to number listed

S. Shower Valves and Mixing Valves: Chicago Faucet, Grohe, Kohler, or Moen Commercial equal to number listed

T. Multiple Showers: Acorn, Bradley, or Willoughby equal to number listed

2.03 CARRIERS AND SUPPORTS

A. Carrier manufacturers shall be Josam, J.R. Smith, Wade, Watts or Zurn, as outlined herein, with models suitable to fixture and use intended. Provide carriers with adjustable faceplate, rectangular steel uprights and at least 3 bolt lugs for securing carrier to floor. Adjustable water closet carriers shall be either right or left, single or double, horizontal or vertical as suggested by drawings and riser diagrams.

1. Water Closet: Adjustable face plate, rear support for single carries, barrier-free fixtures mounted with top of bowl at 17” from finished floor, _____.
2. Urinal: Rectangular uprights, bearing plate, barrier-free fixtures mounted with rim 17” maximum from finished floor, _____.
3. Lavatory: Concealed arms, rectangular steel uprights, _____.
4. Clinical Service Sink: rectangular steel uprights, _____.

2.04 WATER CLOSETS AND URINALS

A. Provide appropriate gaskets for fixture installation.

B. Provide bolts with chromium plated caps, nuts and washers.

2.05 WATER CLOSET SEATS

A. Heavy duty, elongated bowl, open front, plastic seat less cover, with stainless steel self-sustaining hinge, white, Bemis 1955-SSCT.

2.06 DRAINS

A. Lavatories: Chrome plated brass grid drain, 1-1/4” seamless tailpiece, _____

B. Barrier-free Lavatories: Chrome plated brass offset grid drain, 1-1/4” seamless tailpiece, _____

C. Self-rimming Stainless Steel Sinks: Stainless steel, 1-1/2” diameter tailpiece with conical strainer basket, Elkay LK99

D. Stainless Steel Scullery Sinks: Stainless steel, 1-1/2” diameter tailpiece with perforated grid strainer, Elkay LK18

E. Scrub Sinks: Stainless steel, pull-out strainer, Kohler K-9115

F. Laboratory Sink: Refer to Division 12.

2.07 TRAPS

A. Lavatories: P-traps shall be chrome plated brass body with cleanout plug, 17 ga seamless tubular wall bend, cast brass slip nuts and wall escutcheon. Trap size to match fixture connections.

B. Sinks: P-traps shall be chrome plated brass body with cleanout plug, 17 ga seamless tubular wall bend, cast brass slip nuts and wall escutcheon. Trap size to match fixture connections.

C. Laboratory Sinks: Corrosion resistant p-trap, refer to Section 22 6653 - Corrosion Resistant Waste And Vent System.

2.08 STOPS AND SUPPLIES

A. Lavatories: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem and gland nut, 1/2” NPT inlet x 3/8” compression outlet, _____

B. Sinks: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem and gland nut, 1/2” NPT inlet x 1/2” compression outlet, _____

C. Electric Water Cooler: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem and gland nut, 1/2” NPT inlet x 1/2” compression outlet, _____

D. Laboratory Sinks: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem and gland nut, 1/2” NPT inlet x 1/2” compression outlet, _____

2.09 PROTECTIVE PIPE INSULATION COVERS

A. Manufactured plastic wraps for covering plumbing fixture hot and cold water supplies, trap and tailpieces shall comply with Americans with Disabilities Act (ADA) requirements.

B. Lavatories: _____

2.10 PLUMBING FIXTURES

A. Refer to schedule on drawings for detailed fixture selection criteria not contained herein.

B. Submittal sheets for water closets, urinals, public lavatories and shower heads shall contain EPA WaterSense Label.

2.11 LABORATORY FIXTURES

A. Refer to schedule on drawings for detailed fixture selection criteria not contained herein.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install plumbing fixtures as recommended by manufacturer. Caulk around fixtures mounted on irregular surfaces such as tile or stone with silicone sealant, same color as fixture.

B. Support fixtures with proper carrier for each use. Ensure that carrier is solidly anchored to prevent rocking whatever piping is used. Anchor bolts in carrier foot shall extend 3” minimum into concrete slab.

C. Fixture carriers shall be suitable for securing each plumbing fixture in place solidly, yet allowing its removal when necessary. Carriers shall be capable of mounting "Barrier Free" fixtures at suitable heights.

D. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

E. Install barrier free fixtures in compliance with local code and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27” above finished floor to avoid contact by wheelchair users.

F. Return fixture waste and supply piping into wall as high as practical under fixture. Provide accessible shutoff in fixture supply. Protect "barrier free" supply and drain piping with white colored wrap neatly trimmed to prevent contact with hot or sharp surfaces by user.

G. Coordinate with Electrical Contractor for electronic sensor wiring necessary to install "sensor" operated fixtures. Provide "shockstops" at supplies to solenoid activated fixtures.

H. Provide individual supplies to fixtures and rough-in fixture piping with adequate support to prevent movement fore, aft and laterally. Provide additional blocking as required.

I. Install flush valves for barrier-free water closets with operator handle facing wide side of toilet stall.

J. Provide unions at water connections to drinking fountains and electric water coolers.

3.02 LABORATORY CASEWORK OUTLETS

A. Set fixtures in predrilled casework.

B. Make final connection of fixture to service piping.

3.03 FUME HOODS

A. Set cup sink, faucet, drain and tailpiece.

B. Make final connections to service piping or pre-piped hood. Vent piping for cup sink will not be pre-piped.

3.04 PROTECTION

A. Protect finished surfaces of fixtures from accidental damage or discoloration by use of protective covering.

3.05 CLEANING

A. Prior to Owner acceptance, clean fixtures with compounds recommended by manufacturer and remove stains and marks from surrounding walls and countertops.

END OF SECTION

SECTION 22 6114
LABORATORY COMPRESSED AIR SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section covers piping and equipment required to provide laboratory grade compressed air as shown on drawings.

1.02 RELATED WORK

A. Section 22 0529 - Plumbing Piping and Equipment Supporting Devices

1.03 SUBMITTALS

A. Shop drawings and product data on items specified herein.

1.04 PRODUCT DELIVERY

A. Deliver pipe and equipment properly packaged to protect against shipping and handling damage.

B. Installed pipe shall be sealed during construction to prevent construction debris from entering piping system.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials herein specified shall be new unless otherwise noted.

2.02 PIPE AND FITTINGS

A. Above Ground
   1. Copper
      a. Pipe:
         1) Copper tube, Type L hard temper, cleaned and capped, ASTM B280, marked “ACR” or similar in accordance with ASTM
         2) Copper tube, Type L hard temper, cleaned and capped, ASTM B819, marked “MED” or similar in accordance with ASTM
      b. Fittings: Wrought copper, solder joint, pressure rated, cleaned and bagged, ANSI B16.22
      c. Joints: Brazed, silver solder, BCu-3 or BCuP-5 type, AWS A5.8, 1250ºF melting point minimum.
   2. Copper
      a. Pipe: Copper tube, Type L, hard temper, ASTM B88
      b. Fittings:
         1) Wrought copper or bronze, solder joint, pressure rated, ANSI B16.22
         2) Cast copper alloy, solder joint, pressure rated, ANSI B16.18
      c. Joints (3” and smaller): Lead free (<0.2%) solder, Bridgit or Silvabrite, ASTM B32; flux, ASTM B813
      d. Joints (4" and Larger): Brazed, BcuP-5 type, AWS A5.8M/A5.8, 1250°F melting point minimum.

2.03 UNIONS

A. Copper 3” and smaller:
   1. Wrought copper union, Nibco 633-W

B. Copper 4” and larger:

1. Cast red brass flanges, alloy 844, ASTM B584, Class 150, ANSI B16.24 with neoprene gasket

2.04 VALVES

A. Ball Valves:
   1. Acceptable manufacturers: Apollo, Nibco, Watts
   2. 3” and Smaller:
      a. Full port, 2-piece, bronze body, chrome plated bronze ball, teflon seats, blowout-proof stem, and threaded or soldered joint, Watts FBV or FBVS
      b. Full port, 3-piece, bronze body, stainless steel ball, PTFE seats, stainless steel trim, blow-out proof stem, 6” tube extension, oxygen cleaned and bagged, quarter turn handle, 600 psi CWP; _____ through 2"
      c. Full port, 3-piece, bronze body, stainless steel ball, PTFE seats, stainless steel trim, blow-out proof stem, 600 psi CWP; _____ through 3”
   3. 2” and Smaller for Lock-out/Tag-out
      a. Conventional port, 2-piece, bronze body, stainless steel ball, Teflon seats and seals, stainless steel trim, blow-out proof stem, pad locking handle in closed position, automatic venting of downstream pressure in closed position, cleaned and bagged for oxygen service, 600 psi CWP; Apollo 75-140-41-57

B. CHECK VALVES
   1. Acceptable manufacturers: Apollo, Nibco, Watts
   2. 2” and smaller:
      a. Spring loaded, bronze or bronze/stainless steel body, 316 stainless steel spring, straight through flow, shipped bagged and oxygen clean. Apollo Ball-Cone Model 62-100-57.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install compressed air piping as shown on drawings and details.

B. Provide low point drain valve at bottom of risers. Pipe mains shall not be trapped between connection at riser and last branch take-off. Branch take-offs to rooms or individual spaces shall be from top of main.

C. Provide flexible connections at compressor inlet and outlet connection points as shown on details.

D. Cut copper tube square and ream before assembly. Keep piping capped during construction to prevent intrusion of construction debris.

E. Support piping drops through finished ceiling from structure above to prevent any lateral or up/down movement. Other outlet drops shall be supported from walls, columns, or workbenches using appropriate hangers, anchors, or Unistrut.

F. Install unions on equipment side of shutoff valves for items such as: air dryers, receiver, compressors, filters, and similar equipment requiring periodic replacement or maintenance.

G. Install vented valve for lock-out/tag-out at connection to equipment. Vented valve shall meet OSHA requirements for disabling power source and bleeding downstream energy.

H. Install temporary plugs and caps on openings during construction phase.

3.02 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Soldered Copper Joints:
   1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
   2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves.
   5. Follow manufacturer's recommendations when heating valves and equipment for soldered connections.

C. Brazed Copper Joints:
   1. Brazed joints shall be ASTM Grade 4 or 5 and have melting point at approximately 1250ºF. Solder impurities shall not exceed 0.15%.
   2. Tubing shall be delivered to site with original mill caps in place.
   3. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   4. Joints shall be cleaned and polished before brazing.
   5. Flux of any type shall not be used.
   6. Apply heat carefully to prevent damage to pipe, fittings and valves. Disassemble valves where possible to prevent damage to seats during brazing.
   7. Purge tube with nitrogen during brazing procedure. Provide manual shut-off valve and check valve as required for purge gas.

3.03 TESTING

A. Refer to testing paragraph of Section 22 0000 - General Plumbing Requirements.

B. Air piping shall be tested at 150 psig for 2 h prior to connection of laboratory fixtures. Soap test each joint to detect leaks during test period. No loss of pressure allowed during test period. Defective joints shall be cut out and replaced. Air piping shall be re-tested at 100 psig for 8 h after final connection of laboratory fixtures.

C. Air compressor equipment shall be delivered pre-assembled and tested by equipment manufacturer.

D. Verify proper signal transmission for each condition specified to Building Automation Controller.

3.04 CLEANING

A. All pipe, fittings and valves will be cleaned by manufacturer. On- or off-site cleaning of any components by Contractor is not allowed. Any components, which have become contaminated, will not be used on any clean systems. They may be used in laboratory vacuum or any water system using copper pipe or fittings.

B. Before system is placed into use, flush piping with product air to remove foreign particles.

3.05 WARRANTY

A. Manufacturer shall warrant air compressor package and components complete, for period of 2 yrs from date of start-up.

END OF SECTION

SECTION 22 6653
CORROSION RESISTANT WASTE AND VENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies pipe, fittings, equipment and methods for corrosion resistant waste and vent piping system installed to 5 ft outside the building wall.

1.02 RELATED WORK

A. Section 22 0529 - Plumbing Piping and Equipment Supporting Devices

B. Section 22 2114 - Plumbing Specialties

1.03 SUBMITTALS

A. Shop drawings on items specified herein.

B. Submit Manufacturer's technical data for the following:
   1. Pipe and fittings
   2. Joints
   3. Floor drains
   4. Cleanouts

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use new materials unless otherwise noted.

2.02 PIPE

A. Above Ground:
   1. Polypropylene (PP)
      a. Pipe: PP, Schedule 40, ASTM D4101, flame retardant in conformance with ASTM D635, plain end
      b. Fittings: PP, Schedule 40, flame retardant in conformance with ASTM D635, drainage pattern, electrofusion
      c. Joints: Electrofusion
      d. Manufacturers: Georg Fischer “Fuseal”, Ipex “Enfield”, Orion “Rionfuse”, Zurn
   2. Polypropylene (PP)
      a. Pipe: PP, Schedule 40, ASTM D4101, flame retardant in conformance with ASTM D635, grooved end
      b. Fittings: PP, Schedule 40, flame retardant in conformance with ASTM D635, drainage pattern, mechanical joint
      c. Joints: Mechanical
      d. Manufacturers: Georg Fischer _____, Ipex “Labline”, Zurn
   3. Chlorinated Polyvinyl Chloride (CPVC)
      a. Pipe: Schedule 40, ASTM D1784, and ASTM F2618
      b. Fittings: Drain, waste, and vent (DWV) pattern, ASTM D3311
      c. Joints: Solvent cement, ASTM F493
      d. Manufacturers: Charlotte “ChemDrain”, Spears “LabWaste”

2.03 ADAPTERS

A. Provide where indicated and as necessary; glass to plastic compression coupling, plastic to metal mechanical joint, or glass to metal mechanical joint and/or compression coupling.

B. Plastic to plastic 1” through 4”: Fernco Proflex 3000 Series shielded coupling with neoprene gasket, stainless steel shield, and stainless steel clamping bands.

C. Stainless Steel to Polypropylene 1" to 10": 316L stainless steel shielded coupling with EPDM inner gasket, and 316 stainless steel fasteners. Teekay Type IV stepped transition coupling or approved equal.

D. Submit adapter fittings for approval prior to installation.

2.04 CLEANOUTS

A. Corrosion resistant materials similar to piping materials. Refer to Cleanout Schedule on drawings.

2.05 FLOOR DRAINS

A. Refer to Drain and Cleanout Schedule.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install piping neat and orderly; accomplish changes of direction using proper pipe fittings. Connect to sinks, cup sinks, floor drains, and other devices as shown on drawings. Conceal piping unless noted to be exposed in reagent rack. Piping within casework shall be coordinated with casework supplier.

B. Pitch vent piping to waste line. Install horizontal waste piping with minimum pitch of 1” in 4 ft; except piping 3” and larger may pitch 1” in 8 ft. Make changes in direction of flow by use of drainage pattern fittings.

C. Set floor drains level and at low points. Protect weep holes from filling with concrete. Clamp safing to drain body for proper drainage.

D. Install cleanouts as shown on drawings. Locate cleanout access cover so that snake of 100 ft can be properly used.

E. Encase dilution basins with 4” of concrete to provide support against collapse of basin.

F. Provide caps and plugs on open pipe ends during construction phase to prevent construction debris from entering pipe.

G. Provide necessary transition fitting and couplings required when changing from one piping material to dissimilar material.

3.02 PLASTIC PIPING

A. Install plastic pipe and fittings as recommended by respective manufacturer. Fuse plastic pipe joints with surrounding temperature above freezing using equipment supplied by pipe manufacturer. Adhere to instructions for fusing as published by manufacturer. Instructions for fusing shall be kept on site.

B. Install mechanical joints in accordance with instructions from pipe/fitting manufacturer. Use materials of same manufacturer, especially made for mechanical jointing. Use pipe and fittings with factory cut groove, except pipe may be grooved in field using equipment and methods as recommended by manufacturer of pipe. Use hangers on each side of mechanical couplings.

C. Manufacturer's representative shall instruct workmen in proper installation techniques required for ____ and provide certification to Owner that instruction has been given and proficiency demonstrated by Contractor in execution of installation of piping system.

D. Use special precautions and approved/listed systems when PP material penetrates fire resistive or smoke barrier. Refer to Section 07 8400 - Firestopping.

E. Do not use plastic pipe when high temperature (above 100°F) water (at autoclaves, sterilizers, glasswashers, and similar devices) is discharged to receptor or drain. Provide minimum of 25 ft of PVDF or stainless steel piping material downstream of high temperature drain discharge point.

3.03 TESTING

A. Refer to Testing paragraph of Section 22 0000 - General Plumbing Requirements.

B. Water test may be applied to system either in its entirety or in sections. Piping shall be tightly plugged and submitted to 10 ft head of water located at highest point. Provide separate standpipe above highest point being tested or extend system to obtain required 10 ft head of water. Head shall be maintained for at least 30 minutes before inspection starts.

C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

D. Testing with air will not be allowed.

3.04 CLEANING

A. After successful pressure test, clean and flush piping system to eliminate debris in drainage system.

END OF SECTION

SECTION 22 6714.13
PLASTIC PIPING FOR HIGH PURITY SERVICE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section covers requirements for procurement, installation, inspection, and sanitization of Polyvinylchloride (PVC) piping, fittings, valves, and specialties for High Purity Water (HPW) service.

B. HPW system is defined by:
   1. This document
   2. Sections under Related Work below.
   3. Piping Plan drawings _____, _____

C. HPW piping is defined as piping downstream of RO system.

1.02 RELATED WORK

A. Section 07 8400 - Firestopping

B. Section 22 0529 - Plumbing Piping and Equipment Supporting Devices

1.03 SCOPE OF WORK

A. Contractor shall be responsible for procurement, installation, inspection, and sanitization of piping system.

B. Contractor shall provide personnel trained and experienced in installation of selected manufacturer's piping system. If personnel are not experienced at start of installation, piping manufacturer's representative shall train Contractor prior to installation. Training certification and experience record is required.

C. Contractor shall submit documentation on components proposed for system and shall obtain approval prior to purchase or fabrication of those components.

D. Contractor shall inspect system and provide documentation to demonstrate that system is installed according to Specification, is leak free, and has been sanitized according to procedure.

1.04 BASIS OF DESIGN

A. Service: HPW
   1. Process Fluids: _____ _____
   2. Operating Pressure/Temp 100 psig at 80°F
   3. Piping System
      a. Design Pressure: 144 psig at 68°F for components
      b. Material: _____ as specified below.
         1) Joining method: _____
         2) Elastomer: EPDM _____

B. Service: HPW _____ water
   1. Process Fluids: _____ _____
   2. Operating Pressure/Temp. 100 psig at 80°F
   3. Piping System
      a. Design Pressure: 150 psig at 100°F for components
      b. Material: _____ as specified below.
         1) Joining method: Solvent weld
         2) Elastomer: EPDM

1.05 SUBMITTALS

A. The following items must be submitted for review, and approved prior to purchase of item:
   1. Detailed descriptions of pipe, fittings, valves, and other components.
   2. Identification of joining method and fusion equipment.
   3. Detailed Sanitization Procedure (see Part 3.1).
   4. Training certification for installation personnel.
   5. Isometric drawings of piping from RO unit through distribution equipment.

B. The following documentation is required to be delivered with system:
   1. Pressure Test Report
   2. Sanitization Records
   3. Manufacturer's material certifications
   4. Record of fusion machine operating parameters for every joint
   5. Joint inspection records

1.06 DELIVERY

A. Pipe, fitting, and components shall be furnished with plastic end-caps/plugs to prevent contamination and damage.

B. Pipe, fitting, and components shall be furnished in individually sealed bags to prevent contamination.

C. Pipe, fittings, and components shall be handled and shipped so as to protect from contamination and damage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Spears Harvel LXT PVC

2.02 GENERAL

A. Piping, fittings, and valves that are to be heat fused shall be products of same manufacturer.

B. Piping, fittings, valves, gaskets and accessories shall be compatible with Design Conditions in Part 1.5 as stated above.

C. Dimensions of end connections for valves shall be compatible with pipe and fittings.

D. Materials in contact with water shall be FDA approved for sanitary product contact surfaces.

E. Pipe and fittings shall be permanently identified with production lot and wall thickness or pressure rating.

F. Piping, fittings, valves, and components shall be manufactured in dedicated equipment in clean environments and bagged.

G. Material Certification Documentation shall be furnished for piping, fittings, valves, and components.

2.03 PIPE, FITTINGS, & JOINTS

A. Low Extractable PVC
   1. Pipe: Low-extractable PVC, virgin material, Schedule 80, with cell classification per ASTM D1784
   2. Fittings: Low-extractable PVC, Schedule 80, socket pattern, ASTM D2467
   3. Joints: One-step solvent cement. Use of threaded fittings shall be limited to locations where equipment requires threaded connection.
   4. Flanges: Low-extractable PVC, ANSI Class 150 bolt pattern, rated for 150 psig at 73°F.

2.04 VALVES

A. General
   1. Valve type shall be as indicated on flow diagram.
   2. Valves shall be same material and manufacturer as piping.
   3. Valves shall conform to Basis of Design in Part 1.5 above.
   4. End Connections shall be spigot ends for _____ or, if indicated on P&IDs Tri-Clamp or flanged ends.

B. Low Extactable PVC Valves
   1. Diaphragm Valves
      a. Low-extractable PVC body, weir style, PTFE diaphragm backed by EPDM, EPDM o-ring seals, true union ends, socket pattern, rated for 150 psig at 73°F.
      b. Size 2” and smaller: Spears 2729T Series
   2. T-Style Diaphragm Valves
      a. Low-extractable PVC body, zero dead leg t-style, PTFE diaphragm, EPDM o-ring seals, true union ends, socket pattern, rated for 150 psig at 73°F.
      b. Size 2” and smaller: Spears 2729TZD Series
   3. Ball Valves
      a. Low-extractable PVC body and ball, full port, PTFE seat, _____ o-ring seats, true union ends, socket pattern, rated for 150 psig at 73°F.
      b. Size 2” and smaller: Spears 1839 Series
      c. Size 2-1/2” and larger: Spears 1832 Series
   4. Ball Check Valves
      a. Low-extractable PVC body and ball, EPDM o-ring seals, true union ends, socket pattern, rated for 150 psig at 73°F.
      b. Size 2” and smaller: Spears 4539 Series
      c. Size 2-1/2” and larger: Spears 4532 Series
   5. Sampling Valves
      a. Low extractable PVC body, replaceable PTFE seals, socket pattern, rated for 150 psig at 73°F.
      b. Straight Pattern (1/2” and smaller): Spears 5592 Series
      c. Angle Pattern (1/2” and smaller): Spears 5692 Series

C. Actuators
   1. Valve actuators for on/off control to be provided integral to valve by manufacturer of valve.
   2. Actuator type (pneumatic/electric) shall be as indicated on P&ID. Position switches shall be provided if indicated on P&ID.

2.05 SPECIALTY ITEMS

A. Orifice Plates
   1. Manufacturers: Rubber Fab Mold and Rubber Co., Newman Gasket Co., or Georg Fischer
   2. Flow restriction orifice plates shall be 316L stainless steel with minimum finish of 25 Ra micro-inch, or Kynar, for installation in Tri-clamp or sanitary union.
   3. Orifice plates shall be tagged with instrument number and orifice bore size.
   4. Orifice plates shall be concentric or eccentric depending upon installation orientation
   5. Preliminary sizing information is shown on P&ID. Sizing information shall be verified by Engineer after Contractor submits drawings.

B. Flexible Sections

1. Flexible sections indicated on drawings shall be _____ FDA Approved Teflon with external polypropylene reinforcing braiding and tri-clamp connections. Teflon inner core is extended through flange and flared to form gasket. Backing flange to be PVDF with 150 # ANSI dimensions. Flexible sections shall be rated for at least 150 psig.

C. Faucet Connections
   1. Tubing for connection to lab faucets shall be polypropylene, or PFA tubing, 3/8" OD; 0.062" wall, rated to at least 150 psig at 80°F. Polypropylene tubing shall be made from virgin copolymer conforming to FDA requirements for food contact.

2.06 INSTRUMENTATION

A. Instrumentation Specifications are covered in Section 22 6720.13 - High Purity Water System.

PART 3 - EXECUTION

3.01 GENERAL

A. Install and inspect piping and accessories as per Contract Documents and recommendations of equipment manufacturers.

B. Provide installation personnel who are trained and experienced with assembly of selected piping in high purity systems.

C. Provide diaphragm valves or type of valves as indicated on drawings.
   1. Inspect delivered components to verify conformance to specification and to check for evidence of damage or contamination. Do not use suspect materials.

D. Maintain high level of cleanliness during handling and installation.
   1. Prior to starting work, identify areas that will be used for storage and fabrication, and take measures to prevent contamination from adjoining areas.
   2. Handle and store tubing, fitting, and components in a manner that prevents impact damage, excessive stress, and contamination.
   3. Maintain manufacturer's protective packaging in place until immediately prior to use.
   4. Keep openings on assemblies sealed during fabrication to prevent contamination prior to final installation.

E. Install piping using minimum number of joints.

F. Monitor and inspect installation process to ensure:
   1. Conformance with this Specification.
   2. Compliance with manufacturer's requirements.
   3. Piping is supported as specified.

3.02 INSTALLATION

A. Configuration
   1. Horizontal runs shall be continuously supported by equal leg aluminum, stainless steel, or galvanized steel "V" channel under pipe. _____
   2. Install tubing so that there are no undrainable pockets. _____
   3. Provide adequate support of pipe at pump discharge.
   4. Orient diaphragm valves per manufacturer's instructions to ensure complete drainage.
   5. Install check valves and orifice plates in vertical sections. If installation in horizontal is required, provide eccentric valve or plate and orientate properly.
   6. Provide low point drains and high point vents in compliance with drawings and Engineering review of isometric drawings.
   7. Rough or sharp edges must not be in contact with pipe.
   8. Erect tubing without spring or force. Connect to equipment such that stress is not transferred to equipment.

9. Install all tee connections so as to minimize dead leg. Distance from sealing point on branch to inside of main line wall shall be less than _____ branch line diameters.
10. Route lines so as to accommodate thermal expansion where required. Provide supports appropriate for thermal expansion. Install supports so that movement of piping due to thermal expansion is not impeded.

B. In-Line Devices
1. Locate and orient in-line specialty items and instrumentation so as to allow for access after insulation is installed, including:
   a. Access for maintenance and calibration.
   b. Viewing of gauges by operating personnel.
   c. Clearance for removal of regularly replaced components (filter elements, UV lamps, etc.)
   d. Convenient operator access to sample valves and insertion of sampling container.
2. Install in-line specialty items and instruments such that they are free draining.
   a. Install restriction orifices in vertical section of pipe. Provide orifice that is eccentric drilled and orientate with hole at low point if orifice must be installed in horizontal pipe.
   b. Install in-line specialty items and instruments in strict accordance with manufacturer's instructions.
   c. Install sensors for conductivity and resistivity in run of a horizontal tee with flow exiting upward branch.
   d. Provide length of straight pipe upstream and downstream of flowmeters. As specified by manufacturer.
   e. Install pressure regulators and backpressure regulators with at least 10 pipe diameters of straight pipe upstream and downstream of regulator.
   f. Install sanitary orifice plates in sanitary unions or in Tri-Clamp joints as indicated on drawings. Clearly tag orifice location.
   g. Securely support relief valves and relief discharge lines.

C. Penetrations
1. Floor
   a. Provide sleeves on piping penetrations through floor slabs one pipe size larger than service piping, and extend sleeve 2" above finished floor.
2. Fire-Rated walls:
   a. Provide firestopping per Section 22 0700 - Plumbing Systems Insulation.

3.03 USE POINT CONNECTIONS

A. Faucets
1. _____
2. Connect outlet of valve to faucet with 3/8" polypropylene or PFA tubing.
3. Use shortest length of tubing as possible.

B. Equipment
1. _____
2. Install piping per size from valve to equipment.
3. Install Restriction Orifice if indicated on drawing.
   a. Use concentric plate in vertical lines.
   b. Use eccentric plate in horizontal lines.

3.04 TESTING

A. Inspection

1. Visually inspect all joints and verify that they comply with manufacturer's criteria for a properly formed joint.
2. For joints fused by machines that generate labels, verify that each joint has label.
3. Check diaphragm valve bonnet bolts for correct torque.

B. Hydrotest
1. Execute all pressure testing safely.
   a. Do not pressurize plastic piping with gas.
   b. Isolate equipment or instrumentation that cannot to be exposed to test pressure.
   c. Notify personnel with access to system that testing is to take place. Tag each use point to indicate that valve is not to be used.
   d. Ensure that air is completely vented from system to avoid a hazardous condition.
   e. Pressurize system gradually.
   f. Provide controls to prevent pressure from exceeding specified test pressure.
2. Ensure that cleanliness of system is not compromised.
   a. Provide water for testing and flushing that has quality equal to or better then service water.
   b. When performing preliminary testing of sections of system, after test is complete flush all water out of system and ensure that it drains completely. Close all openings in system after draining.
3. Execute final acceptance test on completed piping system.
   a. Do not insulate or conceal piping until testing is complete.
   b. Test system in sections or as a whole, but all joints need to be covered in test.
   c. Ensure that air is completely vented from system.
   d. Pressurize gradually and hold system at 100 psig for 4 hours. An initial pressure decrease will occur due to pipe elongation after pressurization. After 4 hours, pressure loss will stabilize, and pressure must then hold at test pressure without a loss of 1% over period of one hour to pass test.
   e. Monitor pressure with gauge located near bottom of system that is readable to at least plus or minus 1 psi.
   f. Note if pressure drops more than 1% over test period and determine source of leakage.
      1) Cut out and reinstall defective joints.
      2) Hand tighten wing nuts on sanitary clamps if required. If leakage continues, install new gasket. Do not tighten using tools.
      3) Retest.
4. Provide written certification that includes identification of portion of system tested, date, time, test criteria, test medium and pressure, duration, and name and title of person responsible for test.

3.05 SANITIZING/FLUSHING

A. General
1. Perform sanitization after inspection, documentation, and acceptance of system. If chemical sanitation is not required then this procedure will be used for flushing, without addition of sanitant.
2. Prior to sanitization, slowly fill system with water while venting air from system. Continue to check that all air has been vented after water is recirculating.
3. Adjust any pressure regulators to their preliminary setpoints.
4. Perform sanitization immediately prior to placing system in operation and coordinate with Owner's representative.
5. Safety:

a. Follow manufacturer's safety recommendations for handling of chemicals.
b. Disconnect power to UV lights prior to sanitization.
c. Provide controls to ensure that system remains within pre-established sanitization conditions and that system pressure does not exceed Design Conditions in Part 1.5 above.
d. Ensure that proper chemicals are used and that they are handled safely.
e. Notify personnel with access to system that sanitation is being performed. Prior to cleaning, tag each use point to indicate that valve is not to be used.

6. Provide all equipment, fittings, and supplies necessary to execute sanitization.
7. Prepare a procedure which identifies:
   a. Recirculation circuit(s) and sampling points.
   b. Measures required to confine sanitizing solution.
   c. Step-by-step procedure (including any modifications to piping or controls).
   d. Sign-off matrix.
8. Isolate equipment or instrumentation that is not to be exposed to sanitant.
   a. Bypass ion exchange beds.
   b. Turn off UV lights.
   c. Record all changes made to system that are required to execute test.
9. Record execution of procedure including Owner sign-off.

B. Procedure for hydrogen peroxide
1. Makeup solution of 5% hydrogen peroxide with water. Water shall be equivalent to service water quality or deionized water (minimum 1 megohm) that has passed through a 1.0 micron filter.
2. Fill entire system with solution. All gas must be vented, and system set up for recirculation so that all parts will be exposed to solution.
3. Recirculate at flow rate of at least 3 fps. Draw samples at points of use and at other key sample points to confirm presence and concentration of peroxide.
4. Confirm that there is solution throughout system, and then continue to recirculate for at least 4 h. Draw off water for at least one minute at each use point.
5. After recirculation with solution flush system with product quality water for at least 45 minutes, rotating draw off from all use points.
6. Test water with solution residual test strips at key sample points to ensure less than 1 ppm is achieved.
7. Continue to flush for 30 minutes. Draw off water for at least 1 minute at each use point.
8. Return system to its original configuration. Verify that all modifications that were made to piping or controls were restored. Prepare system for normal operation.

C. Procedure for peracetic acid _____
1. Makeup solution of 1% Minncare with water that is less than 70°F. Water shall be equivalent to service water quality or deionized water (minimum 1 megohm) that has passed through a 1.0 micron filter. Fill entire system with solution. All gas must be vented, and system set up for recirculation so that all parts will be exposed to solution.
2. Recirculate at flow rate of at least 3 fps. Draw samples at points of use and at other key sample points to confirm presence and concentration of peracetic acid solution using test strips. Monitor system temperature to ensure that is does not rise above 75°F.
3. Confirm that there is solution throughout system, and then continue to recirculate for at least 3 h. Draw off water for at least one minute at each use point.
4. After recirculation with peracetic acid solution flush system with product quality water for at least 45 minutes, rotating draw off from all use points.
5. Test water with peracetic acid solution residual test strips at key sample points to ensure less than 1 ppm is achieved.

6. Continue to flush for 30 minutes. Draw off water for at least 1 minute at each use point.
7. Return system to its original configuration. Verify that all modifications that were made to piping or controls were restored. Prepare system for normal operation.

END OF SECTION