PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 220500 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to the following:

1. Pipe and Fittings
    a. Sanitary waste and vent
    b. Storm drain and overflow
    c. Potable Cold water
    d. Potable Hot water
    e. Fuel gas
    f. Compressed air
    g. Pumped discharge
2. Valves
    a. Water valves
    b. Backwater valves
    c. Natural gas valves
    d. Compressed air valves
    e. Balancing valves
    f. Backflow prevention valves
    g. Pressure reducing valves
    h. Gas pressure regulator valves
    i. Thermostatic mixing valves
    j. Process valves
3. Thermometers and gauges
4. Piping specialties
5. Pipe escutcheons
6. Strainers
7. Drip pans
8. Air vent
9. Dielectric unions
10. Unions
11. Flanges
12. Pipe sleeves
13. Sleeve seals
14. Valve boxes
15. Pipe coating
16. Gas connectors

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 220500: Basic Plumbing Materials and Methods

B. Section 223000: Plumbing Equipment

C. Section 224000: Plumbing Fixtures

D. Division 26: Electrical

E. Division 09: Finishes/Painting

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications:
1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

B. Codes and Standards:
1. All work shall be in full accordance with all applicable codes, ordinances and code rulings.
2. The Contractor shall furnish without any extra charge the labor and material required for compliance of codes.
3. Perform all tests required by governing authorities and as required under all Division 22 Sections. Provide written reports on all tests.
4. Electrical devices and wiring shall confirm to the 2013 standards of CEC; all devices shall be UL or ETL listed and so identified.
5. All plumbing work shall comply with the Americans with Disabilities Act (ADA).
6. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.
7. Provide thermostatic mixing valves and fixtures conforming to ASSE 1070 to limit the maximum water temperature to 110°F for all public lavatories and 120°F for all other public fixtures served with hot water. Handle position stops and temperature mixing valves shall be used as required to limit maximum temperature to prevent scalding. Water heater thermostats shall not be considered a suitable control.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for all piping, valves and specialties indicating dimensions, valve CV, tolerances etc.

B. Shop Drawings: Submit shop drawings indicating underground piping installation showing all fittings with inverts. Indicate all footings and grade beams.

C. Maintenance Data: Submit maintenance instructions on accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. Type M copper piping is not acceptable for any pressure water piping unless specifically noted otherwise.

C. For all Grade B piping specified below grade provide a mill report with production identification numbers for piping submitted to permit tracking of pipe by mill and production lot.

D. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturer's names used herein, unless specifically noted that substitutes are not allowed.

2.2 STANDARD PIPE AND FITTING

A. Domestic Water Pipe & Fittings (Below Grade):
1. Pipe: ASTM B88, Type K hard drawn copper water tube.
2. Fittings: Domestic Only, Elkhart, ANSI B16.22, wrought copper, 95%-5% tin-antimony solder joints. Wrap underground piping with Scotch Wrap or Pasco Wrap.

B. Domestic Hot and Cold Water Pipe & Fittings and Pumped Systems (Above Grade):
1. Pipe: ASTM B88, Type L, hard drawn copper water tube.
2. Fittings: ANSI B16.22, wrought copper, 95%-5% tin-antimony solder joints.

C. Condensate and Indirect drains:
1. Pipe: ASTM B88, Type M, hard drawn copper water tube.
2. Fittings: ANSI B16.22, wrought copper.
3. Insulate condensate drain pipes with minimum 1/2" insulation to prevent moisture dripping from pipe.

D. Trap Primer Piping:
1. Pipe: ASTM B88, Type K below grade only or Type L above grade, soft drawn copper water tube.
2. Fittings: For pipes below grade double wrap with Scotch Wrap #51 or PASCO Wrap, with 50% overlap.

E. Sanitary Sewer, Vent, Rainwater Pipe & Fittings:
1. Sch 40 solid wall PVC.
2. Pipe: ASTM A-74, ASTM A-888 cast iron, bituminous coated, “No-Hub”. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and manufactured by AB&I, Charlotte, Tyler or approved equal. Pipe showing rust or cracks in coating shall be removed and replaced.
3. Fittings: No-hub, ASTM A-888.

4. Couplings Below Grade: Heavy Duty Type 304 stainless steel couplings conforming to FM 1680 and ASTM C-1540 with heavy-duty shield and neoprene sealing sleeve conforming to ASTM C-564 and CISPI 301. Husky SD-4000, Clamp-All Hi-Torq 125 or Ideal Tridon HD or equal.
5. Above grade: Use standard ANACO no hub bands or equal and appoved per ATSM and SCIPI requirements.

F. Rainwater Leader Pipe and Fittings-Alternative for Exposed Areas Above Grade:
1. Pipe: ASTM B306, DWV class, copper tube.
2. Fittings: ANSI B16.23 cast bronze or ANSI B16.29 wrought copper. Drainage pattern fittings.
3. Joints: Lead free solder.

G. Aboveground sanitary-sewage forced mains (pumped discharge) up to 6” shall be one of the following:
1. Hard copper tube, ASTM B88 Type L or Type K, copper pressure fittings and soldered joints.
2. Galvanized-steel pipe, ASTM A53 Schedule 40, pressure fittings, and threaded joints.
3. Pressure rated transition coupling where connecting to dissimilar materials.

H. Underground sanitary-sewage forced mains (pumped discharge) up to 4” shall be one of the following:
1. Hard copper tube, ASTM B88 Type K, wrought copper pressure fittings; and soldered joints.
2. Ductile-iron, ANSI A21.51, mechanical-joint piping and mechanical joints.
3. Ductile iron, ANSI A21.51, grooved-joint piping and grooved joints.
4. Fitting-type transition coupling for piping smaller than 1-1/2” and pressure transition coupling for 1-1/2” and larger if dissimilar pipe materials.

I. Single Wall Acid Waste Pipe and Fittings:
1. PP Drainage Pipe and Fittings: ASTM F1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D4101; with fusion welded-joint ends.
2. Manufacturers:
   1) IPEX Inc.
   2) Orion Fittings, Inc
   3) Sloane, George Fischer Inc
   4) Zurn Plumbing Products Group, Chemical Drainage Systems
   5) Or equal
3. PVC Drainage Pipe and Fittings: ASTM D2665, pipe and drainage-pattern fittings.
4. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

J. Natural Gas Pipe & Fitting (Above Grade)
1. Pipe: ASTM A53, Schedule 40 black steel.
   a. Fittings: 150 lb. rating, ANSI B16.3, malleable iron threaded; ANSI B16.5, flanged; ANSI B16.9, steel.
   b. Joints 2" and smaller: Threaded in accessible areas. Welded in concealed areas such as shafts and plenums.

c. Joints 2-1/2" and larger: ANSI B16.25 bevelweld, ANSI B16.5 flanges, or ANSI B16.11 socket weld. Welded in concealed areas such as shafts and plenums. Open-butt welded fittings or sock welded shall be acceptable where meeting ANSI requirements.

K. Natural Gas Piping (Below Grade)
1. Polyethylene, Grade 23, Type II, ASTM 2513, plain ends, heat fused joints, orange finish.

2.3 VALVES: GENERAL

A. General: Valve ratings shall exceed respective system operating pressures by 50% (minimum). All valves shall be line size unless otherwise noted.

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve.

C. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

D. Acceptable manufacturers (manufacturer and model number listed for individual valves indicates minimum acceptable by all manufacturers):
1. Gate, Ball, Check or Butterfly: Apollo, Hammond, Nibco (commercial grade, US manufacturer only), Milwaukee, Victaulic or Watts.
2. Lubricated Plug Valves: Homestead, Resun, or Rockwell.
3. Backflow Preventors: Apollo, Ames, Febco, Cla-Val, Watts or Wilkins.
4. Pressure Reducing Valves: Apollo, Cash-Acme, Cla-Val, Watts, or Wilkins.
5. Solenoid Valves: ASCO, Automatic or Magnatrol.
6. Circuit Setters: Griswold (Venturi with characterized ball valve only), Caleffi, Wheatley (Y-globe type only), Armstrong, or Tour & Anderson.

E. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on the valve body.

F. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, other than plug valves. Provide one wrench for every 10 plug valves, and one in each size. Provide extended levers/stems for valves on insulated lines. For manual valves 2 ½" and larger located 8 feet above the floor in mechanical rooms provide chain operator to permit operating the valve from 4'-0" above floor.

G. Valve Features:
1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.
2. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).
3. Threaded: Valve ends complying with ANSI B2.1.
4. Solder-Joint: Valve ends complying with ANSI B16.18.

5. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

2.4 DOMESTIC PLUMBING SERVICE VALVES

A. Ball Valves:
1. 2" and Smaller: 600 psi, 2 piece, bronze body, soldered ends for copper pipe and threaded ends for iron pipe, chrome plated brass ball, Teflon seat, brass stem, steel handle, full port, low lead compliant. Apollo Lead Free #77CLF Series or equal.

B. Butterfly Valves:
1. 2-1/2” and Larger: MSS SP-67, lug wafer, ductile iron body, stainless steel disc, stainless steel stem, EPDM seat, low lead compliant, memory stop control, lever handle thru 5" size and worm gear operator for 6" and larger. Mount stem in horizontal position. Apollo #LD141/WD141 Series or equal.

C. Check Valves:
1. 2" and Smaller: Class 125, MSS SP-80, ASTM B62 and ASTM B16, cast bronze body, soldered ends for copper pipe, screwed cap, swing type, Teflon bronze disc, low lead compliant. Apollo Lead Free #163LF Series or equal.
2. 2-1/2" and Larger: Class 125, MSS SP-71, ASTM A126 class B cast iron body, bolted bonnet flanged ends, bolted cap, swing type, cast iron disc with bronze face rings, low lead compliant. Apollo Lead Free #910F Series or equal.
3. Vertical or High Flow: Class 125, cast bronze, high-flow body, TFE seat, brass check, low lea compliant, stainless steel guide and spring. Apollo Lead Free #61LF Series or equal

D. Angle Stop Valves:
1. Heavy duty 1/4 turn commercial stop, brass body, chrome plated compression type, 125 psi working pressure, ASME A112.18.1, low lead compliant. Provide with loose key handle in public access spaces for vandal resistance. Chicago Faucets #ST Series, Brasscraft #KT Series, or equal.

2.5 NATURAL GAS SERVICE VALVES

A. General: All valves to be UL listed for the required fluid service.

B. Ball Valves:
1. 1/2" and 3/4": Brass body, UL listed, CSA approved for pressure of system, bronze ball valve, 175 WOG, with integral lever handle. Apollo #77F Series, Watts #FBV-1 or equal.
2. 1" thru 1-1/2": 175 psi working pressure, CSA and UL approved, bronze body, stainless steel ball, stainless steel stem, steel handle with memory stop tab, conventional port. Apollo #77F-140 Series or equal.
3. Lubricated Plug Valve, 2" and Larger: Class 125, MSS SP-78, 200 PSI, UL listed, CSA approved for pressure of system, lubricated plug type, semi-steel body, loose wrench operated, straight way pattern round port, combination button head fitting and lubricant screw, Teflon seal and discs.

C. Seismic Gas Shutoff Valves:

1. 3/4” thru 2” (low and medium pressure, screwed body): U.L. Listed valve meeting ASCE 25-97, positive closure, soft seal seating, visual open-close indicator, manual reset, and closure time interval within 5 seconds when subjected to a sinusoidal oscillation with peak acceleration of 0.3G and a period of 0.4 seconds. Koso/California Valve Series EV, or approved equal, sized for 0.5 PSI or 20 PSI max operating pressure, respectively.
2. 2”, 3” and 4” (High pressure, screwed body): U.L. Listed valve meeting ASCE 25-97,manual reset, soft seat construction for positive sealing, visual open-close indicator, tripping mechanism with non-creeping rolling latch, and closure time interval within 5 seconds when subjected to sinusoidal oscillation with peak acceleration of 0.3G and a period of 0.4 seconds. Koso/California Valve Series EV315, or approved equal, sized for 20 PSI max. operating pressure.
3. 6” (high Pressure, Flanged body): U.L. Listed valve meeting ASCE 25-97,manual reset, soft seat construction for positive sealing, visual open-close indicator, tripping mechanism with non-creeping rolling latch, and closure time interval within 5 seconds when subjected to sinusoidal oscillation with peak acceleration of 0.3G and a period of 0.4 seconds. Koso/California Valve Series EV317, or approved equal, sized for 60 PSI max. operating pressure.

2.6 COMPRESSED AIR AND VACUUM SERVICE VALVES

A. Ball Valves:
1. 2" and Smaller: 175 psi working pressure, 2 piece bronze body, soldered or threaded ends, stainless steel ball, stainless steel stem, steel handle with conventional port. Apollo #140 Series or equal.

B. Butterfly Valves:
1. 2-1/2" and Larger: MSS SP-67, lug wafer ductile iron body, stainless steel disc, stainless steel stem, EPDM seat, memory stop control, lever handle. Mount stem in horizontal position. Apollo #LD141/WD141 Series or equal.

C. Air Vent Needle Valves:
1. 3/4" and Smaller: 200 psi working pressure, needle globe valve, bronze body, threaded ends, bronze stem, steel wheel handle. Milwaukee #600 or equal.

2.7 BALANCING VALVES: MAXIMUM 125 PSIG SYSTEM WORKING WATER PRESSURE

A. Pressure Dependent Water Flow:
1. 1/2" and Larger: Construction and attachment style as required by piping system. Autoflow valves Caleffi or equal lead free copper valves. Install in pipe with minimum length of unrestricted straight pipes. Install in pipe with minimum length of unrestricted straight pipe equivalent to five pipe diameters upstream and two pipe diameters downstream.

2.8 BACKFLOW PREVENTION VALVES

A. General: All backflow prevention valves shall be State approved and listed.

B. Reduced Pressure Principal Backflow Prevention Assembly for High Hazard Applications:

1. 2" and Smaller: Assembly shall consist of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1013 and AWWA C506. Bronze construction, threaded ends, stainless steel internal parts, and air gap fitting. Route pipe from air gap fitting to approved waste receptor. Apollo Lead Free #RP4ALF Series valve with #AGD4A air gap fitting.
2. 2-1/2" and Larger: Assembly shall consist of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1015 and AWWA C506. Stainless Steel body construction, flanged ends, center stem guided check valves, and air gap fitting. Route pipe from air gap fitting to approved waste receptor. Apollo Lead Free #RP4ALF-OS&Y valve with #AGD4A air gap fitting or equal.

C. Atmospheric Vacuum Breaker: Assembly shall consist of a bronze vacuum breaker body with silicone disc, and full size orifice. Device shall be IAPMO listed, meet ASSE 1001 and ANSI A113.1.1. Chrome plated in finish areas. Apollo Lead Free 38LF Series.

D. Pressure Vacuum Breaker: Assembly shall consist of a one piece bronze or stainless steel body, with stainless steel spring loaded check, rubber diaphragm, and atmospheric vent, breakaway set screw. Provide chrome plated in finish areas. Apollo #4A-PVB Series or equal.

2.9 PRESSURE REDUCING VALVES

A. Single seated, direct operated type; high capacity, having bronze body with strainer, by-pass feature, pressure gauge tappings and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and fail-off at inlet and outlet pressure indicated. Apollo Lead Free #36HLF Series or equal by Watts or Cash Acme.

B. Single seated, pilot operated globe valve type having ductile iron body with FDA approved epoxy coating inside and out, with Y strainer, stainless steel seat, FDA approved diaphragm, copper control tubing, pressure gauge tappings and complying with requirements of ANSI Standard A112.26.2. Select proper size for maximum flow rate and fall-off at inlet and outlet pressure indicated. Apollo #A108 series or equal by Watts or Cash Acme.

2.10 PRESSURE RELIEF VALVES

A. Pressure Relief Valve: Lead free bronze body construction, thermostat and test lever, and initial pressure relief set at 125 psi (adjust for system requirements). Certified to meet ASME low pressure heating boiler code.

B. Manufacturers: Watts #LF3L, Cash Acme #LFF-95 Series or equal.

2.11 TEMPERATURE AND PRESSURE RELIEF VALVES

A. Temperature and Pressure Relief Valve: Lead free bronze body construction, thermostat and test lever, temperature relief set at 210^0F, and pressure relief set at 125 psi. Certified to meet ASME low pressure heating boiler code and ANSI Z21.22.

B. Manufacturers: Watts #LF Series (100XL, 40, 140, N240, 340), Cash Acme #FVX Series or equal.

2.12 VACUUM RELIEF VALVES

A. Vacuum Relief Valve: Lead free brass body construction, protective cap, 1/2" male NPT, maximum operating temperature 250^0F. Tested and rated to ANSI Z21.22.

B. Manufacturers: Watts #LFN36 Series, Cash Acme #VR-801, or equal.

2.13 GAS PRESSURE REGULATOR VALVES - VENTED

A. Diaphragm operated with adjusting screw and relief valve. Steel, cast iron or ductile iron construction as required for application. Size and capacity as indicated on drawings. Regulators shall be approved by the serving gas supplier. CSA and UL listed.

B. Where gas supply regulator will be located indoors provide internal relief valve with overpressure protection and set to discharge at 10% above equipment operating setpoint. Route relief vent pipe to exterior of building in compliance with code.

C. Manufacturer: Emerson Fisher #SC800 Series, Maxitrol or equal.

2.14 GAS PRESSURE REGULATOR VALVES – VENT LIMITING

A. Lever acting design for 2 psi propane piping systems or 5 psi natural gas piping systems with adjusting screw for outlet pressures of 7" to 11" wc. Aluminum body with threaded connections.

B. ANSI Z21.80/CSA 6.22 listing with vent limiting device for indoor installation in ventilated (occupied) spaces. Vent piping to outdoor is not required. Install per manufacturer's installation instructions. Size and capacity as indicated on drawings.

C. Manufacturer: Maxitrol #325 Series with vLimiter, or equal.

2.15 THERMOSTATIC MIXING VALVE ASSEMBLY

A. Factory assembled cabinet with one thermostatic mixing valve to serve low volume flow range and adjustable to maintain +/-5^0F up to leaving water temperature of 150^0F. Refer to drawings for locations, capacities, pressure drops, flow rates, and models.

B. Full cabinet enclosure for all components. Stainless steel or powder coated steel cabinet for recessed or surface mounting with hinged access door. Refer to drawings for mounting requirements. Top or bottom water supplies as required. Provide access door with cylinder lock. Finish color as selected by Architect or Owner's Representative.

C. Thermostatic valve constructed of brass and stainless steel, with screwdriver locking temperature regulators, check stops, removable/replaceable cartridge, stainless steel piston, ball valves, bimetal dial thermometer (20^0F to 200^0F range), brass pipe fittings, and unions. Interior parts in standard rough bronze, nickel or chrome finish.

D. Mixing valve assembly shall be ASSE 1070 (Performance Requirements for Water Temperature Limiting Devices) compliant with adjustable and lockable means to limit the hot water temperature setting.

E. Valve assembly shall be ASSE 1017 certified and meet low lead requirements of wetted surface area containing less than 0.24% lead by weight. Compliant with ASME A112.18.1/CSA B125.2, CA 116875 and NSF 372.

F. Manufacturers: Apollo #34 Series, Symmons #Maxline 7 Series, Leonard #LF Series or equal.

2.16 THERMOSTATIC MIXING VALVE ASSEMBLY – HIGH/LOW FLOW

A. Factory assembled cabinet with two thermostatic mixing valves to serve broad range of flow conditions and adjustable to maintain +/-5ºF up to leaving water temperature of 150ºF. Refer to drawings for locations, capacities, pressure drops, flow rates, and models.

B. Full cabinet enclosure for all components. Stainless steel or powder coated steel cabinet for recessed or surface mounting with hinged access door. Refer to drawings for mounting requirements. Top or bottom water supplies as required. Provide access door with cylinder lock. Finish color as selected by Architect or Owner's Representative.

C. Thermostatic valve constructed of brass and stainless steel, with screwdriver locking temperature regulators, pressure reducing valve, check stops, removable/replaceable cartridge, stainless steel piston, ball valves, two pressure gauges, bimetal dial thermometer (20^0F to 200^0F range), brass pipe fittings, and unions. Interior parts in standard rough bronze, nickel or chrome finish.

D. Mixing valve assembly shall be ASSE 1070 (Performance Requirements for Water Temperature Limiting Devices) compliant with adjustable and lockable means to limit the hot water temperature setting.

E. Valve assembly shall be ASSE 1017 certified and meet low lead requirements of wetted surface area containing less than 0.24% lead by weight. Compliant with ASME A112.18.1/CSA B125.2, CA 116875 and NSF 372.

F. Manufacturers: Apollo #34 Series, Symmons #Maxline 7 Series, Leonard #LF Series or equal.

2.17 SOLENOID VALVES

A. UL listed, globe pattern bronze valve with threaded ends, stainless steel pilot, bronze piston, malleable iron solenoid assembly with 1/2" tapped conduit connections and Class "A" coil, 120 Volt, 60 Hertz. Solenoid valve shall be wired to the Fire Alarm System. The valve shall close instantly on application of current and open when de-energized. Provide solenoid valve on gas line into boiler and water heating rooms

where the aggregate gas input is over 400,000 Btuh. Wire to “mushroom” button(s) outside of each door to room.

2.18 THERMOMETERS AND GAUGES

A. General:
1. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.
2. No mercury shall be used in thermometers due to hazardous material classification.
3. Acceptable Manufacturers: Weksler, Winters, Trerice, Marshalltown or US Gauge.

B. Thermometers:
1. Bi-Metal Type: Provide bi-metal glass thermometers of materials, capacities, and ranges indicated, designed and constructed in service indicated. Accuracy shall be 1% +/- full scale with adjustable recalibration.
a. Case: Type 300 series stainless steel, hermetically sealed, glass window, 3" diameter dial, with adjustable angle.
b. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.
c. Scale: Satin faced, non-reflective aluminum, permanently etched markings.
d. Stem: Stainless steel, adjustable angle socket, length to suit installation.
2. Range: Conform to the following:
1) Hot Water: 20°F - 240°F with 2°F scale divisions.
2) Cold Water: -40°F - 160°F with 2°F scale divisions.

C. Thermometer Test Wells:
1. Provide thermometer test wells as indicated, constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

D. Temperature Gauge Connector Plugs:
1. Provide temperature gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

E. Pressure Gauges:
1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
2. Type: General use, 1% accuracy ANSI B40.1 grade A, phosphor bronze bourbon type, bottom connection.
3. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.
4. Connector: Brass with 1/4" male NPT.
5. Scale: White coated aluminum, with permanently etched markings.
6. Pressure differential range shall be 100 psig minimum for the appropriate application with maximum 1 psig divisions.

F. Pressure Gauge Cocks:
   1. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Gauge cock constructed of brass with ¼" female NPT on each end, and "T" handle brass plug.
   2. Syphon: 1/4" straight coil constructed of brass tubing with 1/4" male NPT on each end.
   3. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

G. Pressure Gauge Connector Test Plugs:
   1. Provide pressure gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Constructed of brass and finish in nickel-plate, equip with ½" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion pressure gauge. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

2.19 PIPING SPECIALTIES

A. General:
   1. Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is installer's option.

B. Pipe Escutcheons:
   1. Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas only.
   2. Pipe Escutcheons for Dry Areas: Provide steel/chrome escutcheons, solid or split hinged.

C. Low Pressure Y-Type Pipeline Strainers:
   1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125% of the working pressure of piping system, with Type 304 stainless steel screens, with 3/64" perforations at 233 0.045" perforations per square inch.
   2. Threaded ends, 2" and smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with hose bibb. Sarco, Wheatley or Mueller.
   3. Flanged ends, 2-1/2" and larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with hose bibb. Sarco, Wheatley or Mueller.
   4. Grooved ends 2-1/2” and larger: Ductile iron body, bolted screen retainer with off center blowdown fitted with hose bibb. Victaulic or Gustin-Bacon.

D. Drip Pans:
   1. Provide drip pans fabricated from 16-gauge galvanized sheet metal with watertight joints, and with edges turned up 2-1/2. Provide hole, gasket, and

flange at low point for watertight joint and 1" copper drain line connection. Extend 1" drain to nearest approved receptor as illustrated on drawings.

E. Air Vent with Valves:
1. Cold water and hot water vent valve with 1/4 turn ball shut-off valve. Tapped at top for 1/8" or 1/4" NPT drain connection. Removable top and built-in check valve. Maximum operating pressure 75 psi. Maximum operating temperature 250ºF. Hoffman #79, Dole #75 or equal.

F. Dielectric Unions:
1. Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

G. Dielectric Flanges: Provide dielectric flanges for flanged transitions between dissimilar metal piping. Watts Series 3100 C.T.S. flanges or approved equal.

H. Unions:
1. Unions shall be of type specified in following schedule:
   a. Black Steel, 2" and smaller: 250 lb. screwed malleable iron, ground joint, brass to iron seat.
   b. Black Steel, 2-1/2" and larger: 150 lb. cast iron screwed flanged, flat faced, full faced gasket.
   c. Soldered Copper or Brass Pipe, 2" and smaller: 150 lb. cast bronze or copper, ground joint, non-ferrous seat with soldered ends.
   d. Screwed Copper or Brass Pipe, 2" and smaller: 150 lb. cast brass, ground joint, brass to brass seat, with threaded ends.
   e. Flanged Copper or Brass Pipe, 2-1/2" and larger: two (2) 150 lb. cast bronze flanges.
   f. Manufacturer: EPCO, Mueller, Stanley G. Flagg or Watts.

I. Flanges:
1. Provide flanges at flanged connections to equipment, tanks and valves. Faces of flanges being connected shall be alike in all cases. Connection of raised-face flange to flat-faced flange not permitted.
2. Use ASTM A307, Grade B, bolts and nuts for cast iron flanges and ASTM A193 for steel flanges. Regular square head unfinished bolts with heavy semi-finished hex nuts ASTM A194. Cadmium plated where exposed to weather. Rating: 150 lb. or 300 lb. in high pressure portions.
3. Type of pipe and corresponding flanges as follows:
   a. Screwed Black Steel Pipelines: 125 lb. black cast iron screwed flange, flat faces.
   b. Welded Steel Pipe, 150 lb. black forges steel welding flanges, 1/16" raised fact ASTM A181 Grade I. Use flat face when connected to flat faced companion flange.

J. Pipe Sleeves:
1. Sleeves shall provide a minimum ½" annular clearance around pipe.
2. Sheet metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or spotwelded longitudinal joint. Fabricate from 28 gauge metal.
3. Steel pipe: Fabricate from Schedule 40 black steel pipe; remove burrs.
4. Iron pipe: Fabricate from cast iron or ductile-iron pipe; remove burrs.

5. Plastic and copper pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.
6. Sleeves through interior concrete walls and floors: Telescopic, submerged, adjustable sleeves by Adjust-to-Crete, AMI or Shamrock or equal.
7. Through exterior walls and floor on grade: 150-pound class cast-iron pipe sleeve. Where waterproof membranes are used, provide membrane clamps by others. For insulated piping, sleeve diameter shall not be less than diameter of insulated pipe.
8. Where watertight sleeves are required in exterior walls use link seal plastic waterstop sleeves with linkseal and seal to pipe.

K. Valve Boxes: Concrete body, cast iron cover with vandal resistant screws, extensions as required to extend full depth to valve. Valve box cover lettering shall correspond to the valve service, "Water", "Gas", "Fire", "Sewer", etc. Christy #G8 or equal.

2.20 PIPE COATING

A. Pipe coatings and or wrapping may be required for certain pipe materials where pipes are located in corrosive soils or corrosive air environments. Verify local soil and air conditions with building department and soils report, when available. Protect all underground buried steel and copper pipe and fittings. Protect all aboveground exposed steel and copper pipe and fittings located in corrosive air environments. Buried cast iron does not require protection unless specifically required by the AHJ or project Soils Report.

B. Provide pipe protection using one of the following methods:
1. Twice Wrap 20 Mil. Scotch Wrap PVC No. 51, 50% overlap.
2. Prefabricated extruded plastic cover with joints sealed with two coats of 20 Mil. Scotch Wrap No. 51 or Pasco Wrap 20 mil weight.

2.21 GAS CONNECTORS

A. General Areas: CSA rated, UL listed, braided stainless steel gas hose of size and capacity to meet appliance input requirements.

B. Gas connectors for outdoor applications shall be listed for exterior use.

2.22 EXPANSION COMPENSATORS

A. General: Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. All piping mains, branches and runouts shall be installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Stresses shall be within allowable limits of ASME B31.1 for pressure piping. Expansion products to conform to the standards of the Expansion Joint Manufacturer's Association. Expansion joints shall not required packing. Installer shall select materials and pressure/temperature ratings to suit intended service. Select packless expansion joints to provide 150% absorption capacity of calculated maximum piping expansion between anchors. All connections shall have ends to match piping system application.

B. Flexible Expansion Joint/Seismic Connector for Steel Pipe: Stainless steel hose and braid, 180° return, CSA approved, and end fittings. Metraflex #Metraloop or approved equal.

C. Flexible Connection for Steel Pipe (Piping and Equipment Located Outside the Building): Stainless steel hose and braid, with threaded or flanged ends. Metraflex #SST or approved equal.

D. Flexible Connection for Copper Pipe: Bronze hose and braid, copper tube ends. Metraflex #BBS or approved equal.
   1. For non-critical pump connections. Furnish with fluorelastomer tube and cover to ASTM D2000 Grade 1HK710. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/kevlar fabric rated 190#/26" vacuum at 250°F. Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension. Garlock #206 EZ-FLO or approved equal.

E. Pipe Alignment Guides: Provide pipe alignment guides on both sides of expansion joints, and elsewhere as indicated on drawings. Guide shall be of carbon steel construction with split guiding cylinder and integral anchor base and internal four finger two-piece spider. Cylinder wall thickness shall be equal to schedule 40 wall thickness of pipe being guided. Spider shall be capable of clamping directly to pipe and moving only in an axial direction while inside cylinder. Anchoring directly to building substrate. Metraflex #Style IV or equal.

F. Expansion Loops: Provide field fabricated pipe expansion loops as detailed on the drawings or in place of mechanical expansion joints.

2.23 PROCESS VALVES

A. Refer to Section 222114.

2.24 FIRE PROTECTION VALVES:

A. Refer to Section 211000.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work unless so indicated on Drawings or approved by Architect.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.3 INSTALLATION

A. Coordinate the work between the various Plumbing Sections and with the work specified under other Divisions of the work or contracts toward rapid completion of the entire project. If any cooperative work must be altered due to lack of proper supervision or failure to make proper provisions in time, then the work hereunder shall include all expenses of such changes as are necessary in the work under other contracts, and such changes shall be directly supervised by and made to the satisfaction of the Engineer.

B. The cooperative work not included in the Plumbing Division related to the general construction work is as follows:
1. All formed concrete work.
2. Framed openings in masonry and other Architectural and Structural elements.
3. Wood grounds and nailing strips in masonry and concrete.
4. Sloping of floors to drains and floor sinks.
5. Sloping of roof-to-roof drains and overflow drains.

C. Inspect all material, equipment, and apparatus upon delivery and do not install any that may be subject to rejection as a result of damage or other defects. Provide tarps and visqueen cover to protect equipment and piping delivered to and stored at the site.

3.4 WORKING PRESSURES

A. All fittings, valves, pipe, specialties equipment shall be rated for the working pressure subjected in the installed locations.

B. Drawings indicate working pressure in each system. The rating of the equipment and material shall not be less than that of the system pressures.

3.5 PIPES SIZES TO EQUIPMENT

A. General: Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of equipment.

B. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valve.

3.6 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints or couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Comply with ASME B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

C. Elevator Machine Rooms, Switchgear, Generator, Telecommunications, Telephone Rooms, and Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces. Route drip pan drain piping to floor drain, floor sink or other approved receptor.

D. Manual type vent may be used in lieu of automatic type, where specifically shown on the Drawings.

3.7 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, and roofs.

B. Install sleeves in concrete floors above grade, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) minimum above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

3.8 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

C. Aboveground, Cast-in-Place Watertight Sleeves. Select sleeve size based on pipe size and material to be inserted, and thickness of wall.
   1. Install cast-in-place watertight sleeves for pipes NPS 6 (DN 150) and smaller in diameter.
   2. Position cast-in-place water tight sleeve in wall space securing sleeve to reinforcing steel using tie wire.

D. Underground, Exterior-Wall, Cast-in-Place Watertight Penetrations. Select sleeve size based on pipe size and material to be inserted, and thickness of wall.
   1. Install cast-in-place watertight sleeves for pipes NPS 6 (DN 150) and smaller in diameter.
   2. Secure sleeve to the reinforcing steel using tie wire.

3.9 WELDING

A. Qualifications of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators". Installation shall conform to ANSI 31.1 "Power Piping".
   1. Submit for approval the names, identification, and welder's assigned number, letter or symbol of welders assigned to this project.
   2. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.

3.10 PIPING SYSTEM JOINTS

A. All piping shall be cut squarely, free of rough edges and reamed to full bore. Piping shall be mechanically cleaned prior to make-up of joints and fully inserted into fittings.

B. Provide joints of type indicated in each piping system.

C. Thread pipe in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint.

D. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM. B-32, in accordance with IAPMO IS 3-93, ASTM B-828 and Copper Development Association recommended procedures. Joints shall be cleaned by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes shall be applied liberally to the outside of the pipe and the solder cup of the fitting. Fluxes shall be water soluble for copper and brass potable water applications, and shall meet CDA standard test method 1.0 and ASTM B813-91. Solder shall be applied until a full fillet is present around the joint. Solder and flux shall not be applied in such excessive quantities as to run down interior of pipe. Lead solder or corrosive flux shall not be present at the jobsite.
   1. Manufacturers:
      a. Solder: JW Harris "Bridgit" or Englehard "Silvabrite 100".
      b. Flux: Laco "Flux-Rite 90", MW Dunton "Nokorode CDA Flux", Hercules "Fluid Action Solder Flux".

E. Braze copper tube and fitting socket or extrude joints (T-drill) with BCUP series filler metal without flux. Listed brazing flux shall be used for joining of copper tube to brass or bronze fittings and shall meet AWS FB3A or FB3C. Medical gas system

brazing shall be as specified in Section 226313. "Shock" cooling is prohibited. A continuous fillet shall be visible around the completed joint. After cooling, flux residue shall be thoroughly removed with warm water and a brush prior to testing. Do not use BCUP filler on copper alloys containing over 10% nickel.

F. Alternative domestic water piping mechanical press type connections with pre-approval from Owner's Representative. Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. Copper press fittings shall conform to the material and sizing requirements of ASME B16.22. O-rings for copper press fittings shall be EPDM. Viega/Ridgid or approved equal.

G. Piping shall be capped during construction to prevent entry of foreign material.

H. Weld pipe joints in accordance with recognized industry practice and as follows:
1. Weld pipe joints only when ambient temperature is above 0°F.
2. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
3. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and at edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.
4. Do not weld out piping system imperfections by tack-welding procedures. Refabricate to comply with requirements.
5. At Installer's option, install forged branch-connection fittings whenever branch pipe is indicated, or install regular T-fitting.

I. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

J. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

3.11 VALVES

A. General: Except as otherwise indicated, comply with the following requirements:
1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where shown on drawings. Locate valves so as to be accessible and so that separate support can be provided as necessary.
2. Install valves, except butterfly valves, with stems pointed up, in vertical or equal position where possible, but in no case with stems pointed downward from horizontal plane without prior written approval. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
3. Install butterfly valves with stems mounted horizontally or above horizontal plane.

4. All valves mounted higher than 8’ above floor in mechanical rooms and where indicated shall be installed with stem horizontal and equipped with chain wheels and chains extending to 6' above floor.
5. Provide Seismic shut off valve on gas main downstream of meter.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends of types of pipe/tube connections:
1. Copper Pipe, 2-1/2" and Smaller: Soldered-joint valves.
2. Steel Pipe, 2" and Smaller: Threaded joint valves.
3. Larger Pipe Sizes: One of the following, at installer's option:
   a. Flanged valves.
   b. Lug valves.

D. Fluid Control: Except as otherwise indicated, install gate, ball, plug, circuit setter, globe, and butterfly valves to comply with ASME B31.9.

E. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.

F. Wafer Check: Install between 2 flanges in horizontal or vertical position.

G. Ball Valve: Ball valve used on gas systems shall be UL listed, CSA approved for pressure of system, no exception.

H. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

I. Valve Identification: Tag each valve in accordance with "Mechanical Identification" section.

J. Cleaning: Clean factory-finished surfaces. Repair marred or scratched surfaces with manufacturer's touch-up paint.

3.12 TEMPERATURE GAUGES

A. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor without supplemental illumination. All gages to be installed with snubbers to absorb system shock.

B. Install in the following locations, and elsewhere as indicated:
1. At outlet of hot water heaters.
2. At inlet and outlet of boilers.

3.13 MECHANICAL SLEEVE SEALS

A. Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form a watertight seal.

B. Fire Barrier Penetration Seals: Fill entire opening with sealing compound in compliance approved and listed UL system number. Adhere to manufacturer's installation instructions.

3.14 SUPPORTS AND HANGERS (SEE 220500-BASIC PLUMBING MATERIALS AND METHODS)

3.15 EQUIPMENT RAILS AND PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed.

C. Verify roof insulation thickness and adjust raise of cant to match.

3.16 VIBRATION CONTROL ISOLATORS

A. Refer to Section 220548 – Vibration Isolation for Plumbing Piping and Equipment.

3.17 EXPANSION LOOPS

A. Expansion Loops: Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by installer for adequate expansion of installed piping system. Subject loop to cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by installer to properly anchor piping in relationship to expansion loops.

B.

3.18 EXCAVATION AND BACKFILL

A. Underground piping shall be installed in stable, open trench work. Trench excavations shall be a minimum of 16” wide, true to line and grade. Contractor shall exercise all due shoring and safety procedures. No stones larger than 1” may be present in the trench to a minimum depth of 4” below the trench bottom. The trench shall be free of job site debris, and free of corrosive media. Pipe crown shall be not less than 24” below the finished ground surface for metallic pipe, and 30” for non-metallic pipe, unless otherwise indicated on the drawings or directed by the Architect. Trenches shall be kept free of excess moisture, and shall be kept open for only a short a time as necessary for installation, testing and inspection. Dispose of surplus excavation and seepage water as directed by the Architect.

B. Piping shall be properly bedded and backfilled over stable trench bottom to a level of at least 12” above the pipe crown with thin layers of unwashed sand, dampened but not puddle, and free of organic or corrosive materials and excessive moisture. Backfill shall be placed in thin layers not to exceed 12” and tamped by mechanical tampers to a minimum 90% Modified Proctor Density, in accordance with ASTM D-1557-12. All pipes shall be covered with at least 3 feet of backfill prior to being subjected to wheel loads, per detail #2 on sheet C-003. In graded and undeveloped areas, in addition to procedures specified above, backfill trenches with crown 8” above the surrounding surface.

C. Excavated and backfill in soils of unstable nature shall be provided as directed by Architect.

3.19 PIPE INSPECTIONS

A. It is the intent of the Contract Documents that systems be inspected at completion of each phase while under tests required for administrative authorities, and prior to concealment, i.e. “Rough-in” “top-out” and final.

B. Inspection – Below Grade: All piping installed below grade shall be inspected prior to burial by the Owner’s Representative. Contractor must notify Owner’s Representative no less than 24 working hours prior to inspection time. Should the piping be buried prior to inspection the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

C. Inspection – Above Grade: All piping installed above grade shall be made available for inspection upon completion and prior to finish of walls and ceilings. Contractor must notify Owner’s Representative no less than 24 working hours prior to the desired inspection time. Should the piping be hidden within the structure prior to inspection the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

3.20 CLEANING, FLUSHING, DISINFECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any).

B. Inspect pressure piping in accordance with procedures of ASME B31.

C. Disinfect water mains and water service piping in accordance with Section 220500.

3.21 TESTING

A. Provide all tests specified hereinafter. All tests shall meet or exceed the minimum requirements of applicable codes and local ordinances. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Architect, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Piping: Remove from the system, during testing, all equipment which would be damaged by test pressure. Replace removed equipment when testing has been accomplished. The system may be tested in sections as the work progresses; however, any previously tested portion shall become a part of any latter test of a composite system. Correct leaks by remaking joints with new material.

C. Test time will be accrued only while full test pressure is on the system, unless indicated otherwise. “Tolerance” shall be no pressure drop, except that due to temperature change in a 24-hour period. Inspect and test all work prior to burying or concealing. Test pressure shall be one and one-half times the system operating pressure or the listed test pressure below, whichever is greater:

System	Test Medium	Test Pressure	Tolerance-Test Period
Domestic Water	Water	150 psig	None –1 hour
Sanitary Sewer (non-plastic)	Water	10 ft head (or 5 psi air)	No leaks – 15 minutes
Vent (non-plastic)	Air	5 psi	No leaks – 15 minutes
Storm	Water	10 ft head (or 5 psi air)	No leaks – 15 minutes
Automatic Fire	Water	200 psig	None – 8 hours
Natural Gas	Air or Nitrogen	100 psig	None – 1 hours
Compressed Air	Air	200 psig	None – 1 hours
Gases/Vacuum	Nitrogen	1.5 times operating pressure	No leaks – 1 hour or per NFPA requirement

D. Valves: Test all valve bonnets for tightness. Test operate all valves at least once from closed-to-open-to-closed position while valve is under test pressure.

E. Piping Specialties: Test all thermometers, pressure gauges, and water meters for accurate indication; automatic water feeders, air vents, trap primers, and vacuum breakers for proper performance. Test all air vent points to ensure that all air has been vented.

F. Backflow Preventers: Each testable backflow prevention device shall be tested and approved by certified testers after installation. Submit test results.

END OF SECTION