SECTION 400515 - PIPING SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the requirements necessary to furnish and install the plant mechanical and process piping systems, including, but not limited to, pipe, tubing, in-line valves, instruments and piping specialties, hangers, supports, restraints, isolators, labeling, pipe cleaning and testing.

B. Related Sections:
1. Section 230516 “Sleeves and Sleeve Seals for HVAC Piping.”
2. Section 230529 “Hangers and Supports for HVAC Piping and Equipment.”
3. Section 230719 “HVAC Piping Insulation.”

C. CAUTION: Use of this Section without including the above-listed items results in omission of basic requirements.

D. In the event of conflict regarding requirements between this Section and another section, the provisions of this Section govern.

1.2 REFERENCE STANDARDS

A. ASTM International (ASTM):
1. ASTM A-380 – Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
2. ASTM A-967 – Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
3. ASTM F1372 – Standard Test Method for Scanning Electron Microscope (SEM) Analysis of Metallic Surface Condition for Gas Distribution System Components.
4. ASTM F1375 – Standard Test Method for Energy Dispersive X-Ray Spectrometer (EDX) Analysis of Metallic Surface Condition for Gas Distribution System Components.

B. American Society of Mechanical Engineers (ASME):
1. ASME B31.3 – Process Piping.
2. ASME B46.1 – Surface Texture (Surface Roughness, Waviness and Lay).
3. ASME Boiler and Pressure Vessel Code, Section II, Part C - Specifications for Welding Rods, Electrodes and Filler Metals

1.3 DEFINITIONS

A. Examiner: Person provided by the Contractor; also known as the quality control representative (QCR).

B. Inspector: Person provided by the Owner; also known as the quality assurance representative (QAR).

1.4 SUBMITTALS

A. Refer to Submittal Schedule at the end of this Section for a list of submittal requirements for this Section.

1.5 QUALITY ASSURANCE

A. Maintain programs to monitor the manufacturing process, in-process product quality and final product quality. Include the following in the program:
   1. A change control process.
   2. Standard manufacturing procedures.
   3. Standard calibration and test methods.
   4. Calibration records.
   5. Calibration standard traceability.
   6. A sampling plan.
   7. Test records.
   8. Documentation of upset conditions and corrective actions.

B. A Quality System Program is required for the design, construction, inspection, examination, testing, manufacture, fabrication and erection of process piping. The requirements herein are supplemental to the guidelines of ASME B31.3.
   1. The Owner will provide an Inspector, also known as a quality assurance representative (QAR). The Inspector will:
      a. Aid the Contractor in monitoring manufacturing and installation product quality and activities. Quality issues on the project will be resolved jointly by the Contractor, Inspector, the A/E and Owner.
      b. Perform and direct testing by the Contractor as required by the Piping Services Datasheets.
      c. Have authority to reject all or any part of the systems that does not conform to the requirements specified. The Inspector will have full technical jurisdiction over the Contractor in matters relating to quality control.
   2. The Contractor will provide a representative, known as the Examiner, to perform the quality control examinations required per Chapter VI of ASME B31.3. The Examiner is also known as the quality control representative (QCR). Multiple Examiners with experience in each piping system may be required to adequately monitor the quality program. The Examiner has primary responsibility for the following:
      a. Setting up the project quality program.
      b. Implementing and monitoring conformance to the program standards.

c. Monitoring Contractor conformance to pipe/tubing manufacturer installation procedures.
d. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
e. Maintaining appropriate logs for shipping, materials, inspection, installer qualifications, welder qualification, test welds/joints, weld/joint samples and test documentation for the project.
f. Ensuring each Contactor has been trained and is qualified per the pipe/tube manufacturer standards to install the system.
g. Observe leak testing.
h. Resolving quality issues arising during the project jointly with the Contractor, the A/E and the Inspector.

3. In addition, 5% of circumferential butt welds for metallic piping systems from each individual welder shall be randomly radiographed at the discretion of the Owner's Inspector and at the Contractor's expense. For each defective weld found, examine two additional welds made by the same welder that produced the defective weld. Repair or replace each defective item and re-examine. Such additional examinations are in addition to the minimum required by the Code. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory until all defective items have been repaired or replaced and successfully re-examined.

## 1.6 DELIVERY, STORAGE AND HANDLING

A. Do not ship loose components or other pieces inside one another.

B. Firmly fasten and pad components to prevent shifting or flexing of the load while in transit.

C. Store piping, tubing, fittings and valves such that no warping, packaging damage, or undue stress on the components is created. Do not create stress or distort the bottom pipe by storing an excessive amount of piping on a rack.

D. Physically separate stored piping, tubing, fittings and components by material type and finish.

E. Transport, handle and store materials and equipment in a sheltered location with protection from sunlight and weather elements to prevent damage and/or contamination.

F. Store piping, tubing, fittings and components in their original factory-sealed packaging.

G. Inspection and Acceptance Criteria:
1. Confirm materials conform to specifications.
2. Confirm manufacturer's documentation and certifications conform to specifications.
3. Do not accept material or installation equipment that becomes damaged in shipment.
4. Perform additional specific inspections as required by the Examiner or Inspector per the quality control program.
5. Reject items found defective during inspection. Repackage items, record disposition and give to the Examiner for final disposition.

6. Reject materials or installation equipment that is contaminated or supplied with damaged or improperly sealed packaging. Replace with new, clean and properly packaged material.

H. Handling of PFA, PP, and PVDF piping materials must meet the following additional criteria:
1. Proper handling and preparation of piping materials to be performed by individuals trained by the manufacturer to limit contamination prior to installation or any welding being performed.

## PART 2 PRODUCTS

### 2.1 GENERAL

A. Materials, fabrication, installation, inspection and testing for piping systems shall comply with ASME B31.3 and the supplemental requirements of this Section unless indicated otherwise in this Section or on the Piping Service Index.

### 2.2 MANUFACTURERS

A. For piping services manufacturers shall be of highest quality and regionally represented. They shall have been providing the product regionally for no less than 10 years.

### 2.3 MATERIALS

A. Provide piping system materials as specified in this Section.

B. Provide tube in 20-foot nominal lengths and packaged in quantities easily hand-transported by two personnel.

C. Bolts, Nuts and Washers:
1. Where not otherwise specified, provide corrosion-resistant bolts, nuts and washers and other attachment hardware constructed of stainless steel, galvanized or cadmium-plated carbon steel, aluminum-bronze, or similar the A/E-approved material suitable for the service intended or the area of use.
2. Contain bolts, studs and nuts in marked boxes denoting material and conformance to applicable ASTM specifications. Use flat washers matching the bolt/nut material for nonmetallic piping.

D. Gaskets to be as specified on the Piping Service Index.

E. Thread sealant to be as specified on the Piping Service Index.

F. Service Saddles:
1. Service saddles may be used only when specifically approved in advance.

2. Provide service saddles capable of withstanding 1034-KPa internal pressure without leakage or overstressing.
3. Provide the run diameter compatible with the outside diameter of the pipe on which the saddle is installed. Provide taps with American National pipe threads.
4. Provide saddles of malleable or ductile iron bodies and galvanized steel straps, steel hex nuts with washers, and neoprene seals. Provide service saddles of double-strap design.

G. Pipe Legends/Markers:
1. Provide plastic-coated vinyl film with permanent adhesive for pipe identification labels and flow directional tape.
2. Pipe marking system to consist of banded directional flow arrow tape immediately adjacent to each service legend on the downstream side. Markers and tape color to be coded to the legend color identified on the piping service datasheets. For piping/tubing too small in size or not readily accessible for application of piping legends, labeling system to consist of plastic base, mechanical fastener and label.
3. Provide legends consisting of pipe size and unabbreviated service names as listed in the Piping Services Data Index and consisting of upper-case letters and Arabic numerals.

## 2.4 CLEANING, FLUSHING, FABRICATION AND TESTING FLUIDS

A. Where specified for cleaning, flushing, fabrication, or testing, provide fluids in compliance with the following criteria.
1. Construction Argon (Ar):
   a. Filtered to 0.01 micron absolute.
   b. Oxygen: Impurities less than 100 ppb.
   c. Moisture: Impurities less than 100 ppb.
   d. Total Hydrocarbon (THC): Impurities less than 100 ppb.
   e. Particles 0.1 Micron and Larger: Less than 30 particles per cubic meter.
2. Construction Nitrogen (N2):
   a. Filtered to 0.01 micron absolute.
   b. Oxygen: Impurities less than 1.5 ppm.
   c. Moisture: Impurities less than 1 ppm.
   d. THC: Impurities less than 1 ppm.
   e. Argon may be used in lieu of nitrogen.
3. Construction Helium (He):
   a. Filtered to 0.01 micron absolute.
   b. Moisture: Less than 1 ppm.
4. Clean Dry Air (CDA):
   a. Filtered to 0.1 micron absolute.
   b. Minus 40 degrees C dew point.
   c. Non-lubricated compressor.
   d. Argon or nitrogen may be used in lieu of CDA.
5. Water:
   a. Potable water quality, with 0.1 ppm residual chlorine minimum.
   b. Filtered to 25-micron nominal.
6. Deionized (DI) Water:
   a. Filtered to 0.1 micron absolute.
   b. Resistivity: 17 MOhm-cm, minimum.

c. TOC: 100 ppb maximum.

7. Reverse Osmosis (RO) Water:
   a. Filtered to 0.2 micron absolute.
   b. 0.5 MOhm-cm minimum resistivity or RO product quality.
8. Isopropyl Alcohol (IPA):
   a. Electronics grade.
9. Non-Ionic Surfactant Solution (Surfactant):
   a. 0.1 percent solution of non-ionic, phosphate-free surfactant in DI Water.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Metallic Piping and Tubing:
   1. Welders and brazers are required to be qualified to ASME Boiler and Pressure Vessel Code (BPVC), Section IX and identified in the worker's status chart by Welding Procedure Specification (WPS) or Brazing Procedure Specification (BPS) and piping service. Limitations of each qualification, including extension of qualification to other WPS or BPS, are as defined in the BPVC.
   2. Submit Welding Procedure Specifications (ASME Section IX Form QW-482), and Procedure Qualification Records (ASME Section IX Form QW-483), to the A/E for approval. Submit Welder's Performance Qualifications (ASME Section IX Form QW-484) for each welder and WPS. Submit a log showing that each welder has welded with each qualified process, under the supervision and control of the Contractor, at least once during every six-month period since the original qualification. Welding shall not start until these documents are returned to the Contractor with authorization to proceed.
   3. WPSs shall list all the essential and non-essential variables. Any change to these variables will require re-qualification of the procedure.

B. Non-Metallic Piping and Tubing:
   1. Qualify bonders for each bonding procedure specification (BPS) for each piping service in conformance with ASME B31.3 Chapter VII A328 Bonding of Plastics.
   2. In addition to the above requirements, welders for PFA, PP and PVDF pipe must meet the following additional criteria:
      a. Certified by the piping manufacturer in each fusion process within the past 2 years. Display certificate of qualification at all times.
      b. Qualified for this project (at the Contractor's expense) by being trained in project protocol and the requirements of this Specification and by making at least three typical pipe joints in a test spool piece that withstands a test pressure of 1.5 times the design pressure. Include one flanged joint in the spool. Testing to be witnessed by the Examiner and Inspector.
      c. Provide a sample of correctly welded pipe and fittings in the work area to serve as a reference check of welds.
      d. Each fitter must submit a sample fused joint to the Examiner for inspection at the following times:
         1) Start of each shift.

2) Indication of defective weld.
3) Change in weld area temperature of 11 degrees C.
4) As directed by the Examiner.

## 3.2 FABRICATION REQUIREMENTS

A. General:
1. If there is a conflict between the piping drawings and Original Equipment Manufacturer (OEM) information, request clarification.
2. Deviations from the Specifications and Drawings require prior review and written acceptance.
3. Designate equipment and tools exclusively for the fabrication and installation of each unique material type and finish.
4. Cut piping or tubing using manufacturer-recommended tools.
5. Maintain and clean tools and equipment throughout construction.
6. Supply consumables used in the process of performing the work.
7. Drawings:
   a. Spool drawings indicate the complete line, showing welded and assembly items, except for insulation shoes or nonstress-relieved lines.
   b. Except for ring-joint flanges, dimensions are to the centerline of pipe and the contact face of flanges. This includes the contact face of male and female tongue-and-groove flanges. Ring-joint flanges are dimensioned to the centerline of pipe and to the extreme face of the flange and not to the contact surface of the groove.

## 3.3 INSTALLATION REQUIREMENTS

A. General Considerations:
1. Install insulation per Section 230719 “Equipment and Piping Insulation.”
2. Install instruments and specialty items according to the manufacturer’s instructions and with sufficient clearance and access for ease of operation and maintenance.
3. Use flanges or unions for connections to equipment. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated or per requirements of equipment vendor and pipe material datasheets.
4. Install isolation valves for equipment and instruments in a manner that will allow ease of access and removal of the isolated items.
5. Do not install liquid piping immediately over or within a 1-meter plan view clearance of any electrical panel, motor starter, or control panel. Where piping must be located within these zones, either install piping inside a PVC conduit or shield the electrical device to prevent direct liquid access to electrical equipment. Locate piping such that bottom of pipe (or pipe covering, if pipe is covered) is not less than a clear height of 2 meters above the highest part of electrical equipment located directly below the pipe.
6. Install piping without springing or forcing the pipe in a manner that would set up stresses in the pipe, valves, or connected equipment.
7. Where piping connects to equipment, support it by a pipe support and not by the equipment.
8. Cut pipe from measurements taken at the site, not from the drawings.
9. Vibration Compensation Joints:

a. Comply with manufacturer's requirements of installation for all vibration compensation units.
b. Do not use vibration compensation units to make up for misalignment of piping, poor workmanship, or pipe-to-equipment connections.
c. Tack weld the locking nuts to the retaining (or control) rods supplied on vibration joints and pump bellows connectors at the position set by the manufacturer. Do not remove or adjust these rods from their factory settings. When retaining rods are not installed by the manufacturer, install the rods with sleeves at the settings specified by the manufacturer of the compensator.
d. When shipping retainers are supplied on the compensators by the manufacturer, leave the retainers until after the compensator is installed and the permanent piping supports are completed, and any temporary supports are removed. Shipping retainers are typically tack welded to the flanges. Be certain that retaining rods are not removed.
e. Do not use gaskets with compensators that have elastomeric or polytetrafluoroethylene (PTFE) flange faces.
f. Install compensators with internal sleeves with the fixed end of the sleeve on the inlet side of the compensator.
g. Compensators Installation Sequence:
    1) Connect a pipe spool with the same face-to-face dimension as the compensator.
    2) Install loose piping flange to the compensator spool.
    3) Route piping to the loose flange on the compensator spool.
    4) Make the final weld in the piping to the compensator spool. Fabricate piping such that no springing or forcing of the pipe is necessary to make this final weld.
    5) Install piping anchors, supports and guides as specified on the Drawings.
    6) Replace compensator spool with actual compensator. A representative of the compensator manufacturer witness removal of the compensator spool and take measurements to certify that the axial, torsional and angular alignments are within the manufacturer's allowable tolerance for an acceptable installation. Furnish certification furnished to the Owner after installation.
    7) Remove shipping supports (not the control rods) provided on the compensators.
h. After the installation of the compensators, re-inspect the units to determine if the compensators are within the manufacturer's allowed offset, compression and extension limits or if any units have been pulled tight against the retaining rods or compressed against the sleeves. Repeat the inspection after the piping system has been pressurized. Notify the A/E of units that have moved to the maximum allowed position or are outside the manufacturer's limits, including offset before attempting to adjust the piping.
i. Final: Align motor shafts to pumps (if applicable).

B. Seal Welding:

1. When seal welding is required, make connections without using sealing compound or PTFE tape.
2. Do not seal weld threaded joints that have failed a pressure test, unless all thread compound and PTFE tape have been removed.
3. Cover exposed threads when seal welding threaded connections.

C. Bolts:

1. Coat bolt threads with none seizing coating.
2. Bolt flanges using a calibrated torque wrench and following manufacturer's instructions. Do not torque flange bolts beyond manufacturer specifications to seal joint. Discard and replace flange parts with a new flange when a bolt is torqued beyond specification or when flange connection is not in compliance with the manufacturer's torquing procedure.
3. Tighten bolts in a star sequence. Tighten based on three passes of the bolts. Torque bolts to levels in the tables provided to the Contractor by the gasket vendor being used for that service. Accomplish bolt torques with a calibrated torque wrench. Recalibrate torque wrench at the end of each day. After two weeks of service, re-tighten bolts.

D. Dimensional Tolerances:

1. These tolerances apply to in-line items and connections for other lines.
2. Accomplish general dimension tolerances, such as face-to-face, face-on-end-to-end, face- or end-to-center and center-to-center at plus or minus 3 mm.
3. Provide inclination of flange face from true of no more than 2 degrees in any direction. The inclination is considered 90 degrees in relation to the adjoining pipe centerline.
4. Rotation of flange bolt holes not to exceed 2 mm.

E. Piping that Penetrates Floors, Ceilings and Walls:

1. Provide chrome escutcheon finish plates where piping passes through walls, floors, or ceilings in finished areas and cabinets.
2. Provide major piping penetrations of footings, slabs, floors, walls and roofs as shown on the Drawings. Verify the size and location of building and structure penetrations prior to pouring concrete or finishing.
3. Provide necessary penetrations of footings, slabs, floors, walls and roofs as required to complete the work. This includes design, arrangement, installation and finishing of such penetrations in conformance with required fire ratings and other sealing requirements as stated in this Section and elsewhere in the project bid documents.
4. Embed wall pipes and pipe sleeves embedded in concrete walls, floors and slabs as shown on the Drawings. Support pipes embedded in concrete walls, floors and slabs with formwork to prevent contact with the reinforcing steel.
5. Use galvanized steel pipe sleeves on standard wall penetrations. Provide waterproof pipe sleeves manufactured by Link-Seal that incorporate waterproof membrane seals for piping penetrating exterior walls, roof and floor slabs on grade.
6. Use galvanized or PVC sleeves on penetrations of footing walls and grade beams as shown on the Drawings.

7. Install piping that penetrates fire-rated or smoke-rated walls, floors, or ceilings in accordance with Section 230517 “Sleeves and Sleeve Seals for HVAC Piping.”
8. Install piping which is parallel to horizontal and vertical building lines except as indicated otherwise in the Drawings.
9. Maintain uniform slope between bottom-of-pipe elevations defined on the Drawings.

F. Piping Supports, Expansion and Flexibility:
1. Provide pipe supports, hangers, hanger rods and anchors as specified in Section 230529 “Hangers and Supports for HVAC Piping and Equipment.”
2. Allow for pipe expansion in mains, runouts and risers by means of natural flexibility in piping swing joints and by expansion loops where indicated on the Drawings.
3. Install with sufficient flexibility to avoid or minimize the use of flexible couplings or expansion joints. Provide flexible couplings or expansion joints for piping connections to equipment where shown on the Drawings. Use of additional flexible couplings or expansion joints, other than those indicated on the piping drawings, requires approval of the A/E.

G. Piping Legend:
1. Determine legend sizes and install color bands and line labels to ensure good visibility in conformance with ASME A13.1.
2. Provide color bands and line labels per Section 230553 “Identification for HVAC Piping and Equipment.”
3. Apply band and label after piping insulation and piping are complete.
4. Clean and dry surfaces to which tape and/or labels are to be applied.
5. Install legend on piping/tubing as follows:
    a. Next to each valve.
    b. At each change in direction.
    c. At each branch connection.
    d. Within 1 M of connection to equipment.
    e. Adjacent to each side of wall or floor for pipes penetrations.
    f. On all horizontal and vertical pipe runs at a minimum of 6 M spacing between labels.
    g. Install arrows to indicate correct direction of flow.
    h. Apply banding tape completely around outside diameter of pipe with 50 mm overlap at the end of each marker.

H. In-Line Devices: Install piping adjacent to in-line devices in accordance with the requirements of the manufacturer of the device.

I. Air Vents and Low Point Drains:
1. Vents and drains at high and low points in the piping that are required for complete venting and draining may not be shown on the Drawings. Add such items during detail piping design and/or piping installation.
2. Provide label at the bottom of overhead piping indicating high point vent location. Label shall be visible from the floor.

3. Additional requirements for Hydronic Systems:
   a. Provide vent tubing to nearest drain with outlet easily visible.
   b. Install air vents and drains on piping connected to each piece of equipment. Locate vents and drains such that equipment can be drained when isolation valves are closed.

J. Dielectric Insulating Flanges, Couplings and Unions:
1. Install insulating flanges, couplings, or unions in the following locations:
   a. Ferrous metals to non-ferrous metal piping connections.
   b. At equipment connections of dissimilar metals.
   c. Where shown on the Drawings.
2. Insulate and isolate nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel.
3. Test each point of dielectric insulation with an ohmmeter to insure proper isolation of dissimilar materials. Minimum reading should be 10 Kohm.
4. Install the following at each flanged connection where one flange is iron or steel and mating flange is copper, bronze, copper alloy, or bronze alloy:
   a. Full face non-metal insulating gasket, outside diameter (OD) to match flange.
   b. Insulating non-metal sleeve for each flange bolt or stud.
   c. Insulating non-metal washer under head of each flange bolt.
   d. Insulating non-metal washer under each nut used on flange bolt or stud.
5. Install insulating flange assembly above finished grade at each location where steel pipe and copper tubing comes above grade.
   a. Bolt flange guard mounting brackets to weld side of flanges between flange and phenolic washer.
   b. Cut flange guard to required length and connect brackets with stainless steel nuts, bolts and washers. Locate flange guard at approximate elevation of lower flange face.
   c. Preassemble insulating flange assembly completely before welding to adjacent piping. Do not ground welding machine across insulating flange.

K. Coating System for Buried Steel Pipe and Buried Copper Tubing Systems:
1. Surface Preparation:
   a. Clean surfaces of oil and grease in accordance with SSPC SP-1.
   b. Blast clean all surfaces to receive coatings in accordance with SSPC SP-6.
2. Provide Shop-Applied Extruded Polyethylene Protective Coating: Coating system and materials conforming to ASME/AWWA C215 and NACE SP0185-2007-SG and include the following:
   a. Provide a Liberty Coatings coating system and include the following materials:
      1) Adhesive undercoating.
      2) High density polyethylene copolymer seamless extrusion.

b. Coating thicknesses to be as follows:

| Nominal Pipe Size | Standard Thickness (mils) | |
|---|---|---|
| | Nominal | Minimum |
| DN15 to DN40 (1/2 to 1-1/2 inch) | 25 | 23 |
| DN50 to DN65 (2 to 2-1/2 inch) | 30 | 27 |
| DN80 to DN100 (3 to 4 inch) | 35 | 32 |
| DN125 to DN600 (5 to 24 inch) | 40 | 36 |

3. Heat Shrinkable Coating for Polyethylene System:
   a. Provide coating of heat shrinkable polyolefin-backed sleeve precoated with mastic, in accordance with ASME/AWWA C216.
   b. Make the thickness of sleeve less than nominal thickness of extruded coating.

L. Cooling Tower Water Piping:
   1. Paint uninsulated cooling tower water piping.

3.4 WELDING CRITERIA

A. General
   1. Accomplish all welding and fabrication in accordance with the submitted welding procedure qualifications.
   2. Backing Rings and Inserts: Do not use backing strips or rings on stainless and specialty metal piping systems. Root gap inserts that are completely melted and consumed in the weld bead are acceptable if they are in conformance with ASME B31.3
   3. Attachment and branch connection welds shall be kept away from longitudinal and circumferential girth welds by a minimum distance of four times the pipe wall thickness.
   4. Repairs to flanges or fittings shall be performed in accordance with the applicable ASTM specification.
   5. Where access or constraint is more difficult than for the WPS, re-qualifications of the procedure will be required.
   6. Welding shall not be carried out when the quality of the completed weld would be impaired by prevailing weather conditions, unless adequately shielded from moisture, high winds, blowing sand or low temperatures.
   7. Ground leads from welding machines are to be securely fastened to the material being welded. Connections shall avoid notch damage to the pipe. No arcing between ground leads and pipe shall be permitted.

B. Joint Preparation and Welding Processes:

1. Welding Processes:
   a. Make welds by the direct current, straight polarity, inert gas tungsten arc welding (GTAW) process or the direct current, reverse polarity, inert gas metal arc welding (GMAW) process or shielded metal arc welding (SMAW) process as required in the datasheets.
   b. Wherever possible, make welds using approved automatic bench weld equipment.
   c. Weld Contour and Finish:
      1) Provide 100 percent penetration to the root of the joint on longitudinal welds.
      2) Remove defects and repair by welding. Re-examine defect area.
2. Filler Metals:
   a. Filler metal shall be as specified in ASME BPVC Section II, Part C.
   b. The use of carbon - 1/2 moly filler metal for welding carbon steel is not permitted.
   c. For like, or dissimilar joints in base metals composed of ferritic materials, carbon steel (P-No. 1) through 12 chrome (P-No. 7), the filler metal shall be of the low hydrogen type and comparable to the analysis of either base metal. The lower alloy filler metal is generally preferred.
   d. For dissimilar joints consisting of carbon and low alloy steels, P-No. 1 to P-No. 8, on one side and austenitic stainless steel, higher chrome, nickel-chrome, or monel, on the other, the filler metal shall meet the requirements of AWS Classifications ENiCrFe-2 or ENiCrFe-3, except that Type 309 or 309L filler metal may be used.
   e. Solid wires for automatic-welding processes shall contain the principal elements required for the deposited weld metal. Welds deposited by the submerged arc process shall not derive any principal elements from the flux.
   f. Fluxes that the flux supplier recommends for single pass shall not be used for multiple pass welds.
   g. ASME SFA 5.18, Classification filler wire is permitted to be used on carbon steel when deposited with the GTAW.
   h. Electrodes for SMAW shall be basic, low hydrogen type.
   i. For field fabrication Type 309 electrodes may be used for seal welding on P-No. 1 to P-No.8 materials provided that the correct preheat in accordance with the applicable Code is used, and all welds are dye penetrant tested.
3. Storage and Handling:
   a. SMAW Electrodes:
      1) Low Hydrogen Electrodes:
         a) Always store electrodes in one of the following:
            (1) Within unopened factory sealed container.
            (2) Within electrode storage oven at 250 degrees F (121 degrees C) minimum.
            (3) Within electrode baking oven at temperatures as specified.

(4) Within portable electrode container (4 hours maximum). A TED type electrode dispenser is highly recommended for portable storage.

b) Issue no more than 4 hours supply of electrodes to welders at a time.

c) Re-bake or scrap unused low-hydrogen electrodes at the end of 4 hours. Only 1 re-baking is permitted.

d) The re-baking cycle shall be:

(1) Re-dry 1 to 2 hours at 82 degrees C (179 degrees F).

(2) Bake 1 hour at 700 degrees F to 800 degrees F (371 degrees C to 426 degrees C) or manufacturer's recommendations.

e) Properly identify electrodes until time of usage.

f) Do not use wet, damaged or oil contaminated electrodes.

2) Non-Low Hydrogen Electrodes:

a) Storage temperature is 100 degrees F (38 degrees C) minimum. Re-baking is not recommended for E6010 and E6011 electrodes. Consult and comply with the electrode manufacturer for electrode handling recommendations.

b) Do not use wet, damaged or oil contaminated electrodes.

b. SAW:

1) Store submerged arc wire with the supplier's wrapper intact. Protect and identify partly used coils before returning them to storage. Do not use rusty or unidentified wire.

2) Use flux for SAW that is dry and free of contamination. Store flux in factory packaging until time of use. Dry flux from damaged packages at 500 degrees F (260 degrees C) minimum for 1 hour before use. Do not use fused flux.

c. FCAW, GMAW and GTAW:

1) Store wires with supplier's wrapper intact. Protect and identify coils/fillers that have been partly used before returning them to storage. Do not use rusty or unidentified wire.

2) Use a welding grade gas or gas mixture used with a dewpoint of minus 40 degrees F (minus 40 degrees C) or lower.

C. Nonmetallic and Nonmetallic Lined Piping and Tubing:

1. Design, fabricate, install, inspect and test nonmetallic and nonmetallic lined piping, tubing and fittings per the manufacturer’s recommendations and in conformance with ASME B31.3, Chapter VII, per code, this section and any additional requirements of this specification.

2. PVC and CPVC Piping:

a. Fabricate and install in conformance with approved BPS including the following:

1) Minimum requirements of BPS to include the requirements of ASTM D2855.

2) Do not use threaded Schedule 40 pipe. Use Schedule 80 threaded nipples where necessary to connect threaded valves or fittings.
3) Do not thread male metal pipe threads into female plastic fittings.
4) Do not expose piping or fittings to direct sunlight either in storage or after installation.
5) Paint PVC pipe installed in direct sunlight outdoors with two coats of white high-pigment water-based latex paint to prevent UV degradation.
6) Do not make alignment corrections by applying force to piping. Report assembly dimension irregularities and misalignments to the Engineer.
7) Install secondarily contained piping according to the approved BPS including manufacturer's instructions.

3. PFA, PP and PVDF Piping:
   a. Fabricate and install in conformance with approved BPS and the following:
      1) BPS to be based on piping system and bonding equipment manufacturer's recommended procedures.
      2) Use cutting and fusion tools and equipment only as recommended by the manufacturer. Operate tools and equipment per the manufacturer's instructions.
      3) Do not exceed 80 feet for uninterrupted piping runs without a flange, union, or other mechanical joint. Use flanges as the mechanical connection for piping sizes 2 inches and larger.
      4) Label welds with weld number and welder ID. Cross-reference the weld number to the fusion machine printout and weld log. Print label in permanent ink on white cleanroom tape and affixed to the pipe adjacent to the weld.
      5) Make thermal fusion welds by heating the appropriate connections only once. Repair practices such as back-welding that reheat pipe connections are unacceptable. Hot air and rod-welding is unacceptable. Cut-out and replace connections that are faulty or improperly welded at no additional cost to the Owner.
      6) Welds made with hand-held heating devices are not allowed. Use flanges and unions where necessary, in lieu of hand welds.
      7) Protect small projections from the piping system, such as sample ports, vents and drains, to avoid breakage.
      8) The Contractor may be requested to remove any system joint deemed not in compliance with the specification or is otherwise unacceptable to the A/E or Owner. Should the suspected joint, prove to be sound, the Owner will reimburse the Contractor for time and materials as specified in the Contract. Should the suspected joint prove to be faulty, or the adjacent piping found to be unclean, the destructive test will continue joint by joint until sound, clean joints are found. Replace faulty work and/or materials at no cost to the Owner.

9) Where outdoor polypropylene piping exposed to sunlight is not shown as insulated, over-wrap with or insulation covers for UV protection.

b. Additional BPS requirements for services specified for fabrication in FE-3:

1) Storage and Handling:

a) Handle and store material and equipment in an enclosed controlled environment throughout the job to prevent damage or contamination.

b) Reject incoming material which is defective or contaminated. Do not re-clean material on site. Document the problem and provide to the A/E and the Inspector for resolution.

c) Double bag and tape the ends of components and prefabricated tubing spool assemblies transported between the fabrication environment and the installation point.

d) Double-bag and tape or double-bag and polyethylene cap incomplete spools or open ends in the field.

e) Store piping in the fabrication area a minimum of 12 hours prior to fabrication for thermal stabilization.

2) Fabrication:

a) Wear approved gloves when handling pipe, valves and fittings, whether in the fabrication environment or in the field.

b) Cut piping using wheel-type cutters or peeling pipe cutters. Designate pipe cutters for use on one system only and keep clean at all times. Use of any type of saw is prohibited.

c) Use only non-contact infrared heating equipment for fusion bonding.

d) Keep tools separate from other tools and use exclusively on the specific piping system.

e) At the start of each shift, clean tools with IPA, rinse with DI water and blow dry with nitrogen. Maintain and clean tools and equipment throughout the construction activity.

3) Installation:

a) Install components and prefabricated spools within 72 hours of removal from the fabrication environment.

b) Minimize dead legs in piping. Fit valves and other components using short, prefabricated, or pre-molded fittings.

4. Plastic-Lined Piping:

a. Fabricate and install in conformance with approved BPS and the following:

1) BPS to be based on piping system and bonding equipment manufacturer’s recommended procedures.

2) Do not remove flange protectors until pipe and fittings are ready to be installed. Replace flange protectors after inspection and/or when an item is removed from service.
3) Gaskets are not normally required at each flanged connection. Follow manufacturer's recommendations for gasket placement.
4) Vent Holes:
   a) Do not plug vent holes with paint or insulation. Follow manufacturer's recommendations for venting insulated services.
   b) Do not use sharp instruments to clean out vent holes.
5) Do not weld piping or fittings after liner is in place.
6) Perform field flaring in accordance with the manufacturer's procedures.
7) Connections to equipment or other piping systems require either a gasket or a spacer with gaskets, depending upon the specific application. Make connections in accordance with manufacturer's installation instructions.
8) Use full-face lug-style taper bore spacers to install butterfly valves.
9) Install wrap-around safety shield after pressure testing, water-startup and retorquing of the flange bolts.

5. Thermoplastic Tubing: Fabricate and install in conformance with approved BPS.

## 3.5 INSTALLATION OF PRESS FITTINGS

A. General
1. Press connections: press fittings shall be made in accordance with the manufacturer's installation instructions.
2. Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22.

B. Installation
1. Visually inspect sealing elements, separator rings and grip rings prior to installation to ensure the seal is intact and properly located within the fitting.
2. Fully insert tubing into the fitting and mark at the shoulder of the fitting. Check the fitting alignment against the mark on the tubing to assure the tubing is fully inserted in the fitting.
3. Press connections using the tool approved by the manufacturer.
4. For stainless steel tubing, the following requirements also apply:
   a. Label each joint with bonder ID, date, and tool number when complete. Verify fittings have been labeled before any pressure tests.
   b. Perform gross leak CDA test at ≤69 KPa for 30 minutes prior to final pressure test.

C. Commissioning
1. Inspect fittings per manufacturer recommendations for press-fit system.

D. Training

1. Use pipe fitters that are trained and certified by authorized manufacturer and/or manufacturer's representative on proper technique and tool operation.

## 3.6 FLUSHING AND CLEANING

A. General

1. Procedures listed are recommended procedures only. The Contractor may submit proposals that include alternate cleaning procedures. Regardless of the procedure used, the Contractor is responsible for achieving the required cleanness.
2. Allow the Owner access to the premises to witness all cleaning and testing operations.
3. Furnish cleaning and sanitization materials and supplies.
4. Contractor is responsible for all pumps, compressors, etc., to provide the motive force for cleaning and flushing piping systems. Provide electrical or other fuel requirements for operation of the cleaning equipment. The plant mechanical or electrical equipment may be used for cleaning or flushing of systems. Blank off permanent plant equipment and fabricate spool pieces to provide a pathway around each piece of equipment. Common types of equipment may share the same spool piece. Move spools from piece to piece until the respective supply and return lines are cleaned. Removal of temporary blanks is the responsibility of the Contractor.
5. Identify, provide and install temporary branches, fittings, vents, drains, etc., required for performance of cleaning.
6. Remove control valves and other in-line devices that may be damaged by the cleaning method employed or bypassed and cleaned separately.
7. Incorporate sections of piping which are removed for temporary connections in the piping circuit being cleaned or cleaned separately.
8. Return the piping system to its original integrity following the cleaning process.
9. Safety Considerations:
    a. Hold a safety and coordination meeting attended by all cleaning personnel to assure the site safety rules are adhered to. These rules typically include posting cleaning schedules prominently and well in advance, confined space entry permit procedures, audible warnings, flashing lights, etc.
    b. Notify the Owner of special safety precautions that must be taken to protect all personnel working in the area of systems being cleaned. Take steps necessary to protect these people from the hazards identified.
    c. Designate pipe systems utilizing steam blowdown or hot liquid or hot vapor cleaning. Accommodate thermal expansion in these piping systems. Accomplish this even if the system normally operates at ambient temperature.
10. Environmental Considerations:
    a. Contractor is required to manage the disposal of leftover and used chemicals incorporated in the cleaning procedures performed. Meet SBC and local regulations. The procedures must be in a written form approved by the Owner before cleaning is started.

b. Use of chemicals classified as nonhazardous is preferred for onsite cleaning. The Owner must approve variance from this in writing.

11. Following assembly and testing, use water to flush piping systems not specifically listed as not to be wetted to remove any debris and other foreign material. Provide flushing velocities at a minimum of 0.75 meters per second.
12. For water, water-based fluids, steam and steam condensate insert cone strainers in the piping service connections to attached equipment and leave there until cleaning has been accomplished to the satisfaction of the inspector.
13. Dry lines designated as requiring drying immediately after the completion of the flushing. Before forced drying is started, remove control valves and in-line instruments that may be damaged and replaced as necessary with pipe spools. Provide instrument air (minus 40 degrees C dew point) or nitrogen to purge the piping until a minus 29 degrees C dew point is reached. Blow each low point drain and the end of each branch line until the minus 29 degrees C dew point is reached. After each section of piping is dried and approved by the A/E, replace the in-line instruments.

B. The following flushing and cleaning protocols apply to manufacturing or field applications:

1. Water Flush:
   a. Force sufficient clear water through the piping system to achieve 100 percent of normal operating system velocity for not less than 8 hours. Intermittently blow down strainers and low point drains to remove any foreign objects. If normal operating system velocity is not possible, use a minimum flushing velocity of at least 0.75 Meters per second.
   b. Continue flushing until the water discharged to the process sewer is visibly clean and the iron level in the water is below 1 ppm. Analytical test to be completed by qualified water service technician.
2. Compressed Air Blow:
   a. Perform at least three cycles of 3 minutes blowing time each with a blowing duration and velocity as long and as high as achievable with the available air source. If necessary, the system can be pressurized and then quickly opened to enhance blowing velocity.
   b. Place a sounding board target approximately 1 Meter from the discharge point. Fine particulate blown from the pipe will strike this board and make an audible tapping noise until all particulate has been purged from the system.
   c. Continue blow cycles until the discharge is visibly and audibly clean.
3. Dry Air or Nitrogen Blow:
   a. Perform at least three cycles of 3 minutes blowing time each with a blowing duration and velocity as long and as high as achievable with the available dry air or nitrogen source. If necessary, the system can be pressurized and then quickly opened to enhance blowing velocity.
   b. Continue blow cycles until the discharge is visibly clean and free of residual moisture at the downstream end of the blowdown line. Verify dryness by placing a white cloth target at the discharge point during the last blow cycle. The target has no noticeable moisture at the end of this cycle. Perform a more rigorous dryness verification on noted pipe

systems. Blow such systems with instrument-quality air until dry, as indicated by comparison of the discharge-air dew point with the inlet-air dew point.

c. This procedure may be specified for use in conjunction with other cleaning processes (e.g., water flush, etc.). In such applications, this procedure is performed last to dry the pipe; cycling and velocity requirements may be waived.

4. Detergent Degreasing:
   a. Flush fresh water through the system to remove excess debris and loose scale per the requirements in the Water Flush. Drain system to process sewer.
   b. Fill system again with detergent solution at the manufacturer's recommended concentration.
   c. Circulate solution through system for a minimum of 1 hour. Where recirculation is not practical, fill system with solution and allow to soak for a minimum of 3 hours.
   d. Drain system to process sewer and flush with water until discharge is visibly clean and clear of detergent.

## 3.7 FIELD QUALITY CONTROL

A. The Examiner is required to perform the following duties:
   1. Certify records of examination procedures employed, showing dates and results of procedure qualifications and maintain them and make them available to the Inspector.
   2. Examine piping per ASME B31.3 and as modified in this Specification.
   3. Review the latest revisions of the applicable codes, drawing(s), specification(s), field orders, addenda, and design revision bulletins prior to performing examinations.
   4. Bring to the attention of the A/E conflicting requirements between this Specification, its checklists, Drawings and referenced standards.
   5. Define, identify and track welds requiring in-process and final inspection in accordance with applicable codes and design specification requirements.
   6. Provide a biweekly summary report:
      a. Nonconformance identified.
      b. Status of nonconformance remedies.
      c. Receiving reports for compliance with specification of all piping materials and components.
      d. Summary of systems cleaning status.
      e. Summary of systems pressure testing status.
   7. Material Certification, Identification and Storage Examinations:
      a. Ensure that the receiving inspection has been completed by verification of the receiving accept tag.
      b. Perform a 25 percent random sampling for materials compliance of fittings, pipe, valves and flanges. Accept materials if the Examiner can visually identify foundry or mill markings and the ASTM markings comply with the Specifications.

8. Pipe Assembly and Erection Examinations:
   a. Verify that the cleaning and flushing operations after piping/tubing installation are performed and accepted in accordance with procedures specified.
   b. Prior to hydrostatic or pneumatic tests, develop a pressure test datasheet.
9. Documentation:
   a. Completed testing and inspection reports and checklists.
   b. Forward completed documentation to the A/E.
   c. Weld maps and/or other documentation.
10. Discrepancies and Nonconformances:
   a. Report discrepancies and nonconformances that are identified but not corrected prior to completion of the inspection.
   b. Note discrepancies and nonconformances that are identified and corrected prior to completion of the inspection noted in the remarks section of the applicable inspection report.

B. Inspections and Acceptance:
1. After fabrications of spools and before field installation, inspect piping, fittings and components for contamination or damage such as scratches and gouges. Report contamination or damage to the Examiner and Inspector for disposition. Remove and replace rejected materials.
2. Hydrostatically test shop-fabricated spools in the shop before installing.
3. Inspect repairs authorized before final acceptance.
4. The Examiners the right to have any section of the piping system that is suspected to be faulty cut out of the system by the Contractor for inspection and testing. Should the joint prove to be sound, the Owner will reimburse the Contractor on a time-and-material basis as specified in the Contract. Should the joint prove to be faulty, continue the destructive test joint by joint until sound joints are found. The Contractor is responsible for costs for replacement of faulty work and/or materials.

C. Testing:
1. Leak Testing:
   a. Follow the requirements of ASME B31.3 for leak testing, except as revised by the following and as noted on the Piping Service Index.
   b. Notify the owner a minimum of 1 week prior to leak testing.
   c. Prior to leak testing, thoroughly examine the completed pipe system for the following items.
      1) System is complete per Drawings with all valves and supports in place.
      2) Pipe, valves and equipment are supported correctly as shown on the Drawings and with no concentrated loads on the system.
      3) Pipe is in good condition with no visible cracks, gouges, or other evidence of abuse. Pipe flanges are aligned and correct sloped maintained. Correct gaskets and bolting, including washers, are used at flanges. Fittings and flanged joints are free from visible cracks.

4) Adequate vent valves and drain valves are provided to remove entrained air during leak testing and to drain pipe for repairs.
5) Small projections from the piping system (e.g., sample ports, vents and drains) that are susceptible to breakage are protected.
6) If the examination reveals deficiencies, correct as specified by the Engineer or Inspector.

d. Furnish necessary equipment and material and make taps in the pipe, as required.

e. Do not subject the following piping and equipment to pressure testing:
1) Rotating machinery, such as pumps, turbines, compressors and chillers.
2) Pressure-relieving devices, such as rupture discs and pressure safety relief valves when the relief pressure is within 10 percent of the test pressure.
3) Vessels that do not satisfy impact requirements at the piping test temperature.
4) Locally mounted pressure-indicating gauges, where the test pressure would exceed their scale range.

f. Testing Media Requirements:
1) Provide hydrostatic and pneumatic test media with the minimum quality standards in compliance with this Section.
2) For testing austenitic stainless-steel materials use water with chlorine content below 100 ppm.
3) After hydrostatic testing, all water be drained immediately. Open all vents to avoid pulling a vacuum during draining.

g. Hydrostatic Leak Test Procedures:
1) Submit calibration records for gauges used for testing.
2) Install two pressure gauges for each testing system. Install gauges for testing as close as possible to the low point of the piping system.
3) Fill piping slowly and carefully open vents and other connections that can serve as vents so that all air is vented prior to applying test pressure to a system.
4) For larger sections or loops, begin with a low-pressure flush. While flushing, open and monitor vents again to verify entrapped air is gone.
5) During and after flushing, walk the system again with a flashlight to look for drips, leaks, entrapped air, or other problems.
6) After flush is complete, slowly pressurize the system at a rate no faster than 34 KPa per minute. At least every 10 minutes, cease increasing pressure and hold for 15 minutes. Walk the system with a flashlight again looking for drips, leaks, or entrapped air.
7) Examine all joints and connections for leakage. Repair leaks per procedure approved the Inspector. If the pressure falls after the pressurizing system is shut off, the source of pressure loss must be determined and corrected. The system must be able to hold

the test pressure for the test duration specified on the Piping Services Datasheets.

8) If the ambient air temperature is less than 4 degrees C at the time of the leak testing, heat the test medium as required to achieve the following temperatures when filling is complete:
   a) For pipe wall thickness 25 mm or less, 21 degrees C minimum.
   b) For pipe wall thickness greater than 25 mm, 38 degrees C minimum.

h. Pneumatic Leak Test Procedures:
   1) Remove instruments or devices that may be damaged by the test from the piping or suitably isolated prior to applying the test. Apply a preliminary pneumatic test, not to exceed 172 KPa, to the piping system prior to final leak testing as a means of locating major leaks. Check for leaks at joints and connections using a water-detergent mixture. After visible leaks have been corrected, gradually increase the pressure in the system to not more than 1/2 of the test pressure, after which increase the pressure in steps of approximately 1/10 of the test pressure until the required test pressure has been reached. Continuously maintain the pneumatic test until all joints in the system or in the portion of the system under test are examined for leaks by means of soapy water. The piping system shall not show evidence of leakage. Correct visible leakage at the Contractor's expense.

i. Containment Piping Leak Test Procedures:
   1) Leak test containment piping by either of the following approaches:
      a) Use 34 KPa compressed air with soaped weld and fitting connections unless not allowed by cleanroom protocol.
      b) Hydrostatic leak test with the pressure loss not exceeding 1.5 KPa over a minimum 15-minute duration. Use a pressure gauge with 0.7 KPa resolution increments. Visually inspect all joints and connections for leaks.

j. Test Repairs:
   1) Replace materials such as gaskets, bolting, etc., damaged during tests and flushing.
   2) Use a new gasket each time a flanged joint is made up.
   3) Repair welded joints that are defective in accordance with the applicable pipe specifications. Examine repaired components by the original method to determine freedom from defects. The Contractor is responsible for costs of such repair.

k. Test Records: Record testing results per the requirements of ASME B31.3 for each piping installation. Also include the following additional information:
   1) Test duration.
   2) Remarks, which include such items as:
      a) Leaks (type and location).

b) Repairs made on leaks.

3) Signature and date of person witnessing the test.

4) Test results to be reviewed by Examiner.

## 3.8 PIPING SERVICE INDEX

| REV | SERVICE | FLUID CODE | DESIGN BASIS | DESIGN CODE | PIPE GROUP | NOTES | GASKET GROUP | BOLTING GROUP | BRANCH TABLE | TEST TYPE | PREFERRED VALVE TYPE SIZE | SHUTOFF | THROTTLE | CHECK | OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **GAS, ENDO - CARBON STEEL** | **ENDO** | 150 PSIG | B31.3 | 1CS11 | 2, 6, 8 | HT | A193-B7-FC | BTSOL | T12 | 2" (DN50) and Under | BA06CS40 | GL06CS40 | CH06CS40 | BA06CS50 |
| | (GAS MIXTURE - HYDROGEN, NITROGEN AND CARBON MONOXIDE) | | 100 DEGF | Cat "NFS" | | | | | | | 3" (DN80) to 6" (DN150) | BA01CS21 | GL01CS20 | CH01S637 | - |
| | | | (10.3 BARG | NFPA 54 | | | | | | | | | | | |
| | | | 38 DEGC) | | | | | | | | | | | | |
| | ***PIPE LABEL=>"ENDO GAS" - BLACK on YELLOW*** | | | | | | | | | | | | | | |
| | **GAS, PROPANE - CARBON STEEL - CLASS 300 DESIGN** | **PG** | 105 PSIG | B31.3 | 3CS12 | 2, 3, 4 | HT | A193-B7-FC | BTSOL | T16 | 2" (DN50) and Under | BA06CS43 | - | - | BA06CS53 |
| | DOWNSTREAM OF METER TO POINTS-OF-USE | | 100 DEGF | Cat "NFS" | | (100% RT) | | | | | 3" (DN80) to 6" (DN150) | PL03CS21 | - | - | - |
| | (ABOVEGROUND) | | (7.24 BARG | NFPA 54 | | 5, 6, 8 | | | | | | | | | |
| | | | 38 DEGC) | | | | | | | | | | | | |
| | ***PIPE LABEL=>"PROPANE" - BLACK on YELLOW*** | | | | | | | | | | | | | | |
| | **GAS, PROPANE - HDPE " YELLOWSTRIPE"/"BLACKSTRIPE"** | **PG** | 105 PSIG | B31.3 | 1PE08 | 2, 6, 8 | YY | A193-B7-FC | BHDPE | T29 | 2" (DN50) and Under | - | - | - | - |
| | DOWNSTREAM OF METER TO POINTS-OF-USE | | 100 DEGF | Cat "NFS" | | | | | | | 3" (DN80) to 6" (DN150) | - | - | - | - |
| | (UNDERGROUND) | | (7.24 BARG | NFPA 54 | | | | | | | | | | | |
| | | | 38 DEGC) | | | | | | | | | | | | |
| | ***PIPE LABEL=>"PROPANE" - BLACK on YELLOW*** | | | | | | | | | | | | | | |
| | **NITROGEN - CARBON STEEL** | **N2** | 150 PSIG | B31.3 | 1CS11 | 1, 7, 8 | HT | A193-B7-FC | BTSOL | T12 | 2" (DN50) and Under | BA06CS40 | GL06CS40 | CH06CS40 | BA06CS50 |
| | DOWNSTREAM OF VAPORIZER TO POINTS-OF-USE | | 100 DEGF | Cat "D" | | | | | | | 3" (DN80) to 6" (DN150) | BA01CS21 | GL01CS20 | CH01S637 | - |
| | (ABOVEGROUND) | | (10.3 BARG | | | | | | | | | | | | |
| | | | 38 DEGC) | | | | | | | | | | | | |
| | ***PIPE LABEL=>"NITROGEN" - BLACK on YELLOW*** | | | | | | | | | | | | | | |
| | **WATER, DEIONIZED - 316L SS** | **DIW** | 150 PSIG | B31.3 | 1S609 | 8 | YY | A193-B7-FC | BRSOL | T28 | 2" (DN50) and Under | BA06S640 | GL03S640 | CH03S640 | BA06S650 |
| | DOWNSTREAM OF DI WATER SYSTEM TO POINTS-OF-USE | | 100 DEGF | Cat "D" | | | | | | | 3" (DN80) to 6" (DN150) | BA01S621 | GL01S620 | CH01S637 | - |
| | (ABOVEGROUND) | | (10.3 BARG | | | | | | | | | | | | |
| | | | 38 DEGC) | | | | | | | | | | | | |
| | ***PIPE LABEL=>"DI WATER" - WHITE on GREEN*** | | | | | | | | | | | | | | |

**NOTES**:

Note 1) Insulate only where shown on drawings.

Note 2) Natural gas, propane gas and other flammable gases shall be electrically grounded in accordance with the NFPA 54 - National Fuel Gas Code.

Note 3) All butt welds shall be made by first making a gas tungsten-arc (GTAW) root pass. Stainless steel piping shall have interior purged during the GTAW welding process.

Note 4) All butt-welded joints shall be examined radiographically (RT) for their full length. All fillet/socket welded joints shall be examined with magnetic partical (MT) or liquid penetrant (PT) for their full length. When a percentage (%) is specified for a given piping service, this indicates the minimum percentage of welds to be examined. The acceptance criteria and procedures shall be in accordance with ASME/ANSI B31.1 as follows: MT - See Paragraph 136.4.3, PT - See Paragraph 136.4.4 and RT - See Paragraph 136.4.5.

Note 5) All Natural Gas or Propane piping shall be painted "Safety Yellow" in accordance with the project specifications.

Note 6) All systems shall maintain a 15 PSIG nitrogen purge until systems are placed into service. Contact local gas authority concerning requirements for safe discharge/venting of any flammable gas system.

Note 7) Refer to piping insulation Specification Section 230719.

Note 8) Refer to 400515 Attachment A - Construction Specifications for Process Piping.

**TEST TYPES:**

T12 - BLOW WITH AIR & "PNEUMATIC" TEST

T16 - BLOW WITH AIR & "PNEUMATIC" TEST, PURGE & LAY UP WITH 15 PSIG NITROGEN

T28 - FLUSH & "HYDROSTATIC" TEST

T29 - FLUSH & "HYDROSTATIC" TEST, PURGE & LAY UP WITH 15 PSIG NITROGEN

3.9 APPENDICES

A. Attachment A – Construction Specifications For Process Piping

END OF SECTION

# ATTACHMENT A – CONSTRUCTION SPECIFICATIONS FOR PROCESS PIPING

## 400515.17005 - GASKET MATERIAL GROUP SPECIFICATIONS

1.0 GASKET - GROUP "HT"

1.1 Gaskets shall be spiral-wound Type 316 stainless steel with graphite filler (suitable for a temperature of 842 DEGF), inner metal ring and carbon steel center ring, conforming to flange series on which they are to be used (1/8" take-out for design layout). Each gasket shall be marked and identified with a color code in accordance with ASME/ANSI B16.20. Flange connections using this Gasket Group shall have bolting torque applied in accordance with Section 400515.17006 and the bolting material shall be high strength alloy studs.

2.0 GASKET - GROUP "YY"

2.1 Gaskets shall be standard, pre-cut, highly compressible microcellular PTFE outer layers and rigid PTFE core (limit to a design temperature of 350 DEGF), 1/8" thick, conforming to the gasket faces of the flanges on which they are to be used. Flange connections using this Gasket Group shall have bolting torque applied in accordance with Section 400515.17006 and the bolting material shall be high strength alloy studs.

End of Section 400515.17005

## 400515.17006 - BOLTING MATERIAL GROUP SPECIFICATIONS

1.0 GENERAL

1.1 All bolt studs (studs), bolts and accompanying nuts shall be threaded in accordance with ASME/ANSI B1.1, Class 2A for external threads and Class 2B for internal threads. Threads shall be the coarse-thread series except that bolting 1-1/8" and larger in diameter shall be the 8-thread series.

1.2 There are several factors which effect the selection of bolting materials: gasket type, design conditions, service, environment, etc. Unless otherwise specified on the drawings, the bolting material group for each service shall be as specified in the 400515 Piping Service Index.

1.3 The use of fully/continuous threaded rod (commonly referred to as all-thread rod) in accordance with ASTM A36 or ASTM A307 shall not be acceptable for bolting material. The minimum grade suitable for bolting material shall be ASTM A193, Grade B7.

1.4 Anti-seize compound, shall be applied liberally to the base of the threads ensuring that the full circumference is covered. Only paste-type thread lubricant shall be acceptable. Lubricate all load bearing surfaces on the bolts, nuts, and washers.

1.5 All bolting shall be tightened with suitable wrenches only. Hammering or bumping shall not be permitted. In tightening bolted joints, care shall be taken to secure uniform pressure on the gaskets and to avoid overstressing bolts or dishing the flanges. Extreme care shall be exercised in making up joints between Van Stone-type flanges, fiberglass flanges, cast iron body valves and lined pipe flanges.

1.6 Flange bolting shall have a length such that after tightening, the bolt projection shall extend completely through their nuts. An exposed thread count for bolt/stud shall be between one (1) and five (5) threads. All bolting on any one flange shall be of the same length.

1.7 Careful consideration must be given in matching bolting material with tapped holes in valves or equipment since manufacturers can vary the number of threads per inch.

1.8 Stainless steel bolting materials shall be avoided in areas where chlorides are present to prevent stress corrosion cracking (brittle failure).

2.0 BOLT TORQUES

2.1 The ASME PCC-1 – Guidelines For Pressure Boundary Bolted Joint Assembly should be used as a guide for assembling flanged joints unless otherwise directed by the Owner's Representative. These guidelines include alignment of flanged joints, installation of gasket, lubrication, tightening of bolts and tightening sequence.

2.1.1 Special Requirements. Coated bolt torque values should be reduced by 20% from the selected gasket manufacturer's listed torque values for the initial tightening of new coated bolts. For second and subsequent tightening of coated bolts by torqueing methods, it is recommended to

use lubricants and to use the full (not reduced) selected gasket manufacturer's listed torque values.

2.1.2 Torque Increments. A four (4) or five (5) stage tightening method with the tightening sequence in accordance with ASME PCC-1 is recommended. The step-by-step instructions are as follows:

- Round 1 - Torque bolts at 30% of final loading using the appropriate tightening sequence.
- Round 2 - Torque bolts at 60% of final loading using the appropriate tightening sequence.
- Round 3 - Torque bolts at 100% of final loading using the appropriate tightening sequence.
- Round 4 - Torque the bolts at 100% of the final loading using a clockwise pattern.
- Optional Round 5 - Time permitting, after a minimum of four (4) hours repeat Round 4.

2.2 All flange connections for fiberglass, plastic, or plastic lined piping systems shall be tightened with a torque wrench in accordance with the manufacturer's recommended bolt torque values and procedures unless otherwise directed by the Owner's Representative.

2.3 All flange connections using spiral-wound type gaskets shall be tightened with a torque wrench in accordance with the manufacturer's recommended bolt torque values and procedures unless otherwise directed by the Owner's Representative. Bolting materials when using spiral-wound type gaskets shall be high strength, continuous threaded, alloy studs.

2.4.2 After the joint is complete, the studs shall be checked to ensure proper elongation. If the actual elongation differs from the calculated elongation by 25 percent or more, all studs of the joint shall be backed off and the joint re-tightened as before.

2.4.3 Submittal. Stud elongation readings shall be recorded with each stud location identified, and these recordings shall be submitted to the Owner's Representative.

2.5 All other flange connections shall be tightened in accordance with a written procedure approved by the Owner's Representative.

3.0 BOLTING MATERIAL - GROUP "A193-B7-FC"

3.1 Studs, Continuous Threaded Alloy Steel, Coated: High strength, fluoropolymer coated, design temperatures 465 DEGF and less. Bolting shall be fluoropolymer corrosion resistant coated high strength alloy steel machine bolts, cap screws or studs. Bolting shall be semi-finished in accordance with ASME/ANSI B18.2.1 and threaded in accordance with ASME/ANSI B1.1, Class 2A. Bolting material shall conform to ASTM A193, Grade B7. Nuts shall be fluoropolymer corrosion resistant coated, heat-treated, heavy, hexagonal nuts, semi-finished in accordance with ASME/ANSI B18.2.2 and threaded in accordance with ASME/ANSI B1.1, Class 2B. Nut material shall conform to ASTM A194, Grade 2H.

End of Section 400515.17006

**400515.1CS11 - PIPING MATERIAL GROUP 1CS11**
**CARBON STEEL PIPE - CLASS 150**
**SEAMLESS, S-XS/S-STD, 2" & DN - SOCKETWELD**
**WELDING NECK OR SLIP-ON FLANGES**

1.0 DESIGN BASIS

1.1 Maximum allowable working pressure-temperature ratings for pipe sizes 24 inches and smaller are as follows:

285 PSIG at -20 to 100 DEGF
260 PSIG at 200 DEGF
230 PSIG at 300 DEGF
200 PSIG at 400 DEGF
170 PSIG at 500 DEGF
140 PSIG at 600 DEGF

1.2 Corrosion allowance, 0.025 inch for all pipe sizes.

1.3 Mechanical strength allowance, 0.065 inch for pipe sizes 3 inches and smaller.

1.4 No bending allowance is included.

2.0 PIPE

2.1 All pipe 24 inches and smaller shall be seamless carbon steel conforming to ASTM A106, Grade B. Pipe wall thickness shall be as follows:

| | | |
|---|---|---|
| 1/2" thru | 2" | Schedule XS |
| 2-1/2" thru | 24" | Schedule STD |

2.2 All threaded pipe nipples shall be carbon steel Schedule "XS". All purchased pipe nipples (MNPT, PE X MNPT and PE) shall conform to ASTM A106, Grade B.

3.0 JOINTS

3.1 Joints 2 inches and smaller shall be socket welded. The preferred branch connections 2" and smaller shall be socketweld. When shown on piping drawings, branch connections 2" and smaller may be threaded.

3.2 Joints 2-1/2 inches and larger shall be butt welded.

4.0 FABRICATION AND ERECTION

4.1 Fabrication and erection shall be in accordance with Section 400515.

5.0 FLANGES

5.1 Flanges 2 inches and smaller shall be Class 150 forged carbon steel socket-weld type in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Material shall conform to ASTM A105.

5.2 Flanges 2-1/2 inches thru 24 inches shall be Class 150 forged carbon steel welding neck or slip-on type in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Material shall conform to ASTM A105.

5.3 Slip-on type flanges shall not be used with spiral-wound gaskets or systems requiring maximum cleanliness.

5.4 Blind flanges 1/2 inches thru 24 inches shall be Class 150 forged carbon steel in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Blind flange material shall conform to ASTM A105.

6.0 FITTINGS

6.1 Fittings 2 inches and smaller shall be Class 3000 forged carbon steel socket-weld type in accordance ASME/ANSI B16.11. Material shall conform to ASTM A105.

6.2 Fittings 2-1/2 inches and larger shall be carbon steel butt-welding type in accordance with ASME/ANSI B16.9 and with the same wall thickness as the attached pipe. Material shall conform to ASTM A234, Grade WPB.

6.3 When shown on the piping drawings or specified in the branch connection table, branch connections 2 inches and smaller shall be made using Class 3000 sockolets. Sockolets shall be bored to match the inside diameter of the attached pipe. Material shall conform to ASTM A105. When shown on the piping drawings or specified in the branch connection table, branch connections shall be made using weldolets. Weldolets shall be bored to match the inside diameter of the attached pipe. Material shall conform to ASTM A105.

7.0 BOLTING MATERIALS

7.1 Unless otherwise indicated on the piping drawings or directed by the Owner's Representative, the bolting material group for each service is specified in the 400515 Piping Service Index. The bolting materials groups shall be in accordance with Section 400515.17006.

8.0 UNIONS

8.1 Unions 2 inches and smaller shall be Class 3000 forged carbon steel socket-weld type with spiral wound Type 316 stainless steel gasket, graphite (non-asbestos) filler, and Type 316 stainless steel gasket retainer. Material shall conform to ASTM A105.

8.2 Unions 2-1/2 inches and larger shall be made with flanges.

End of Section 400515.1CS11

**400515.1PE08 - PIPING MATERIAL GROUP 1PE08**
**HIGH DENSITY POLYETHYLENE (HDPE - IPS) PIPE - SDR11 (125 PSIG)**
**NATURAL GAS/PROPANE GAS SERVICE**

1.0 DESIGN BASIS

1.1 Maximum allowable working pressure-temperature ratings for pipe sizes 2 inches thru 12 inches are as follows (49 CFR Part §192.121 using Design Factor (DF) of 0.40:

125 PSIG at 73.4 DEGF (FT = 1.00)
105 PSIG at 100 DEGF (FT = 0.84)
88 PSIG at 120 DEGF (FT = 0.73)

2.0 PIPE

2.1 The pipe shall be Iron Pipe Size (IPS) high density, extra high molecular weight polyethylene pipe (HDPE). The pipe shall be in accordance with ASTM D3350 with the minimum cell classification values of PE445574C. Pipe shall be suitable for Natural Gas, LPG, and Propane Gas distribution. Dimensions and workmanship shall be in accordance with ASTM F714. The pipe wall thickness shall be SDR11 and have a pressure ratings as listed in Paragraph 1.1 for all sizes.

3.0 JOINTS

3.1 All pipe, fitting, and valve joints shall be prepared using butt-fusion techniques, except where flanged connections are shown on the drawings. The temperature, times, and pressures of fusion shall be in strict accordance with the manufacturer's recommendation.

4.0 FABRICATION, ERECTION, AND INSPECTION

4.1 Fabrication, erection and inspection shall be in accordance with Section 400515 and shall be in accordance with the manufacturer’s recommendation.

5.0 FLANGES

5.1 Flanges shall be made by using molded flange adapter stub ends and ductile iron back-up flanges drilled in accordance with Class 150 ASME B16.5. Flange adapter stub ends for all sizes shall conform to the same requirements as specified for the HDPE piping system and shall be made by the same manufacturer. Bolting of flanges shall be in accordance with manufacturer's recommendation. All back-up flanges shall be hot-dipped galvanized.

6.0 FITTINGS

6.1 Fittings for all sizes shall molded butt-fusion type conforming to the same requirements as specified for the HDPE piping system and shall be made by the same manufacturer. The fittings shall have a pressure ratings as list in Paragraph 1.1 for all sizes.

6.3 Branch Connections. Branch connection tables are given for each service in the 400515 Piping Service Index. Unless shown otherwise on the drawings, the preferred branch connection for each service shall be as specified in the branch connection table listed in the 400515 Piping Service Index. Branch fittings shall be made using reducing tees unless otherwise noted on the drawings.

7.0 BOLTING MATERIALS

7.1 Unless otherwise indicated on the piping drawings or directed by the Owner’s Representative, the bolting material group for each service is specified in the 400515 Piping Service Index. The bolting materials groups shall be in accordance with Section 400515.17006.

7.2 A Society of Automotive Engineers (SAE) washer shall be installed under the head and nut of each bolt.

8.0 UNIONS

8.1 Unions for all sizes shall be made with flanges.

9.0 SUPPORT

9.1 Support spacing shall be in accordance with the manufacturer's recommendation.

10.0 INSTALLATION

10.1 Burial. Trench and trench bottom, embedment materials, and bedding and installation materials shall be in accordance with ASTM D2321 – Underground Installation of Thermoplastic Pipe for Sewers and the pipe manufacturer's recommendations. Piping shall be installed at a minimum depth of 3'-0" to top of pipe.

End of Section 400515.1PE08

**400515.1S609 - PIPING MATERIAL GROUP 1S609**
**TYPE 316/316L STAINLESS STEEL PIPE - CLASS 150**
**WELDED (EFW), S-40S/S-10S/S-STD, 2" & DN - BUTTWELD/SOCKETWELD**
**TYPE "A" STUB ENDS WITH LAP JOINT FLANGES**
**(UNS ALLOY NUMBER S31603)**

1.0 DESIGN BASIS

1.1 Maximum allowable working pressure-temperature ratings for pipe sizes 24 inches and smaller are as follows:

275 PSIG at -20 to 100 DEGF
235 PSIG at 200 DEGF
215 PSIG at 300 DEGF
195 PSIG at 400 DEGF
170 PSIG at 500 DEGF
140 PSIG at 600 DEGF

1.2 No corrosion allowance.

1.3 Mechanical strength allowance, 0.065 inch for pipe sizes 3 inches and smaller.

1.4 No bending allowance is included.

2.0 SUBMITTALS - REPORTS AND RECORDS

2.1 The Contractor shall submit, to the Owner's Representative, certified chemical analyses of all heat code numbers traceable to Mill Test Reports for all materials covered in this piping material group specification. Mill Test Reports shall be furnished in digital format when material is shipped.

3.0 PIPE

3.1 All pipe 1/2 inch thru 24 inches shall be welded Type 316/316L stainless steel conforming to ASTM A312, Grade TP316/316L (dual marking). Pipe wall thickness shall be as follows:

| | |
|---|---|
| 1/2" thru 2" | Schedule 40S (B36.19M) |
| 2-1/2" thru 24" | Schedule 10S (B36.19M) |

3.2 All threaded pipe nipples shall be Schedule 40S. All purchased pipe nipples (MNPT, PE X MNPT and PE) shall conform to ASTM A312, Grade TP316/316L (dual marking). All threaded pipe shall be minimum Schedule 40S.

4.0 JOINTS

4.1 Joints 2 inches and smaller shall be butt welded or socket welded (preferred 1" and smaller). The preferred branch connections 2" and smaller shall be socketweld. When shown on piping drawings, branch connections 2" and smaller may be threaded.

4.2 Joints 2-1/2 inches and larger shall be butt welded.

5.0 FABRICATION AND ERECTION

5.1 Fabrication and erection shall be in accordance with Section 400515.

6.0 FLANGES

6.1 Flanges 1/2 inch thru 2 inches shall be Class 150 Type 316/316L stainless steel socket-weld type in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Material shall conform to ASTM A182, Grade F316/F316L (dual marking).

6.1.1 (Alternate) Flanges 1/2 inch thru 2 inches shall be slip-on, welding neck type or butt welding Type "A" Lap Joint Stub End - Short Pattern in accordance with ASME/ANSI B16.9 with loose lap joint flange and with the same wall thickness as the attached pipe. Stub end material shall be Type 304/304L stainless steel and conform to ASTM A403, Grade WP316/316L (dual marking). Lap joint flanges shall be forged carbon steel in accordance with Class 150 ASME/ANSI B16.5 and material shall conform to ASTM A105. All lap joint flanges shall be hot-dipped galvanized.

6.2 Flanges 2-1/2 inches thru 24 inches shall be butt welding Type "A" Lap Joint Stub End - Short Pattern in accordance with ASME/ANSI B16.9 with loose lap joint flange and with the same wall thickness as the attached pipe. Stub end material shall be Type 316/316L stainless steel and conform to ASTM A403, Grade WP316/316L (dual marking). Lap joint flanges shall be forged carbon steel in accordance with Class 150 ASME/ANSI B16.5 and material shall conform to ASTM A105. All lap joint flanges shall be hot-dipped galvanized.

6.2.1 (Alternate) Flanges 2-1/2 inches thru 24 inches shall be Class 150 Type 316/316L stainless steel slip-on or welding neck type in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Material shall conform to ASTM A182, Grade F316/316L (dual marking).

6.3 Slip-on type flanges shall not be used with spiral-wound gaskets or systems requiring maximum cleanliness.

6.4 Blind flanges 1/2 inch thru 24 inches shall be Class 150 forged Type 316/316L stainless steel in accordance with ASME/ANSI B16.5. Blind flange material shall conform to ASTM A182, Grade F316/F316L (dual marking).

7.0 FITTINGS

7.1 Socket weld type fittings 2 inches and smaller shall be Class 3000 Type 316/316L stainless steel socket-weld type in accordance with ASME/ANSI B16.11. Material shall conform to ASTM A182, Grade F316/316L (dual marking).

7.2 Butt-welding type fittings 1/2 inch and larger shall be Type 316/316L stainless steel butt-welding type in accordance with ASME/ANSI B16.9 and have the same wall thickness as the attached pipe. Material shall conform to ASTM A403, Grade WP316/316L (dual marking).

7.3 When shown on the piping drawings or specified in the branch connection table, branch connections 2 inches and smaller shall be made using lightweight Schedule 10S socket-weld pipets. Socket-weld pipets shall be bored to match the same inside diameter as the attached pipe. Material shall conform to ASTM A182, Grade F316/316L (dual marking). When shown on the piping drawings or specified in the branch connection table, branch connections shall be made using lightweight Schedule 10S butt-weld pipets. Butt-weld pipets shall be bored to match the same inside diameter as the attached pipe. Material shall conform to ASTM A182, Grade F316/316L (dual marking).

8.0 BOLTING MATERIALS

8.1 Unless otherwise indicated on the piping drawings or directed by the Owner's Representative, the bolting material group for each service is specified in the 400515 Piping Service Index. The bolting materials groups shall be in accordance with Section 400515.17006.

9.0 UNIONS

9.1 Unions 2 inches and smaller shall be Class 2000/3000 forged Type 316/316L stainless steel socket-weld type with spiral wound Type 316 stainless steel gasket, graphite (non-asbestos) filler, and Type 316 stainless steel gasket retainer. Material shall conform to ASTM A182, Grade F316/316L (dual marking).

9.2 Unions 2-1/2 inches and larger shall be made with flanges.

End of Section 400515.1S609

**400515.3CS12 - PIPING MATERIAL GROUP 3CS12**
**CARBON STEEL PIPE - CLASS 300**
**SEAMLESS, S-XS/S-STD, 2" & DN - SOCKETWELD**
**WELDING NECK FLANGES**

1.0 DESIGN BASIS

1.1 Maximum allowable working pressure-temperature ratings for pipe sizes 24 inches and smaller are as follows:

352 PSIG at -20 to 650 DEGF

1.2 Corrosion allowance, 0.025 inch for all pipe sizes.

1.3 Mechanical strength allowance, 0.065 inch for pipe sizes 3 inches and smaller.

2.0 PIPE

2.1 All pipe 24 inches and smaller shall be seamless carbon steel conforming to ASTM A106, Grade B. Pipe wall thicknesses shall be as follows:

| | |
|---|---|
| 1/2" thru 2" | Schedule XS |
| 2-1/2" thru 24" | Schedule STD |

2.2 All threaded pipe nipples shall be carbon steel Schedule "XS". All purchased pipe nipples (MNPT, PE X MNPT and PE) shall conform to ASTM A106, Grade B.

3.0 JOINTS

3.1 Joints 2 inches and smaller shall be socket welded. The preferred branch connections 2" and smaller shall be socketweld. When shown on piping drawings, branch connections 2" and smaller may be threaded.

3.2 Joints 2-1/2 inches and larger shall be butt welded.

4.0 FABRICATION AND ERECTION

4.1 Fabrication and erection shall be in accordance with Section 400515.

5.0 FLANGES

5.1 Flanges 2 inches and smaller shall be Class 300 forged carbon steel socket-weld type in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Material shall conform to ASTM A105.

5.2 Flanges 2-1/2 inches thru 24 inches shall be Class 300 forged carbon steel welding neck type in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Material shall conform to ASTM A105. Slip-on type flanges shall not be used.

5.4 Blind flanges 1/2 inches thru 24 inches shall be Class 300 forged carbon steel in accordance with ASME/ANSI B16.5 and raised face, or as required to match the mating flange. Blind flange material shall conform to ASTM A105.

6.0 FITTINGS

6.1 Fittings 2 inches and smaller shall be Class 3000 forged carbon steel socket-weld type in accordance with ASME/ANSI B16.11. Material shall conform to ASTM A105.

6.2 Fittings 2-1/2 inches and larger shall be carbon steel butt-welding type in accordance with ASME/ANSI B16.9 and have the same wall thickness as the attached pipe. Material shall conform to ASTM A234, Grade WPB.

6.3 When shown on the piping drawings or specified in the branch connection table, branch connections 2 inches and smaller shall be made using Class 3000 sockolets. Sockolets shall be bored to match the inside diameter of the attached pipe. Material shall conform to ASTM A105. When shown on the piping drawings or specified in the branch connection table, branch connections shall be made using weldolets. Weldolets shall be bored to match the inside diameter of the attached pipe. Material shall conform to ASTM A105.

7.0 BOLTING MATERIALS

7.1 Unless otherwise indicated on the piping drawings or directed by the Owner's Representative, the bolting material group for each service is specified in the 400515 Piping Service Index. The bolting materials groups shall be in accordance with Section 400515.17006.

8.0 UNIONS

8.1 Unions 2 inches and smaller shall be Class 3000 forged carbon steel socket-weld type with spiral wound Type 316 stainless steel gasket, graphite (non-asbestos) filler, and Type 316 stainless steel gasket retainer. Material shall conform to ASTM A105.

8.2 Unions 2-1/2 inches and larger shall be made with flanges.

End of Section 400515.3CS12

# 400515.BHDPE – BRANCH CONNECTION TABLE

**HEADER SIZES (INCHES) - DESIGN BASIS: 100% REINFORCEMENT REQUIRED**

| BRANCH SIZES | NPS | 48 | 42 | 36 | 30 | 24 | 20 | 18 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 3 | 2 | 1-1/2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | RTE | TEE |
| B | 1-1/2 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | RTE | TEE | |
| R | 2 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | TEE | | |
| A | 3 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | TEE | | | |
| N | 4 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | TEE | | | | |
| C | 6 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | TEE | | | | | |
| H | 8 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | TEE | | | | | | |
| | 10 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | TEE | | | | | | | |
| S | 12 | SAD | SAD | SAD | SAD | SAD | SAD | SAD | RTE | RTE | TEE | | | | | | | | |
| I | 14 | RTE | RTE | RTE | RTE | RTE | RTE | RTE | RTE | TEE | | | | | | | | | |
| Z | 16 | RTE | RTE | RTE | RTE | RTE | RTE | RTE | TEE | | | | | | | | | | |
| E | 18 | RTE | RTE | RTE | RTE | RTE | RTE | TEE | | | | | | | | | | | |
| S | 20 | RTE | RTE | RTE | RTE | RTE | TEE | | | | | | | | | | | | |
| | 24 | RTE | RTE | RTE | RTE | TEE | | | | | | | | | | | | | |
| | 30 | RTE | RTE | RTE | TEE | | | | | | | | | | | | | | |
| | 36 | RTE | RTE | TEE | | | | | | | | | | | | | | | |
| | 42 | RTE | TEE | | | | | | | | | | | | | | | | |
| | 48 | TEE | | | | | | | | | | | | | | | | | |

**TEE - STRAIGHT TEE (SEE NOTE 2)**
**RTE - REDUCING TEE (SEE NOTE 2)**
**SAD - BRANCH SADDLE (SEE NOTE 2)**

NOTES:

1) The actual design conditions of a piping system shall be used to determine branch connection requirements as a minimum.
2) All branch connections shall be in accordance with manufacturer's recommendation. Tees, reducing tees and branch saddles shall have increased wall thickness to provide same pressure ratings as mating pipe with ends machined to match pipe wall thickness.
3) Design calculations for branch connections only consider design pressure and temperature. Thermal forces/moments, hydraulic forces/moments and vibration may require additional reinforcement for the branch connection.

End of Section 400515.BHDPE

# 400515.BRSOL – BRANCH CONNECTION TABLE

**HEADER SIZES (INCHES) - DESIGN BASIS: 200 PSIG AT 250 DEGF MAXIMUM**

| BRANCH SIZES | NPS | 48 | 42 | 36 | 30 | 24 | 20 | 18 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 3 | 2 | 1-1/2 | 1 | 3/4 | 1/2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/2 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | RTE | TEE |
| | 3/4 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | RTE | TEE | |
| | 1 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | RTE | TEE | | |
| B | 1-1/2 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | TEE | | | |
| R | 2 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | TEE | | | | |
| A | 3 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | |
| N | 4 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | |
| C | 6 | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | TEE | | | | | | | |
| H | 8 | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | TEE | | | | | | | | |
| | 10 | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | TEE | | | | | | | | | |
| S | 12 | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | TEE | | | | | | | | | | |
| I | 14 | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | | | | | | | | | | | |
| Z | 16 | RWD | RWD | RWD | RWD | RWD | RWD | RWD | RWD | | | | | | | | | | | | |
| E | 18 | RWD | RWD | RWD | RWD | RWD | RWD | RWD | | | | | | | | | | | | | |
| S | 20 | RWD | RWD | RWD | RWD | RWD | RWD | | | | | | | | | | | | | | |
| | 24 | RWD | RWD | RWD | RWD | RWD | | | | | | | | | | | | | | | |
| | 30 | RWD | RWD | RWD | RWD | | | | | | | | | | | | | | | | |
| | 36 | RWD | RWD | RWD | | | | | | | | | | | | | | | | | |
| | 42 | RWD | RWD | | | | | | | | | | | | | | | | | | |
| | 48 | RWD | | | | | | | | | | | | | | | | | | | |

**TEE - FULL STRAIGHT TEE**
**RTE - REDUCING TEE**
**SWI - FULL TEE WITH S/W REDUCING INSERT OR "SOL"**
**SOL - SOCKOLET or LIGHT-WEIGHT S/W PIPET**
**WOL - WELDOLET OR LIGHT-WEIGHT B/W PIPET**
**RWD - REINFORCED NOZZLE WITH PAD**
**CAL - REINFORCEMENT CALCULATION REQUIRED**

NOTES:
1) The actual design conditions of a piping system shall be used to determine branch connection requirements as a minimum.
2) All branch connections shall be in accordance with ASME/ANSI B31.1, Paragraph 104.3.1.
3) Design calculations for branch connections only consider design pressure and temperature. Thermal forces/moments, hydraulic forces/moments and vibration may require additional reinforcement for the branch connection.

End of Section 400515.BRSOL

# 400515.BTSOL – BRANCH CONNECTION TABLE

**HEADER SIZES (INCHES) - DESIGN BASIS: 100% REINFORCEMENT REQUIRED**

| BRANCH SIZES | 48 | 42 | 36 | 30 | 24 | 20 | 18 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 3 | 2 | 1-1/2 | 1 | 3/4 | 1/2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | RTE | TEE |
| 3/4 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | RTE | TEE | |
| 1 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | RTE | TEE | | |
| 1-1/2 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | RTE | TEE | | | |
| 2 | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | SOL | TEE | | | | |
| 3 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | |
| 4 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | |
| 6 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | |
| 8 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | | |
| 10 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | | | |
| 12 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | | | | |
| 14 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | | | | | |
| 16 | WOL | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | | | | | | |
| 18 | WOL | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | | | | | | | |
| 20 | WOL | WOL | WOL | WOL | WOL | TEE | | | | | | | | | | | | | | |
| 24 | WOL | WOL | WOL | WOL | TEE | | | | | | | | | | | | | | | |
| 30 | RWD | RWD | RWD | TEE | | | | | | | | | | | | | | | | |
| 36 | RWD | RWD | TEE | | | | | | | | | | | | | | | | | |
| 42 | RWD | TEE | | | | | | | | | | | | | | | | | | |
| 48 | TEE | | | | | | | | | | | | | | | | | | | |

**TEE - FULL STRAIGHT TEE**
**RTE - REDUCING TEE**
**SWI - FULL TEE WITH S/W REDUCING INSERT OR "SOL"**
**RWD - REINFORCED NOZZLE WITH PAD**
**SOL - SOCKOLET or LIGHT-WEIGHT S/W PIPET**
**WOL - WELDOLET OR LIGHT-WEIGHT B/W PIPET**

NOTES:

1) The actual design conditions of a piping system shall be used to determine branch connection requirements as a minimum.
2) All branch connections shall be in accordance with ASME/ANSI B31.1, Paragraph 104.3.1.
3) Design calculations for branch connections only consider design pressure and temperature. Thermal forces/moments, hydraulic forces/moments and vibration may require additional reinforcement for the branch connection.

End of Section 400515.BTSOL

## 400515.BA01CS21 – BALL VALVE, CLASS 150, CAST CARBON STEEL BODY

1/2" thru 8": Class 150 “Reduced Port” Ball Valve - Flanged – Cast Carbon Steel. body and Type 316 stainless steel ball and stem, raised face flanged ends, teflon seats and seals, faced and drilled to Class 150 ASME/ANSI B16.5, face-to-face dimension shall conform to ASME/ANSI B16.10 short pattern. Materials for body shall be carbon steel conforming to ASTM A216, Grade WCB. Materials for ball and stem shall be Type 316 stainless steel conforming to ASTM A351, Grade CF8M. Body fasteners shall be stainless steel. Valves 1/2 inch thru 4 inches shall be equipped with a pad-lockable wrench operator; valves 6 inches through 8 inches shall be equipped with an enclosed gear operator. Valves 2" and smaller shall have latch lock handle to prevent inadvertent opening or closing of the valve. Valves shall provide the tight shut-off for the full working pressure of the valve (0 PSIG - 275 PSIG).

End of Section 400515.BA01CS21

**400515.BA01S621 – BALL VALVE, CLASS 150, CAST TYPE 316 STAINLESS STEEL BODY**

1/2" thru 8": Class 150 “Reduced Port” Ball Valve - Flanged - Cast Type 316 stainless steel body, ball and stem, raised face flanged ends, PTFE seats and seals, faced and drilled to Class 150 ASME/ANSI B16.5, face-to-face dimension to conform to ASME/ANSI B16.10 short pattern. Materials for body, ball and stem shall be Type 316 stainless steel conforming to ASTM A351, Grade CF8M. Body fasteners shall be stainless steel. Valves 1/2 inch thru 4 inches shall be equipped with a pad-lockable wrench operator; valves 6 inches and 8 inches shall be equipped with an enclosed gear operator. Valves 2" and smaller shall have latch lock handle to prevent inadvertent opening or closing of the valve. Valves shall provide the tight shut-off for the full working pressure of the valve (0 PSIG - 275 PSIG).

End of Section 400515.BA01S621

## 400515.BA06CS40 – BALL VALVE, 1500 PSIG CWP, CAST CARBON STEEL BODY

1/2" thru 2": 1500 PSIG CWP “Reduced Port” Ball Valve - Socketweld – Cast Carbon Steel body and stainless steel ball, three piece body, socketweld ends, removable or swing out center section design, blow out proof stem, PTFE seats and seals. Materials for body shall be carbon steel conforming to ASTM A216, Grade WCB. Materials for ball shall be Type 316 stainless steel conforming to ASTM A351 Grade CF8M. Body fasteners shall be stainless steel. Valves shall be equipped with pad-lockable lever operated with stops at full open and full closed positions and latch lock handle to prevent inadvertent opening or closing of the valve.

End of Section 400515.BA06CS40

**400515.BA06CS13 – BALL VALVE, 1500 PSIG CWP, CAST CARBON STEEL BODY, U/L APPROVED**

1/2" thru 2": 1500 PSIG CWP "U/L Approved" - Ball Valve - Socketweld – Cast Carbon Steel body and ball, double union design, socketweld ends, blowout-proof stem, PTFE or reinforced-PTFE seats and seals, graphite stem packing, hard chrome plated carbon steel ball, fire safe design, grounding device (ball-to-stem-to-body), pad-lockable level operated with stops at full open and full closed positions. The valve shall have Underwriters' Laboratories approval for gas service.

End of Section 400515.BA06CS43

## 400515.BA06CS50 – BALL VALVE, 1500 PSIG CWP, CAST CARBON STEEL BODY

1/2" thru 2": 1500 PSIG CWP “Reduced Port” Ball Valve - Screwed – Cast Carbon Steel body and stainless steel ball, three piece body, female NPT screwed ends, removable or swing out center section design, blow out proof stem, PTFE seats and seals. Materials for body shall be carbon steel conforming to ASTM A216, Grade WCB. Materials for ball shall be Type 316 stainless steel conforming to ASTM A351 Grade CF8M. Body fasteners shall be stainless steel. Valves shall be equipped with pad-lockable lever operated with stops at full open and full closed positions and latch lock handle to prevent inadvertent opening or closing of the valve.

End of Section 400515.BA06CS50

**400515.BA06CS53 – BALL VALVE, 1500 PSIG CWP, CAST CARBON STEEL BODY, U/L APPROVED**

1/2" thru 2": 1500 PSIG CWP "U/L Approved" - Ball Valve - Screwed – Cast Carbon Steel body and ball, double union design, screwed ends, blowout-proof stem, PTFE or reinforced-PTFE seats and seals, graphite stem packing, hard chrome plated carbon steel ball, fire safe design, grounding device (ball-to-stem-to-body), pad-lockable level operated with stops at full open and full closed positions, latch lock handle to prevent inadvertent opening or closing of the valve. The valve shall have Underwriters' Laboratories approval for gas service.

End of Section 400515.BA06CS53

## 400515.BA06S640 – BALL VALVE, 1500 PSIG CWP, CAST TYPE 316/316L STAINLESS STEEL BODY

1/2" thru 2": 1500 PSIG CWP Ball Valve - Socketweld - Cast Type 316/316L Stainless Steel body and ball, three-piece body, socketweld ends, removable or swing out center section design, blow out proof stem, PTFE seats and seals. Materials shall be Type 316/316L stainless steel body, ball, stem, stem nut and handle conforming to ASTM A351, Grade CF8M/CF3M (dual marking). Valves shall be equipped with pad-lockable lever operated with stops at full open and full closed positions and latch lock handle to prevent inadvertent opening or closing of the valve.

End of Section 400515.BA06S640

## 400515.BA06S650 – BALL VALVE, 1500 PSIG CWP, CAST TYPE 316/316L STAINLESS STEEL BODY

1/4" thru 2": 1500 PSIG CWP "Reduced Port" Ball Valve - Screwed - Cast Type 316/316L Stainless Steel body and ball, three-piece body, female NPT screwed ends, removable or swing out center section design, blow out proof stem, PTFE seats and seals. Materials shall be Type 316/316L stainless steel body, ball, stem, stem nut and handle conforming to ASTM A351, Grade CF8M/CF3M (dual marking). Valves shall be equipped with pad-lockable lever operated with stops at full open and full closed positions and latch lock handle to prevent inadvertent opening or closing of the valve.

End of Section 400515.BA06S650

**400515.CH01S637 – CHECK VALVE, WAFER-TYPE, TYPE 316 STAINLESS STEEL BODY**

1/2" thru 20": Class 150 "Flange Insert" Wafer Check Valve - Thru-Bolted – Type 316 Stainless Steel body, spring-loaded, integral seat, suitable for horizontal and vertical upward flow, designed to fit between two Class 150 ASME/ANSI B16.5 flanges. Materials for body and trim shall be Type 316 stainless steel with Inconel Alloy X750 spring. Valve shall be suitable for service to -320 to 700 DEGF.

End of Section 400515.CH01S637

## 400515.CH03S640 – CHECK VALVE, SWING-TYPE, CAST/FORGED TYPE 316/316L STAINLESS STEEL BODY

1/2" thru 2": Class 300 Swing Check Valve - Socketweld – Cast/Forged Type 316/316L Stainless Steel body and cover, suitable for horizontal and vertical upward flow, socketweld ends, Type 316 stainless steel seats and disc, bolted or integral cover, corrosion-inhibited graphite gasket, integral seats, Type 316/316L stainless steel (dual marking) body conforming to ASTM A351, Grade CF8M/CF3M (dual marking) or ASTM A182, Grade F316/316L (dual marking), Type 316 stainless steel cover and disc (API Trim 10). Working pressure and temperature rating shall comply with ASME/ANSI B16.34. The valves shall be suitable for a service temperature of 750 DEGF.

End of Section 400515.CH03S640

## 400515.CH06CS40 – CHECK VALVE, CLASS 600/800, FORGED CARBON STEEL BODY

1/2” thru 2":  Class 600/800 Swing Check Valve - Socketweld - Forged Carbon Steel body and cover, suitable for horizontal/vertical upward flow, corrosion-inhibited graphite gasket, socketweld ends. Material shall be ASTM A105 body and bolted cover and 13 percent chromium stainless steel (API Trim 8) disk. Working pressure and temperature shall comply with ASME/ANSI B16.34 and API 602.  The valves shall be suitable for a service temperature of 750 DEGF.

End of Section 400515.CH06CS40

## 400515.GL01CS20 – GLOBE VALVE, CLASS 150, CAST CARBON STEEL BODY

2" thru 24": Class 150 Globe Valve - Flanged - Cast Carbon Steel body and bonnet, raised face flanged ends, bolted flanged bonnet, plug or semi-plug type disc, renewable seat rings and disc, corrosion-inhibited graphite packing, outside screw and yoke, rising stem, faced and drilled to Class 150 ASME/ANSI B16.5, face-to-face dimension to conform to ASME/ANSI B16.10. Materials shall be: body and bonnet, ASTM A216, Grade WCB; stem, 13 percent chromium stainless steel; disc face and rings, 13 percent chromium stainless steel or a combination of 13 percent chromium stainless steel and nickel-copper, Stellite or a combination of Stellite and 13 percent chromium stainless steel as recommended by its manufacturer for steam service (API Trim 8). Working pressure and temperature ratings shall comply with ASME/ANSI B16.34 and API 600.

End of Section 400515.GL01CS20

**400515.GL01S620 – GLOBE VALVE, CLASS 150, CAST TYPE 316 STAINLESS STEEL BODY**

1/2" thru 12": Class 150 Globe Valve - Flanged - Cast Type 316 Stainless Steel body and bonnet, raised face flanged ends, bolted flanged bonnet, plug or semi-plug type disc, integral seat ring, PTFE packing, outside screw and yoke, rising stem, faced and drilled to Class 150 ASME/ANSI B16.5, face-to-face dimension to conform to ASME/ANSI B16.10. Materials for body, bonnet, disc, stem, and seat shall be Type 316 stainless steel (API Trim 10) conforming to ASTM A351, Grade CF8M. Working pressure and temperature ratings shall comply with ASME/ANSI B16.34. The valve shall be supplied with a pad-lockable handwheel where offered by the manufacturer. The valves shall be limited to service with temperature of 350 DEGF and lower. All valves 10 inches and larger shall be equipped with an enclosed standard bevel gear operator utilizing an air wrench adapter and locking mechanism.

End of Section 400515.GL01S620

## 400515.GL03S640 – GLOBE VALVE, CLASS 300, CAST/FORGED TYPE 316/316L STAINLESS STEEL BODY

1/2" thru 2": Class 300 Globe Valve - Socketweld – Cast/Forged Type 316/316L Stainless Steel body and bonnet, socketweld ends, bolted bonnet, plug or semi-plug type disc, outside screw and yoke, rising stem, corrosion-inhibited graphite packing, Type 316/316L stainless steel (dual marking) body conforming to ASTM A351, Grade CF8M/CF3M (dual marking) or ASTM A182, Grade F316/316L (dual marking), Type 316 stainless steel disc and stem (API Trim 10). Working pressure and temperature rating shall comply with ASME/ANSI B16.34. The valves shall be suitable for a service temperature of 750 DEGF.

End of Section 400515.GL03S640

## 400515.GL06CS40 – GLOBE VALVE, CLASS 600/800, FORGED CARBON STEEL BODY

1/2” thru 2": Class 600/800 Globe Valve - Socketweld - Forged Carbon Steel body and bonnet, socketweld ends, bolted bonnet, plug or semi-plug disc, Stellite or cobalt based alloy hard faced seat ring, corrosion-inhibited graphite packing, outside screw and yoke, rising stem. Material shall be: body and bonnet, ASTM A105; disc and stem, 13 percent chromium stainless steel (API Trim 8). Working pressure and temperature shall comply with ASME/ANSI B16.34 and API 602. The valves shall be suitable for a service temperature of 750 DEGF.

End of Section 400515.GL06CS40

**400515.PL03CS21 – PLUG VALVE, CLASS 300, CAST CARBON STEEL BODY, U/L APPROVED**

1/2" thru 12": Class 300 "U/L Approved" PTFE Sleeved Plug Valve - Flanged - Cast Carbon Steel body and Type 316 stainless steel plug, fire safe design, raised face flanged ends, flexible-graphite stem seal, enclosed top seal, grounding device (plug-to-stem-to-body), faced and drilled to Class 300 ASME/ANSI B16.5, face-to-face dimension shall conform to ASME/ANSI B16.10. Material for body shall be carbon steel confirming to ASTM A216 Grade WCB. Material for plug shall be Type 316 stainless steel conforming to ASTM A351, Grade CF8M. Valves 1/2 inch thru 3 inches shall be equipped with a pad-lockable wrench operator, valves 4 inches and larger shall be equipped with a pad-lockable enclosed gear operator. The valves shall have Underwriters' Laboratories approval for gas service.

End of Section 400515.PL03CS21