SECTION 13 1401 – WATER FEATURE PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Furnishing and installing PVC pipe and tubing
 - 2. Furnishing and installing PVC pipe joints and fittings
 - 3. Furnishing and installing HDPE pipe and tubing
 - 4. Furnishing and installing HDPE pipe joints and fittings
 - 5. Furnishing and installing Above Grade Copper Pipe and Fittings
 - 6. Furnishing and installing flexible HDPE pipe supports
 - 7. Furnishing and installing anchoring structures for HDPE pipe
- B. Related Sections:
 - 1. SECTION 13 1106 WATER FEATURE TRENCHING
 - 2. SECTION 13 1107 WATER FEATURE BACKFILLING
 - 3. SECTION 13 1402 WATER FEATURE PIPE TESTING AND CLEANING
 - 4. SECTION 13 1403 WATER FEATURE PIPE HANGERS, SUPPORTS, AND ANCHORS
 - 5. SECTION 13 1404 WATER FEATURE WHITE GOODS
 - 6. SECTION 13 1501 WATER FEATURE MECHANICAL IDENTIFICATION
 - 7. SECTION 13 1502 WATER FEATURE PUMPS AND MOTORS
 - 8. SECTION 13 1503 WATER FEATURE FILTERS
 - 9. SECTION 13 1504 WATER FEATURE CHEMICAL FEED SYSTEMS
 - 10. SECTION 13 1505 WATER FEATURE OZONE GENERATION AND INJECTION
 - 11. SECTION 13 1507 WATER FEATURE HEATERS
 - 12. SECTION 13 1511 WATER FEATURE VALVES, GAUGES, AND METERS
- C. References:
 - 1. ASME B16.18 CAST COPPER ALLOY SOLDER JOINTS
 - 2. ASTM B88 STANDARD SPECIFICATION FOR SEAMLESS COPPER WATER TUBING
 - 3. ASTM D1248 STANDARD SPECIFICATION FOR POLYETHYLENE MOLDING AND EXTRUSION MATERIALS
 - 4. ASTM D1785 STANDARD SPECIFICATION FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPE, SCHEDULES 40, 80 AND 120
 - 5. ASTM D2464 STANDARD SPECIFICATION FOR THREADED POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPE FITTINGS, SCHEDULE 80
 - 6. ASTM D2466 STANDARD SPECIFICATION FOR POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPE FITTINGS, SCHEDULE 40
 - 7. ASTM D2467 STANDARD SPECIFICATION FOR SOCKET-TYPE POLY (VINYL CHLORIDE) (PVC) PLASTIC PIPE FITTINGS, SCHEDULE 80
 - 8. ASTM D2564 STANDARD SPECIFICATION SOLVENT CEMENT FOR POLY (VINYL CHLORIDE) PVC PIPE AND FITTINGS
 - 9. ASTM D2657 STANDARD PRACTICE FOR HEAT FUSION JOINING OF POLYOLEFIN PIPE AND FITTINGS
 - 10. ASTM D2683 STANDARD SPECIFICATION SOCKET-TYPE POLYETHYLENE FITTINGS FOR OUTSIDE DIAMETER-CONTROLLED POLYETHYLENE PIPE AND TUBING
 - 11. ASTM D2774 STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PRESSURE PIPING
 - 12. ASTM D2837 STANDARD TESTING METHOD FOR OBTAINING HYDROSTATIC DESIGN BASIS FOR THERMOPLASTIC PIPE MATERIALS

- 13. ASTM D2855 STANDARD PRACTICE FOR MAKING SOLVENT-CEMENTED JOINTS WITH POLY (VINYL CHLORIDE) (PVC) PIPE AND FITTINGS
- 14. ASTM D3035 STANDARD SPECIFICATION FOR POLYETHYLENE (PE) PLASTIC PIPE (DR-PR) BASED ON CONTROLLED OUTSIDE DIAMETER
- 15. ASTM D3261 STANDARD SPECIFICATION FOR BUTT FUSION POLYETHYLENE (PE) PLASTIC FITTINGS OR POLYETHYLENE (PE) PLASTIC PIPE AND TUBING
- 16. ASTM D3350 STANDARD SPECIFICATION FOR POLYETHYLENE PLASTICS PIPE AND FITTINGS MATERIALS
- 17. ASTM F412 STANDARD TERMINOLOGY RELATING TO PLASTIC PIPING SYSTEMS
- 18. ASTM F905 STANDARD PRACTICE FOR QUALIFICATION OF POLYETHYLENE SADDLE-FUSION JOINTS
- 19. ASTM F1056 STANDARD SPECIFICATION FOR SOCKET FUSION TOOLS FOR USE IN SOCKET FUSION JOINTING POLYETHYLENE PIPE OR TUBING AND FITTINGS
- 20. AWWA C207 STEEL PIPE FLANGES FOR WATERWORKS SERVICE SIZES 4 INCH THROUGH 144 INCHES
- 21. AWWA C508 AWWA STANDARDS FOR SWING-CHECK VALVE FOR WATERWORKS SERVICE 2 INCHES THROUGH 24 INCHES NPS
- 22. AWWA C509 AWWA STANDARD FOR RESILIENT SEATED GATE VALVES FOR WATER AND SEWER WORKS
- 23. AWWA C901 STANDARD FOR POLYETHYLENE (PE) PRESSURE PIPE AND TUBING, ½ INCH THROUGH 3-INCH, FOR WATER SERVICE
- 24. AWWA C906 STANDARD FOR POLYETHYLENE (PE) PRESSURE PIPE AND FITTINGS, 4 INCH THROUGH 63-INCH
- 25. PPI TR-4 HYDROSTATIC DESIGN BASES, PRESSURE DESIGN BASES, AND MINIMUM REQUIRED STRENGTH RATINGS FOR THERMOPLASTIC PIPING MATERIALS OR PIPE

1.2 SUBMITTALS FOR REVIEW

- A. SECTION 01 3300 SUBMITTAL PROCEDURES
- B. Product Data: Submit manufacturer's literature including printed recommendations, compliance with Standards and Testing agencies, dimensions and sizes for all piping material, and fittings.
 - 1. Indicate on submittal which materials, models, data, ratings, and options are being selected
- C. Project Record Documents: The Contractor shall record actual horizontal and vertical locations of pipes, fittings, valves, and accessories for all site piping.
 - 1. As-built information shall be given to the owner
 - 2. Information format shall be specified by the owner.

1.3 MATERIALS HANDLING

- A. Upon receiving of shipments, the Contractor shall check to ensure that the correct products and quantities have been delivered. The receiver shall have a procedure for reconciling any shipping discrepancies
- B. Shipment shall be inspected for cuts, abrasions, scrapes, gouges, tears, and punctures
- C. Unloading of shipments shall be done in accordance with manufacturer's recommendations
- D. Pipes shall not be rolled or pushed off the delivery truck
- E. All fabricated parts or fittings shall not be pushed or dumped off or dropped off the delivery truck
- F. Wire rope slings and chains shall not be permitted to move pipe or fittings
- G. Small diameter pipe shall not be stored inside of larger diameter pipe
- H. Storage facility shall be clear of debris

- I. Stacking and storage of pipe and fitting shall conform to manufacturer's recommendations
- J. Non-UV protected components shall not remain in unprotected outdoor storage for more than two (2) years
- K. Pipe shipped by trucking shall have the first third of the load covered with tarpaulins to ensure against diesel smoke contamination
- PART 2 PRODUCTS
- 2.1 POLYVINYL CHLORIDE (PVC) PIPING
 - A. Approved Manufacturers and Suppliers
 - 1. Georg Fischer Harvel
 - 2. JM Eagle
 - 3. Pacific Plastics Incorporated
 - 4. North American Pipe Corporation
 - 5. Approved Equal
 - B. Buried Unplastisized Polyvinyl Chloride (uPVC) Pressure Pipe:
 - 1. To comply with ASTM D1785, Schedule 40
 - 2. If buried depth of pipe exceeds manufacturers recommended loading, Schedule 80 Pipe will be used
 - 3. Schedule 80 pipe will be used for all sleeves
 - C. Above Grade Unplastisized Polyvinyl Chloride (uPVC) Pressure Pipe:
 - 1. To comply with ASTM D1785, Schedule 80
 - 2. Light gray in color
 - D. Screwed and Socketed PVC Pipe:
 - 1. To comply with ASTM D2464
- 2.2 POLYVINYL CHLORIDE (PVC) FITTINGS AND JOINTS
 - A. Approved Manufacturers and Suppliers
 - 1. Spears Manufacturing
 - 2. LASCO Fittings
 - 3. JM Eagle
 - 4. Naco Industries
 - 5. Approved Equal
 - B. Buried Unplastisized Polyvinyl Chloride (uPVC) Fittings:
 - 1. To comply with ASTM D2466 or ASTM D2467
 - 2. Flanged or solvent weld. No "slip type" or "push on type" gasket joints will be permitted
 - 3. Gasket Material for flanged couplings to be composed of Viton®, EPDM, or Teflon® (PTFE)
 - 4. Solvent Cement to comply with ASTM D2564
 - C. Above Grade Unplastisized Polyvinyl Chloride (uPVC) Fittings:
 - 1. To comply with ASTM D2467
 - 2. Flanged or solvent weld. No "slip type" or "push on type" gasket joints will be permitted
 - 3. Gasket Material for flanged couplings to be composed of Viton®, EPDM, or Teflon® (PTFE)
 - 4. Solvent Cement to comply with ASTM D2564
 - 5. All PVC pipe exposed to sunlight shall be coated to resist deterioration due to ultraviolet radiation
 - 6. Color to match above grade piping, light gray

- D. Screwed and Socketed PVC Fittings:
 - 1. To comply with ASTM D2464
- E. Flanges:
 - 1. Dimensions and drilling to comply with ANSI Standards
 - 2. Rated as 250 lbs. (113.5 kg) flanges
 - 3. Gasket Material for flanged couplings to be composed of Viton®, EPDM, or Teflon® (PTFE)
 - 4. Back-up rings, bolts, washers, nuts, and threaded studs shall be 316L Stainless Steel

2.3 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- Α. Approved Manufacturers and Suppliers
 - **ISCO** Industries 1.
 - 2. JM Eagle
 - 3. **US Plastic Corporation**
 - 4. Approved Equal
- Β. Polyethylene Tubing
 - 1. To comply with ASTM D1248
 - 2. Tubing to be black in color
- C. **Buried HDPE Pressure Pipe:**
 - 1. To comply with ASTM D2774
 - 2. Pressure Rating of 130 psi (896 kPa) – Schedule DR 13.5
 - 3. If buried depth of pipe exceeds manufacturer's recommended loading a higher pressure rated pipe shall be used
 - Schedule DR7.3 pipe shall be used for all sleeves 4.
- D. Above Grade HDPE Pressure Pipe:
 - 1. To comply with ASTM D2774
 - 2. Pressure Rating of 200 psi (1,379 kPa) - Schedule DR 9.0
 - 3. Black in color with 2-3% carbon black in the material
- E. Polyethylene Tubing
 - 1. To comply with ASTM D1248
 - 2. Tubing to be black in color
- 2.4 HIGH DENSITY POLYETHYLENE (HDPE) FITTINGS
 - A. Acceptable Manufacturers and Suppliers
 - 1. **ISCO** Industries
 - 2. **US Plastic Corporation**
 - 3. Approved Equal
 - Β. **Buried HDPE Fittings:**

2.

- 1. To comply with ASTM 3261 Flanged or Butt Fused
- 3. Gasket Material for flanged couplings to be composed of Viton®, EPDM, or Teflon® (PTFE)
- 2.5 COPPER PIPE AND FITTING
 - Α. Approved Manufacturers and Suppliers
 - 1. **Mueller Industries**
 - 2. NIBCO

- B. Above Grade Copper Pipe
 - 1. To comply with ASTM B88
 - 2. Type L, Hard Drawn
 - 3. Solder: ASTM B32, Grade 95TA
- C. Above Grade Copper Fittings:
 - 1. To comply with ASME B16.18 or ASME B16.22

PART 3 - EXECUTION

3.1 GENERAL

- A. All pipe installation shall be in strict accordance with the instruction and recommendations provided by the pipe manufacturer.
- B. Size of any section of pipe for which size is not indicated or any intermediate section erroneously shown undersized shall be the same size as the largest pipe connecting to it.
- C. Pipe sizes shown on the Contract Documents are nominal.
- D. Design Velocities in pipe shall not exceed 5.5 feet per second (1.7 m/s).
- E. All Pipe used to transport water that will encounter the general population shall be NSF 50 Approved for potable water use.
- F. Pipe shall have a print line every 2-feet (0.6m) stating the manufacturer, product, trade name, material, size, and dimension ratio, manufacturing standard, production lot code, and date of manufacturing.
- G. Fitting shall be individually marked with the following information: description, material, manufacturing standard, and production lot number.

3.2 PREPARATION

- A. Hot dip galvanize all items that are not factory furnished or 316L Stainless Steel.
- B. Determine depth, size, and alignment of existing utilities before beginning excavation.
- C. Use only tools and components required to construct and installed joints in accordance with the manufacturer's recommendations.
- D. All field connection methods and procedures required that the component ends to be free of surface defects before the connection is made.
- E. Heat Fusion of HDPE Pipe Preparation
 - 1. During inclement weather, a temporary shelter shall be set up over the joining operation to shield operations from rain, frozen precipitation, and cold winds.
 - 2. Entirely review the specific procedures outlined by manufacturer for performing heat fusion joints.

3.3 PVC PIPE INSTALLATION

- A. Below Grade Piping (Site Piping)
 - 1. Obtain written approval from governing Municipality prior to connecting to main lines. Connect to main lines as indicated on the Contract Documents and as approved by governing Municipality.
 - 2. Verify dimensions and elevations of main lines are as indicated on the Contract Documents. Immediately notify Owner/Engineer of any discrepancies or conflicts.
 - 3. Make connections to main lines and visually inspect for leakage with line under pressure prior to backfilling.

- 4. Install pipe to indicated elevation to within tolerance of 5/8-inch (15mm). Avoid installing pipe with high and low points. Install air/vacuum valves at all high points.
- 5. Exercise due care to avoid deposit of excavation material and other foreign substance in interior of pipe. Remove foreign material from pipe before proceeding with the Work. Plug pipe during work stoppages to prevent debris from entering pipes.
- 6. Place a minimum of 4-inch (0.1m) deep bed of approved bedding material.
- 7. Where two or more pipes are placed side by side in the same trench maintain clear spacing between pipes to all for hand operated mechanical compaction equipment or 12-inches (0.3m) whichever is greater.
- 8. Joint deflection greater than two (2) degrees will not be allowed.
- 9. PVC pipe saddles shall be secured to the pipe with two (2) 316L Stainless Steel pipe clamps and both saddle and straps shall be wrapped in a fiberglass liner.
- 10. Where pipes extend under footings run pipe in Schedule 80 pipe sleeves. Sleeves shall be next larger pipe size and extend 10-feet (3m) beyond front and back face of footing
- 11. Repair broken small diameter pipes with glued couplings, large diameter pipes with flexible repair couplings.
- 12. Install liner boots and provide watertight joints between liner and liner boot at all pipe penetrations.
- 13. Install link seal through all wall penetrations that have dry conditions on both sides of the wall.
- 14. Install water stop flanges at all wall penetration that have wet conditions on either side of the wall.
- 15. Welded (glued) buried pipe does not require thrust blocks, except at locations shown on the Contract Documents and immediately after flexible couplings.
- B. Above Grade Piping
 - 1. Locate equipment in location shown on the Contract Documents. Position or rotate equipment to result in good appearance and easy access to all components for maintenance and repairs prior to installing piping.
 - 2. Install, level, and secure equipment. Provide shims, anchors, support straps, angles, grouted bases, or other items as required to accomplish proper installation.
 - 3. Install flanges on pipe larger than 3-inches (80mm) wherever connections are made to pumps, valves, strainers, and other equipment to facilitate removal for servicing. For pipes smaller than 3-inches (80mm) use union connections.
 - 4. Install piping, flues, breaching ducts, and supports so they do not interfere with equipment access.
 - 5. Change pipe size within three pipe diameters of final connection to pumps, filters, and other equipment where it is necessary to reduce pipe size.
 - 6. Cut pipe accurately to job measurements within plus or minus 1/4-inch (6mm) and install without springing or forcing, true to line and grade, generally square with building and structures.
 - 7. Adequately support pipe, fittings, and accessories to prevent undue stress and to comply with SECTION 13 1403.
 - 8. Arrange pipe and hangers to allow for expansion, contraction, and structural settlement
 - 9. Make changes of direction with manufactured fittings.
 - 10. Street elbows, bushings, reducing flanges, close nipples, or bending pipe will not be allowed
 - 11. Pipe shall not contact structure except at penetrations shown on the Contract Documents.
 - 12. Run pipe full size through shutoff valves, balance valves, and control valves unless otherwise noted on the Contract Documents.
 - 13. Seal pipes penetrating and existing wall through core drilled holes with "Link Seal" type expansion seals.
 - 14. Seal pipes penetrating new walls under construction through a PVC sleeve with water stop flange and a Link Seal placed between pipe and approved sleeve.

- 15. Provide dielectric connections between copper and dissimilar metals Install connections in vertical sections of piping only.
- 16. The Contractor shall coordinate pipe routing with electrical duct banks and heating/ventilation duct work.
- 17. All pipes that are installed above grade and outdoors shall have a heavy coat of light color latex base paint that is chemically compatible with PVC pipe and fittings. Compatibility should be confirmed by paint manufacturer.
- C. Joints and Solvent Welds
 - 1. Install above grade, below grade, buried, and imbedded PVC piping using solvent weld fittings in accordance with ASTM D2564, ASTM 2774, and ASTM D2855.
 - 2. Remove any burrs and chamber pipe ends after cutting then prepare each fitting and pipe end with solvent primer.
 - 3. Join each fitting individually and allow enough time for the joint to seal solidly before assembly of adjacent joints.
 - 4. After joining, an even ring of primer shall be visible around entire fitting.
 - 5. If fittings are installed without visible primer, fitting shall be removed and discarded and piping re-cut, rechambered, and joint made up again using a new fitting.

3.4 HDPE PIPE INSTALLATION

- A. Below Grade Piping (Site Piping)
 - 1. Obtain written approval from governing Municipality prior to connecting to main lines. Connect to main lines as indicated on the Contract Documents and as approved by governing Municipality.
 - 2. Verify dimensions and elevations of main lines are as indicated on the Contract Documents. Immediately notify Owner/Engineer of any discrepancies or conflicts.
 - 3. Make connections to main lines and visually inspect for leakage with line under pressure prior to backfilling.
 - 4. Install pipe to indicated elevation to within tolerance of 5/8-inch (15mm). Avoid installing pipe with high and low points. Install air/vacuum valves at all high points.
 - 5. Exercise due care to avoid deposit of excavation material and other foreign substance in interior of pipe. Remove foreign material from pipe before proceeding with the Work. Plug pipe during work stoppages to prevent debris from entering pipes.
 - 6. Place a minimum of 4-inch (0.1m) deep bed of approved bedding material.
 - 7. Where two or more pipes are placed side by side in the same trench maintain clear spacing between pipes to all for hand operated mechanical compaction equipment or 12-inches (0.3m) whichever is greater.
 - 8. Pipes shall not be dumped, dropped, pushed, or rolled into the trench.
 - 9. Wire rope slings and chains shall not be permitted to lower pipe or fittings into trench.
 - 10. Cold or "Field" bending of pipe shall only be done in accordance with the manufacturer's recommendations for the pipe diameter and dimension ratio.
 - 11. Large diameter fabricated fittings (16-inch (400mm) and larger) shall not be joined to more than one pipe before placement in the trench.
 - 12. Where pipe extend under footings, run pipe in DR 7.3 pipe sleeves. Sleeves shall be next larger pipe size whose inside diameter will accommodate the outside diameter of the pipe being sleeved. Sleeves shall extend 10-feet (3m) beyond front and back face of footing.
 - 13. Install liner boots and provide watertight joints between liner and liner boot at all pipe penetrations.
 - 14. Install link seal through all wall penetrations that have dry conditions on both sides of the wall.
 - 15. Install water stop flanges at all wall penetrations that have wet conditions on either side of the wall.

- 16. Buried HDPE Pipe require thrust blocks at locations shown on the Contract Documents and directly after flexible couplings.
- 17. Fitting breakage due to unusual stresses during installation shall be replaced at the Contractor's expense.
- 18. HDPE pipe that enters or exits a structure shall be wrapped in an elastomeric material, and then the annulus between the pipe and the casing shall be sealed with an appropriately sized link seal.
- 19. HDPE pipe that is flanged before entering a structure shall require a structural support to prevent shear and bending loads as shown on the Contract Documents. The pipe shall be protected from chaffing by wrapping with an elastomeric sheet.
- 20. HDPE pipe or fittings that are jointed to valves, hydrants, or other heavy device shall require a support pad as shown on the Contract Documents.
- 21. Locating wire shall be 12 AWG (2mm) copper wire placed in the trench above the pipe but not touching the HDPE pipe.
- 22. Stabilizing Agents that generate temperature more than 200 °F (93 °C) shall not be used in conjunction with HDPE pipe.
- B. Above Grade Piping
 - 1. Locate equipment in location shown on the Contract Documents. Position or rotate equipment to result in good appearance and easy access to all components for maintenance and repairs prior to installing piping.
 - 2. Install, level, and secure equipment. Provide shims, anchors, support straps, angles, grouted bases, or other items as required to accomplish proper installation.
 - 3. Install flanges on pipe larger than 3-inches (80mm) wherever connections are made to pumps, valves, strainers, and other equipment to facilitate removal for servicing. For pipes smaller than 3-inches (80mm) use union connections.
 - 4. Install piping, flues, breaching ducts, and supports so they do not interfere with equipment access.
 - 5. Change pipe size within three pipe diameters of final connection to pumps, filters, and other equipment where it is necessary to reduce pipe size.
 - 6. Cut pipe accurately to job measurements within plus or minus 1/4-inch (6mm) and install without springing or forcing, true to line and grade, generally square with building and structures
 - 7. Adequately support pipe, fittings, and accessories to prevent undue stress and to comply with SECTION 13 1403.
 - 8. Arrange pipe and hangers to allow for expansion, contraction, and structural settlement
 - 9. Make changes of direction with manufactured fittings.
 - 10. Pipe shall not contact structure except at penetrations shown on the Contract Documents.
 - 11. Run pipe full size through shutoff valves, balance valves, and control valves unless otherwise noted on the Contract Documents.
 - 12. Seal pipes penetrating and existing wall through core drilled holes with "Link Seal" type expansion seals.
 - 13. Seal pipes penetrating new walls under construction through a PVC sleeve with water stop flange and a Link Seal placed between pipe and approved sleeve.
 - 14. Provide dielectric connections between copper and dissimilar metals Install connections in vertical sections of piping only.
 - 15. The Contractor shall coordinate pipe routing with electrical duct banks and heating/ventilation duct work.
- C. Joining and Connections
 - 1. Connection design limitations and manufacturer's joining procedures shall be observed throughout construction.
 - 2. All field connection methods and procedures require that the component ends shall be clean, dry, and free of detrimental surface defects before the connection is made.

- 3. Cleaning: General dust and light soil shall be removed with clean, dry, lint free cloths. Heavier soil may be washed off with mild soap and water followed by a through rinsing with clean water and drying with a dry, clean, lint free cloth. Chemical cleaning solvents shall not be used.
- 4. Cutting: HDPE pipe shall be cut with approved equipment and methods to ensure square-cut ends.
 - a. Small diameter pipe (4-inches (100mm) and smaller) shall be cut with guillotine shears, run-around cutters, or small manual saws.
 - b. Large diameter pipe shall be cut with handsaws and chainsaws. Chainsaws shall be operated without chain lubrication.
 - c. Chips from saws shall be removed from pipe bore.
 - d. De-burr pipe ends.
 - e. Branch outlet holes shall be cut with hole saws specified by the pipe manufacturer to ensure adequate chip clearance, saw depth, and an inside relief to retain the couplings.
 - f. Hole saws shall be withdrawn frequently to clear chips.
 - g. Power hole saws shall be operated at low speeds to avoid overheating and melting pipe material.
- 5. Heat Fusion Joining:
 - a. Open flame shall not be used for heating pipe ends.
 - b. HDPE products that have permeated with hydrocarbons shall not be heat fused.
 - c. Faulty Fusions:
 - i. Socket or butt fusions shall be removed and redone.
 - ii. Heat Fusion joints cannot be repaired and shall be removed.
 - iii. Socket and saddle fusion fittings cannot be reused.
 - d. Socket fused pipe or tubing shall be manufactured to Outside Diameter controlled pipe or tubing specifications.
 - e. Saddle fusion processes shall be applied to pipe sizes and pressure ratings as dictated by the pipe manufacturer, and only with approved equipment to perform sizes required.
 - f. Molded butt fusion fittings and fabricated fittings are acceptable for use.
 - g. When installing Polyethylene (PE) pipe in a butt fusion machine, do not bend the pipe against and open fusion machine collets or clamp.
 - h. Bead removal of butt fusion is not required. If bead removal is necessary, the pump must be cooled to ambient temperature and the bead shall only be removed down to the pipe's surface.
 - i. Electro-fusion shall be used to repair damaged sections of pipe or tie-in joints in the trench.
- 6. Flanged Connections
 - a. All flange connections shall have back-up flanges.
 - b. Back-up flanges shall be 316L Stainless Steel.
 - c. One edge of back-up ring bore shall be chamfered. This edge fits against the back of the sealing flange.
 - d. Back-up rings shall be fitted to flange adapter before fusion to pipe.
 - e. Gasket Material for flanged couplings to be composed of Viton®, EPDM, or Teflon® (PTFE).
 - f. Gasket material shall be between 1/8 3/16-inch (3.2 4.8mm) thick.
 - g. Stub end flanges are not permitted.
 - h. Full face gaskets shall be used on larger pipes (greater than 12-inch (0.3m)). Drop-in gasket shall be used on smaller pipe sizes.
 - i. Back-up ring dimensions and drilling shall comply with ANSI standards.

- j. Bolting materials shall be of 316L Stainless Steel. Flange bolts are 1/8-inch (3mm) smaller than the bolt hole diameters on the back-up ring. Flat washers of 316L stainless steel shall be used between the nut and the back-up ring.
- k. Full face HDPE flanges without back-up rings are not acceptable.
- I. Mating flanges shall be aligned together before tightening.
- m. Flange connections shall be properly supported to avoid bending stresses.
 - i. Below grade flanges shall require a support foundation of compacted, stable, granular fill, or compacted cement stabilized granular backfill, or reinforced concrete.
 - ii. Flanged connections adjacent to pipes passing through structural walls must be structurally supported to avoid shear loads as indicated on the Contract Documents.
 - iii. Above grade flanges shall be supported on rigid structures that are designed to withstand flexing due to thermal changes and ensure that the flange does not become anchored in soil.
- n. Prior to fit-up, lubricate flange bolt threads, washers, and nuts, with non-fluid lubricant
- o. Gasket and flange sealing surfaces must be clean and free of significant cuts or gouges
- p. Fit flange components together loosely. Tighten bolts by hand and re-check alignment. Adjust alignment, as necessary.
- q. Tighten bolts in sequence determined by manufacturer to 5 ft-lbs (6.8 N-m) torque to establish a sealing surface.
- r. Once the sealing surface has been established, continue tightening bolts in the recommended sequence in 15 ft-lbs (20 N-m) torque or less. Tighten completely through the sequence before changing to higher torque.
- s. Do not exceed maximum recommended bolt tightening torque values as established by the manufacturer.
- t. Once recommended torque values are reached wait at least one (1) hour and retighten bolts for final value the first time. Retighten bolts in same sequence as outlined before
- u. Do not exceed 15 ft-lbs (20 N-m) torque in any sequence.
- v. When connecting HDPE Pipe to cast iron tighten torque increments should not exceed 10 ft-lbs (13 N-m).
- w. When connecting flanges to butterfly valves, the Installer shall use tubular spacers to ensure that the valve disc clears the inside diameter of the HDPE pipe. Bolt lengths shall be increased to meet spacer requirements.
- 7. Mechanical Joints
 - a. Only fully restrained joints shall be approved for use on pressure lines.
 - b. Fully restrained joints shall include insert stiffeners and exterior mechanical coupling. Materials of mechanical joints shall be approved by the Design Engineer before installation.
 - c. Partially restrained joints and unrestrained joints are only appropriate on non-pressure pipe systems and must be approved for use by the Design Engineer before installation.
- 8. Other Joining Techniques
 - a. Pipe Treads: Pipe threads shall not be used to join HDPE pipe.
 - b. Extrusion Welding shall not be used on pressure pipe systems.
 - c. Hot Gas Welding shall not be used to join HDPE pipe.
- 9. Branch Connections
 - a. Tees in main line sizes larger than 16-inches (0.4m) shall be flanged on two of the three connections.
 - b. Mechanical saddles or branch fittings that clamp around the main and seal with gaskets shall not be installed without the specific consent of the Design Engineer.

- c. Service Saddles shall be secured with wide band straps, and double band straps designs. U-bolt type service saddles shall not be accepted.
- D. Flexible Supports and Expansion Loops
 - 1. Above Grade Supports
 - a. HDPE pipe supports shall accommodate thermal expansion and contraction, limit vertical deflection and comply with manufacturer's guidelines for size and pressure rating of pipe.
 - b. Support for HDPE pipe shall cradle at least 120 degrees of the pipe and be at least on half pipe diameter wide.
 - c. Edges of cradle shall be rounded or rolled to prevent cutting into pipe.
 - d. Use of U-bolt, narrow strap-type hanger, and roller type supports are unacceptable.
 - e. Long term deflection of pipe between hangers shall not exceed 1-inch (25mm).
 - f. Use of pipe racks for support shall be of sufficient width to accommodate expansion and contraction of pipe.
 - g. Centered anchored pipe shall be allowed to pivot at the anchor point.
 - h. Expansion joints are not recommended.
 - i. An initial deflection shall be provided so HDPE pipe does not contract to a straight line.
 - j. Fittings shall be protected from flexing due to expansion or contraction of piping system.
 - k. Fittings and flanges shall be supported on sleepers to ensure that fittings will not become anchored in soil.
 - 2. Below Grade Pipe Supports
 - a. HDPE pipe shall be placed in trench by "snaking" pipe in the trench to allow for expansion and contraction.
 - b. Expected temperature changes in buried pipe shall be addressed with thrust blocks as suggested by the manufacturer.
 - c. When HDPE pipe is connected to bell and spigot joined pressure systems, the two bell and spigot joints closest to the connection shall be restrained.
 - 3. Anchoring Structures
 - a. All HDPE pipe installed underwater or below the ground water line shall be checked for the need of anchoring by the Contractor.
 - b. Ballast Design for HDPE pipe shall conform to manufacturer's recommendations and include the following:
 - i. Submergence weights shall be made of reinforced concrete and formed in two or more sections that clamp around the pipe leaving a clearance between the sections.
 - ii. An elastomeric padding material shall be used between the submergence weights and the pipe.
 - iii. Submergence weights shall be sized such that bottom sections are generally 50-percent heavier thank the top sections.
 - iv. All fasteners that connect the submergence weights shall be rated for marine use.
- 3.5 INSPECTION AND TESTING FOR HDPE PIPE
 - A. Please refer to SECTION 13 1402 WATER FEATURE PIPE TESTING AND CLEANING
 - B. Butt Fusion Joint Quality
 - 1. Visually inspect all butt fusion joints of both pipe and fitting connections.
 - a. The double bead width should be approximately 2 to 2.5 times the height from the pipe surface.
 - b. Both beads should be uniform in size and shape all around the joint.

- c. The depth of the V-Groove between the two beads shall not be more than half of the bead height.
- 2. Destructive Testing
 - a. The first butt fusion of an individual fusion machine shall be destructively tested each day.
 - b. A bent strap specimen is prepared by making a trial butt fusion and allowing it to cool to ambient temperature.
 - c. The test strap shall be at least 6-inches (0.15m) of 15 pipe wall thickness long on each side of the fusion joint.
 - d. The test strap shall be at least 1-inch (25mm) or 1.5 pipe wall thickness wide.
 - e. Bend the strap until ends of the test strap touch. Any disbondment at the fusion joint is unacceptable and indicates that the fusion procedure and/or machine set-up needs to be changed.
 - f. Field fusion shall not proceed until a test joint has passed the bent strap test.
 - g. Precautions shall be taken to ensure that personnel safety is maintained while performing the bent strap test.
- 3. Surface Damage
 - a. Butt fusion misalignment shall not exceed 10-percent the minimum wall thickness for a given pipe size.
 - b. Surface gouges shall not exceed 10-percent of the minimum wall thickness for a given pipe size.
 - c. Deep, sharp notches shall be dressed smooth to reduce chance of crack propagations.
 - d. Minor abrasions from sliding pipe shall not be of a concern.

END OF SECTION