

CONSTRUCTION STANDARD SPECIFICATION

SECTION 02553

EXTERIOR GAS PIPING SYSTEMS

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CONSTRUCTION STANDARD SPECIFICATION

SECTION 02553

EXTERIOR GAS PIPING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section shall apply to the materials and operations required for the installation of underground exterior gas distribution systems, including all piping, fittings, installation, joints, location devices, service risers, and tests.
- B. Related Sections: Refer to Section 02200, "Earthwork" for related work.

1.02 SUBMITTALS

- A. General: Submit the following items in accordance with the Conditions of Contract and Section 01330, "Submittal Procedures."
 - B. Product Data: Submit product data for the following materials and items
 - 1. Pipe
 - 2. Fittings
 - 3. Valves
 - 4. Valve boxes
 - 5. Test Boxes and markers
 - 6. Risers
 - 7. Transition fittings.
 - C. Installation Instructions: Submit installation instructions for the following materials and items
 - 1. Pipe
 - 2. Risers

1.03 QUALITY ASSURANCE

The materials and practices comprising the work shall conform to this and other referenced standard specifications. Where this specification conflicts with the requirements of another referenced specification or manufacturer's recommendation, the more stringent shall prevail.

PART 2 - PRODUCTS

2.01 PIPE

The underground gas distribution system shall be all polyethylene plastic pipe PE 3406, or PE 3408, SDR 11 IPS, (Performance Pipe CPCC8100 or approved equal) unless otherwise specified on the contract drawings. The polyethylene plastic pipe used shall conform with the latest American Society of Testing Materials (ASTM) D2513, publication of specifications for thermoplastic gas pressure pipe, tubing, fittings and the following ASTM minimum test requirements:

<u>Property</u>		<u>ASTM Test</u>
Density	gms/cc	D1505
Melt Flow (Condition F)	gms/10 min.	D1238
Environmental Stress Cracking Resistance (Condition C)	Hrs.	D1693
Tensile Strength, Ultimate	psi 2 in./min.	D638
Tensile Strength, Yield	psi 2 in./min.	D638
Elongation, %,	2 in./min.	D638
Impact Strength, ft. lbs./in. notch		
Specimen thickness	0.250 in. 0.125 in.	D256
Vicat Softening Temperature	deg. F.	D1525
Brittleness Temperature,	deg. F.	D746
Flexural Modulus,	psi	D3350
Modulus of Elasticity,	psi	D638
Hardness,	Shore D	D2240

Coefficient of Linear Thermal Expansion	in./in./deg. F.	
Molded Test Specimen Extruded Pipe		D696
Long-Term Strength,	psi @ 73.4 deg. F.	D2837
Cell Classification		D3350
PPI Material Destination		PE 3406 PE 3408

The pipe shall meet ASTM D3350 cell class PE 345564C. Minimum impact strength shall be 12 ft-lb/in. notch per ASTM D256, method A, 0.125" thick.

2.02 PIPE FITTINGS

- A. Heat fusion fittings shall conform to ASTM D2513 and be installed in accordance with article 3.01 of this specification and the manufacturer's recommendations. Electrofusion fittings shall be Kerotest, Central or approved equal.
- B. Mechanical joint fittings shall conform to ASTM D2513 and be installed as per manufacturer's recommendations.
- C. Valves shall be full-port polyethylene ball valve SDR 11, high density PE3408 body, with 2-inch operating square. Valves shall meet the requirements of American National Standards Institute (ANSI) B16.40, U.S. Department of Transportation (DOT) Title 49 Code of Federal Regulations (CFR) Part 192, and ASTM D2513. Valves shall be Nordstrom "Poly-Gas" valve, Kerotest, or approved equal. Where full-port valves are not available from the manufacturer, the next larger size valve shall be provided. Provide valves with manufacturer's extended stem or fabricate valve extension per Sandia National Laboratories (SNL) standard detail where valve wrench longer than 18-inches would otherwise be required to operate valve. Valves with exposed metal parts requiring cathodic protection or which require any maintenance or lubrication will not be allowed.
- D. Valve Boxes: Valve boxes shall be Tyler model 6860, cast iron shaft screw type, with lid marked "GAS", length to suit burial depth. Install per SNL standard detail.
- E. Test Boxes:
 - 1. Flush mount test boxes shall be Handley model T4H5C, 4" diameter, 18-inch long flared plastic body, cast iron lid with "TEST" cast in cover, heavy duty cast iron flange suitable for direct installation in asphalt, 5 terminals, vent hole in lid.

2. Raised type shall be Cott Manufacturing "Big Fink", number of terminal leads to suit, yellow polyethylene 3" diameter 5-foot long mounting conduit with "GAS" written on post.
- F. Risers shall be R.W. Lyall "Lyco" 90 degree Bend Rigid Anodeless risers or equal.
- G. Transition Fittings shall be R.W. Lyall "Lyco" with PE 3408 and ASTM A53 end connections, size and thickness to match connecting pipe sizes.

PART 3 - EXECUTION

3.01 PIPE

A. Trenching

1. Trench width: Width shall be wide enough to provide at least 6 inches clearance on both sides of the pipe. Trench width shall not exceed outside diameter of pipe plus 24 inches to an elevation 12 inches above the top of pipe.
2. Trench bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along the trench subgrade.
3. Burial Depth: Buried plastic piping shall be buried a minimum depth of 24 inches unless noted otherwise.

B. Plastic pipe shall not be subjected to unnecessary strains such as bending or twisting at any time and shall be handled with care as it is lowered into the ditch. The pipe shall be laid on the ditch bottom in such a manner as to snake the pipe from one side of the ditch to the other with one cycle approximately every 40 feet. The pipe shall be laid and continuously supported on undisturbed or well-compacted soil.

1. Underground Clearance: Each distribution line shall be installed with at least 12" of clearance from any other underground structure not associated with the distribution line. In addition, all plastic pipe and plastic service lines shall be installed with sufficient clearance, or shall be insulated, from any source of heat so as to prevent the heat from impairing the serviceability of the pipe.
2. Bends: The pipe may be bent or deflected no more than to the minimum radius recommended by the manufacturer. Bends shall be free of buckles, cracks, or other evidence of damage. Changes in direction, which cannot be made by bends, shall be made with elbow or tee fittings. Elbow or tee fittings shall not be trimmed to fit. Miter joints are not permitted.
3. Obstructions in the Pipe: The open ends of the pipeline shall be closed at all times, and shall not be reopened until such time as the next joint of pipe is to be connected. This closure shall be capable of preventing the entrance of small

animals or the introduction of foreign material (water included) of any nature into the line.

- a. After the pipe has been strung along the right-of-way, each length shall be swabbed prior to welding it into the pipeline. The swab shall be a soft cloth. Each length shall be visually inspected internally prior to use.
 - b. Care shall be exercised when joining the sections of pipe to minimize the possibilities of any foreign material being in the line after its completion. The Contractor shall remove any obstructions in the pipeline caused by foreign material.
 - c. After the pipeline, or measured portions thereof, is complete, the Contractor shall run a polyurethane pipeline pig through the line twice. Prior to the pigging operations, a pig catcher shall be installed to the end of the pipeline in a manner, which will prevent the pig from blowing off during the operation. The pigging operation shall provide for the controlled running of the pig. The pig shall be moved by air pressure only. The use of gas pressure in the pigging operation is prohibited.
- C. Backfill: In warm weather, backfilling shall be performed during the coolest part of the day whenever possible. Backfill material shall be soft dirt or sand free of stones or debris that may cut or otherwise damage the pipe. Clean backfill material shall surround the pipe for at least 4" or one pipe diameter (whichever is greater) in all directions. Backfill shall be placed level from one wall of the ditch to the other and shall not be mounded over the pipe.
1. Placing backfill in maximum of 8" lifts and compacting with the proper equipment shall perform tamping. The pipe shall not be damaged during compaction. When flooding of the ditch is used to consolidate backfill, the pipe shall not be allowed to float from its bearing on the ditch bottom. Compaction with heavy equipment is not permitted unless the pipe has 24" of cover and the pipe internal pressure exceeds 15 psig.
- D. Location Device: Install an electrically conductive 12 gauge copper wire with yellow insulation above the pipe. The tracer wire shall be installed at a distance of four to six inches above the pipe. The wire and all of its connections shall be insulated to prevent corrosion. The wire and locating tape shall be installed as shown on drawing details. The detectable warning tape shall have a foil core and shall be reinforced consisting of 5 mil total thickness.
- E. Tie-in to Other Lines: After lowering the pipe into the ditch and prior to joining installed sections or making tie-ins to other lines, sufficient time shall be allowed for contraction as the pipe assumes ground temperature. Tie-ins to existing lines shall be performed in an atmosphere absent of gas. Hot tie-ins shall be permitted only when using electrofusion-tapping tee after providing documentation of procedures to be used and obtaining written authorization from Sandia Delegated

Representative (SDR). Procedure shall be performed in the presence of SNL Utilities Maintenance personnel.

- F. Pipe Squeeze-Off: Shall be permitted only using squeeze tool meeting ASTM F1563 and following procedures meeting ASTM F1041. Contractor shall be allowed only to perform squeeze-off operation after providing documentation of procedures to be used and obtaining written authorization from SDR. Procedure shall be performed in the presence of SNL Utilities Maintenance personnel.
- G. Static Discharge Protection: Whenever performing work on or near gas lines that could potentially contain combustible gas contractor shall evaluate potential for static discharge. Work shall be permitted only after providing documentation of procedures to be used and obtaining written authorization from SDR. Procedure shall be performed in the presence of SNL Utilities Maintenance personnel.

3.02 JOINING OF POLYETHYLENE PLASTIC PIPE

- A. General: The Contractor's personnel who perform heat-fusion joining on distribution facilities shall be qualified by the pipe manufacturer's qualifying representative in accordance with article 3.02 E prior to starting any work. The Contractor may, at his option, submit a list of previously qualified candidates to the Sandia Delegated Representative (SDR) in lieu of retesting. The list shall include the date of qualification, and the name of the SDR that was present for the test.
- B. No heat-fusion joining shall be performed when the quality of the joining may be adversely affected by weather conditions. Rain, blowing sand, windstorms, and other inclement weather shall be cause for the SDR to cease welding operations. Windshields may be used during windy weather if approved by the SDR.
- C. Heat-Fusion Joints: heating the mating surfaces to their fusion temperature, compressing the mating surfaces together, and holding the mating surfaces together until the joint cools naturally make heat-fusion joints. Direct application of heat using a torch or other open flame is prohibited.
- D. Equipment and tools, which are manufactured specifically for the fusion process, shall be used. The equipment shall be designed to hold the heating element firmly against and parallel to the mating surfaces, compress the heated surfaces together and hold the surfaces firmly together in alignment until the joint cools naturally. The heating elements shall be the electric type, which are thermostatically controlled. The heating tools shall be capable of maintaining uniform surface temperature within the melt-temperature range specified by the material manufacturer. A crayon temperature indicator shall be used by the Contractor to verify that the heating element temperature is correct prior to making each joint. The temperature crayon mark shall not be applied to the part of the heater face that comes in direct contact with the pipe.

- E. Procedure (Butt-Fusion): The following procedure shall be used when joining pipe, elbows, tees, caps, reducers, and transition fittings:
1. Place pipe ends into alignment equipment. Square the end of each pipe section to be joined using the facing tool of the fusion machine. Remove cuttings and burrs from the pipe ends. Wipe each pipe end to remove dirt, water, grease, and other foreign material.
 2. Place pipe ends together and carefully check alignment of the pipe to ensure that the pipe ends meet squarely and completely over the entire surface to be joined. If they do not meet squarely and completely, reface and recheck.
 3. Insert the hot heating tool between the aligned pipe ends. Push the ends to be joined simultaneously against the heating tool with sufficient force to insure contact only. Hold in place until a bead of molten plastic rolls back from the heated ends. The bead shall be approximately 1/16" in size. During this step, the temperature of the heating tool shall be maintained at the temperature specified by the material manufacturer.
 4. Move the pipe ends away from the heating tool, remove the tool and bring the heated ends together immediately with firm pressure to form a uniform upset flash about 1/8" to 3/16" wide around the entire circumference of the pipe. Maintain this pressure for approximately 15 seconds. (If the pipe ends are pushed together with too much force, all molten material will be pushed out of the joint and cold material will make contact.) If the softened material sticks to the heating tool, discontinue the joint, clean the heating tool and start over with Step 3.02 C.1.
 5. Allow the joint to cool and solidify until the bead feels hard before removing the clamps or other aligning device. The joint shall not be subjected to external stresses until after cooling in ambient air for 5 minutes. Internal pressure shall not be applied until the joint and surrounding material has reached ambient temperature. If the butt joint is not satisfactorily completed, cut out the joint and start over with Step 3.02 C.1.
- F. Procedure (Sidewall Fusion): The following procedure shall be used when joining service tees and saddles to pipe:
1. The pipe shall be round and uniform in the area of fusion. If necessary, cold ring clamps shall be placed on each side of the fusion area.
 2. Remove the glossy coating of the pipe surface and the saddle face using emery cloth. Place saddle against pipe surface and check to see that the surfaces to be joined fit along the circumference of the pipe. If they do not fit, move to another location on the pipe surface and start over.

3. Insert the saddle-heating tool between the pipe surface and the saddle face. Push the surfaces to be joined simultaneously against the heating tool applying a strong firm continuous pressure. Hold this pressure until a completed melt bead can be seen on the pipe. Release strong pressure to a light pressure and continue the heat cycle until a melt bead of approximately 1/8" to 3/16" in size appears on the base of the fitting. During this step, the temperature of the heating tool shall be maintained at the temperature specified by the material manufacturer.
4. Remove saddle from heating tool and heating tool from the pipe surface. Inspect both heated areas for uniformity and for sufficient melt. If either melt pattern appears faulty, repeat Step 3.02 D.3. Bring melted surfaces together rapidly without slamming and apply continuous progressive pressure until proper bead is formed.
5. Allow the joint to cool and solidify until the bead feels hard. The joint shall not be subjected to external stresses until cooling 10 minutes in ambient temperature.

If for any reason the saddle joint is not satisfactorily completed, the section where the melt occurred shall be cut out and replaced with a new section.

G. Procedure (Electrofusion): The following procedure shall be used when joining electrofusion pipe fittings (elbows, tees, couplings, taps).

1. Prepare pipe surface and join piping using procedures and tools as prescribed by manufacturer of electrofusion fittings to be used.

H. Heat-Fusion Joining Qualifications:

1. Heat-Fusion: Heat-fusion joining shall be performed by persons who are familiar with the material manufacturer's recommended procedures and shall be qualified in accordance with the following applicable procedure(s).
2. Butt Fusion and Electrofusion:
 - a. Candidates for qualifications as butt-fusion joiner shall make the number of joints shown in the table below:

<u>Pipe Size</u>	<u>Number of Joints</u>
5/8" Tubing	3
1-1/4" - 2" Tubing	3
4" Pipe	3

- b. For ease in testing, the joints made shall be fabricated into the following test samples:

Pipe Size

Configuration

1-1/4" - 4" Pipe

A cap fused to a 24" section of pipe. The 24" section of pipe fused in a 12" section of pipe. A cap fused to the 12" section of pipe.

5/8" Tubing

A service tee fused to the 24" section of pipe. A 24" section of tubing fused on the service tee. A transition fitting fused to the 24" section of tubing.

3. Qualifying joints shall be made under field condition in the presence of the pipe manufacturer's qualifying representative and the SDR without any assistance or advice.
4. Upon completion of the heat-fusion joining process, the test sample(s) shall be allowed to remain undisturbed until the entire assembly has cooled to ambient temperature. Then the following physical test shall be imposed on the joints:
 - a. Each assembly shall be subjected to a 150-psig-air test for at least 2 hours.
 - b. Upon completion of the pressure test, one joint shall be selected from each diameter assembly for further testing. The selection shall be such that each joint represents the joining of different components; example, one joint can be pipe to pipe, another joint can be pipe to cap. Selection from the service assembly may be either between the tubing and transition fitting, or between the tubing and service tee.
 - c. The selected joints shall be removed from the assembly by cutting the pipe not more than 2" away from the joint. Each joint removed shall be cut axially to split the joint into 90-degree sections. These sections shall be trimmed circumferentially to a strip 1" in width. The 5/8" joint need not be trimmed.
 - d. The bonding strength of this joint shall then be tested by folding each strip at the joint and flattening it in a vise or other compression device. Each strip shall be folded and flattened in each direction. Separation at the joint will be considered failure.
5. The qualification test will be deemed successful and the candidate will be considered qualified if none of the heat-fusion joints fail any of the tests. If unsuccessful, the candidate may be allowed to repeat the test immediately, provided no more than one joint is found to be faulty. If more than one heat-fusion fails, further training will be required before the candidate can repeat the test.

- a. Upon completion of the test, the Contractor shall submit a list of qualified candidates to the SDR for permanent record.
 - b. Marking of Joints: Each person performing heat-fusion joining on a pipeline shall have a distinctive mark which shall be placed on the pipe with a felt-tip pen near each heat-fusion joint completed. The mark shall be that appearing on the Welder's Qualification Card. The color of the pen shall be such that the mark is distinguishable from the color of the pipe.
6. Heat-fusion joints (made by a trained and qualified technician): The SDR may select joints to be tested by destruction or by ultrasonic methods. Destructive tests shall be made by removal of the joint to be tested and replacing the removed section of pipe with a "pup" joint at least 3 feet long. Test specimens shall be cut and tested in accordance with article 3.02 E.
- a. Heat-fusion joints tested by ultrasonic methods shall be free of voids or any imperfection, which would impair the serviceability of the joint.

3.03 MATERIAL HANDLING AND DEFECTS

- A. When loading or unloading plastic pipe, the pipe shall be placed into the desired position without damage. The pipe shall not be allowed to drop freely from the truck bed to the ground. The pipe shall be strung onto terrain free from rocks or other projections, which might cause damage to the pipe. The pipe shall not be dragged over rocks or other abrasive material.
- B. Plastic pipe shall be protected from fire, excessive heat, or harmful chemicals. Cleaning solutions, detergents, solvents, alcohols, etc., shall not be allowed to contact the pipe.
- C. Inspection of Materials: The Contractor shall visually inspect each length of pipe and all components, both inside and out, at the site of installation to insure that it has not sustained damage that could impair its serviceability. A second surface inspection shall be made immediately prior to lowering the pipe into the ditch.
- D. Damage, Defects and Repairs: Any pipe which has cuts, gouges, scratches, or punctures greater than 10 percent of the pipe wall thickness or other damage or defects that would impair the serviceability of the pipe shall be repaired by removal of the defective section and replacement by a new section of pipe.

3.04 TEST REQUIREMENTS

- A. The Contractor in accordance with the following procedure shall test all new segments of line or an acceptable procedure submitted in writing by the Contractor and approved by the SDR. The SDR shall be notified prior to the start of each test.

B. Test Procedure:

- a. Dry air shall be the test media. The air used in testing shall be free of contaminants.
- b. The temperature of the plastic material shall not exceed 100 deg F due to the temperature of the compressed air or any other source.
- c. The minimum test pressure shall be 1.5 times the maximum operating pressure or 60 psig whichever is greater. The minimum test pressure shall be 3 psig. (Typical distribution pressure at SNL NM is 20 psig, so required test pressure for distribution system is typically 60 psig.)
- d. Tie-in joints, which are not included in the test, shall be soap-tested at the operating pressure. After the soap test, all of the soap shall be removed from the pipe by a thorough washing with water.
- e. Polyethylene pipe and tubing shall not be used as vent lines in testing or purging operations.

C. Test Duration: The pressure shall be maintained at or above the minimum test pressure for the periods shown in the following tables. Time shall begin when the pressure in the system has stabilized. Any leakage in the line shall be cause for failure of the test. If the test is failed, the Contractor shall repair the defective line and retest at no additional cost to Sandia National Laboratories (SNL).

2" Pipe or Less

<u>Length</u>	<u>Time in Hours</u>
100 feet or less	1
101 feet to 500 feet	2
501 feet to 2,000 feet	3
2,001 feet to 10,000 feet	4
over 10,000 feet	12

4" Pipe or Greater

<u>Length</u>	<u>Time in Hours</u>
100 feet or less	1
101 feet to 500 feet	2
501 feet to 2,000 feet	3

2,001 feet to 10,000 feet	12
over 10,000 feet	16

- D. Compensation for Change in Temperature: The temperature shall be monitored throughout the test duration. Losses due to change in temperature shall be calculated with the following equation:

$$\text{Corrected Ending Pressure (psia)} = \text{Measured Ending Pressure (psia)} \times \frac{\text{Starting Temperature (F)} + 460}{\text{Ending Temperature (F)} + 460}$$

$$\text{Absolute pressure (psia)} = \text{Gauge Pressure (psig)} + 12.2$$

- E. Pressure Gauges: For test pressures of 10 psig or less, gauge shall have increments of 1/10th psi or less, for pressures greater than 10 psig gauges shall have increments of one psi or less. The maximum scale on the gauge shall be no more than twice the test pressure applied.
- F. Safety During Test: Every reasonable precaution shall be taken to protect workers and the general public during testing. No direct connections will be permitted from the new line to any existing gas lines unless they are physically separated. Suitable steps shall be taken to keep persons not involved in the test procedure out of the testing area during the test.

Test Records: The attached "Exterior Gas Piping System Test Record" shall be prepared as part of the test procedure. The completed form shall be submitted to the SDR for final approval.

ATTACHMENT 1 - Exterior Gas Piping System Test Record

Check off boxes as you complete each line.
 Project No.: _____ Project Title: _____

Test conducted by: Name: _____
Company: _____

SNL Mechanical Inspector: _____

Attached qualifications of individual conducting test.

Pipe size: 2" pipe or less 4" pipe or greater

Total length of pipe: _____ feet

Test duration required: _____

Test duration used: _____

Test fluid used: _____

Maximum operating pressure: _____ psig

1.5 times maximum operating pressure = _____ psig

Required test pressure = greater of 60 psig or 1.5 x MOP = _____ psig

Temperature at start of test: _____ (°F)

Test pressure at start of test: _____ psig

Temperature at end of test: _____ (°F)

Test pressure at end of test: _____ psig

+12.2 = _____ psia

Temperature correction factor = $\frac{\text{starting temperature (F)} + 460}{\text{ending temperature (F)} + 460}$ = _____

Corrected pressure at end of test =
pressure at end of test (psia) x temperature correction factor = _____ psia

-12.2 = _____ psig

Any leaks / failures noted and disposition if any: _____

