

# Specification Section 02553 Exterior Gas Piping Systems

**June 6, 2012**

**Revision 3**

**SAND #2011-3372P**

**This document has been reviewed by the Review and Approval process and its contents have been deemed unclassified/unlimited release.**





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## Change Log

Rev	By	Date	Type	Change Description	ID
2	VL TH	5/11	Subst	Branded, formatted, and edited document for spelling, grammar, consistency, and readability. Changed "shall" to "must." Overall update and corrections	
3	TH/VL	8/11	Subst	Reduced bold formatting in level-3 headings and made minor content corrections suggested by inspection group, including adding "J" products, tracer wires, and marking tape; making measurements consistent with trenching spec; changing SCO to Systems Engineer; addressing materials installed if temperature is above 100°F; and clarifying temperature requirements.	
3	SM/KB	6/6/12	Admin	Per SME suggestion, revised ASTM standard number to reflect current revision and changed "heat fusion" to "thermal fusion."	

## Part 1 - General

### 1.01 Summary

This Section applies to the materials and operations required for the installation of underground exterior gas-distribution systems, including all piping, fittings, joints, location devices, service risers, and tests.

### 1.02 References

#### A. Sandia National Laboratories (SNL) Construction Standard Specifications

Number	Title
Section 02200	Earthwork
Section 03300	Cast in Place Concrete

#### B. Sandia National Laboratories Facilities Management and Operations Center Processes

PCS.128, *Planned Outages*

#### C. American Society for Testing and Materials (ASTM)

Number	Title
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
ASTM D256	Standard Test Method for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer
ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1505	Standard Test Method for Density of Plastics by the Density Gradient Technique
ASTM D1525	Standard Test Method for Vicat Softening Temperature of Plastics
ASTM D1693	Standard Test Method for Environmental Stress Cracking of Ethylene Plastics
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D2513	Standard Specification for Polyethylene Gas Pressure Pipe, Tubing, and Fittings
ASTM D2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM F1041	Standard Guide for Squeeze Off of Polyolefin Gas Pressure Pipe and Tubing
ASTM F1563	Standard Specification for Tools to Squeeze Off Polyethylene Gas Pipe or Tubing

**D. American National Standards Institute (ANSI)**

B16.40 Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems

**E. U.S. Department of Transportation (DOT) Code of Federal Regulations (CFR)**

Title 49, Part 192 Transportation of Natural and Other Gas by Pipeline

### **1.03 Submittals**

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**A. General**

Submit the following items in accordance with the Conditions of Contract and SNL Construction Standard Specification Section 01330, *Submittal Procedures*.

**B. Product Data**

Submit product data for the following materials:

1. Pipe
2. Fittings
3. Valves
4. Valve boxes
5. Valve and box supports
6. Test boxes and markers
7. Risers
8. Transition fittings
9. Concrete mix design

**C. Installation Instructions**

Submit installation instructions for the following materials:

1. Pipe
2. Risers

**D. Welding Certifications**

All welding certifications must be submitted to the Sandia Construction Observer (SCO) for verification of quality assurance at least 2 weeks before starting any work. The SNL-designated certified welding inspector reviews the procedures and certifications.

### **1.04 Quality Assurance**

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The materials and practices involved in the work must 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 prevails.

## Part 2 - Products

### 2.01 Pipe

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The underground gas-distribution system must be all polyethylene plastic pipe PE 4710, SDR 11 IPS (Performance Pipe Driscopipe® 8100 high-density polyethylene [HDPE] or an approved equal), unless otherwise specified on the contract drawings. The polyethylene plastic pipe used must conform to the latest American Society of Testing Materials (ASTM) D2513, the publication of specifications for thermoplastic gas pressure pipe, tubing, fittings, as well as the following ASTM minimum test requirements: D256, D638, D696, D746, D1238, D1505, D1525, D1693, D2240, D2837, and D3350.

### 2.02 Pipe Fittings

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#### A. Thermal-Fusion Fittings

Thermal-fusion fittings must conform to ASTM D2513 and be installed in accordance with the manufacturer's recommendations. Thermal-fusion joints are allowed only when joining new sections of pipe together that are of the same type (ASTM D2513 PE 4710) and size. All other connections must be electrofusion couplings. Electrofusion fittings must be Friatec or an approved equal.

#### B. Mechanical Joint Fittings

Mechanical joint fittings must conform to ASTM D2513 and be installed in accordance with the manufacturer's recommendations.

#### C. Valves

Valves must be full-port polyethylene ball valve SDR 11, high-density PE 4710 body, with 2-inch operating square. Valves must 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 must be Nordstrom Poly-Gas® valve, Kerotest, or an approved equal. Where full-port valves matching the size of the mating pipe are not available from the manufacturer, the next-larger size of valve must be provided. Provide valves with the manufacturer's extended stem, or fabricate valve extension per 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 that require any maintenance or lubrication are not allowed. Valves must be installed per the manufacturer's instructions; the installation must include the compatible valve boxes and valve supports from the specifications noted below.

#### D. Valve Boxes

Valve boxes must be Handley ABS plastic with slip-type design. The lid must be vented, colored yellow, and marked "Gas." The adjustment range must be sized to suit burial depth. Valves and valve boxes must be installed using a compatible valve support. Install per SNL standard detail. Table 1 shows example valve box part numbers for applicable valve sizes (located at standard depth); valves at nonstandard depth and of a different make and model may require a modified part number. Valve boxes must be traffic rated and installed with concrete collars conforming to SNL Construction Standard Specification Section 03300, Cast in Place Concrete, and SNL standard detail drawings.

## E. Valve and Box Supports

Valves must be installed using a Handley valve and box support that is compatible with the valve and valve box being installed. Install per manufacturer's recommendations and instructions. Table 1 shows example valve support part numbers for applicable valve sizes; valves of a different make and model may require a modified part number.

**Table 1 Valve Box and Valve Box Support Model and Part Numbers for Nordstrom Full-Port Poly-Gas Valves**

Valve Size	Valve Box Model	Valve Box Part Number (Standard Depth)	Valve and Box Support Part Number
¾, 1", 1¼"	2" Curb Box	G2IHD22L	V C 22
2", 3"	"C" Model Multibox	G4HAC399ACD	V V 5, V V 6 for 3"
4"	"T" Model Multibox	G6HAT317ACD	V V 17
6", 8", 10"	Bell Plate Valve Box	G6HNC3P1ACD	N/A

## F. Test Boxes

1. Flush-mount test boxes must be Handley model T4H5C, 4-inch-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, the number of terminal leads to suit the application: 2 leads for tracer wire terminal post, or 5 leads for cathodic protection test station; and vent hole in lid. Install per SNL standard detail.
2. Raised-type test boxes must be Rhino TriView™ Tracer Ped with internal terminals, the number of terminal leads to suit the application: 2 leads for tracer wire terminal post, or 5 leads for cathodic protection test station. The post must be colored yellow with a black top; the length must be 66 inches, and the post height must be set at 48 inches above grade level. Post must be marked "Gas" using the standard Rhino gas pipeline warning decals. The test box must be installed according to the manufacturer's recommendation for terrain and soil type and SNL standard detail.

## G. Risers

Risers must be R.W. Lyall LYCO® 90-degree Bend Rigid Anodeless risers or equal. The underground connection must be Driscopipe 8100 HDPE with size and thickness to match connecting pipe size, and the aboveground connection must suit the field application. The riser must be installed according to the manufacturer's recommendation and SNL standard detail.

## H. Transition Fittings

Transition fittings must be R.W. Lyall LYCO with Driscopipe 8100 HDPE and ASTM A53 end connections, size and thickness to match connecting pipe sizes.

## I. Pipeline Markers

Pipeline markers must be TriView 400 installed according to manufacturer recommendations for terrain and soil type. The post must be colored yellow with a black top; the length must be 66 inches, and the post height must be set at 48 inches above grade level. Post must be marked "Gas" using the standard Rhino gas pipeline warning decals.



**J. Tracer Wire**

1. Tracer wire must be installed 6 inches above the grade of the buried pipe. Wrapping the wire around the pipe is not permitted. Wire splices must be done using either a test box or underground wire splice. Wire shall be 12 gauge copper with yellow 30mm PE coating. Use Propak Industries 12SOLCU wire or approved equal.
2. Underground wire splice instructions: Connect the conducting elements of the wire using an underground wire nut, and ensure that no wire is exposed outside of the wire nut. Use Ideal Industries Underground Wire Connectors or approved equal. After the wire nut is installed, twist 4 inches of the wire on each side of the wire nut together, fold the twisted section of wire back on itself, and wrap the wire connection in 3 layers of water- and abrasion-resistant black tape. Use Scotch Super 33+ Vinyl Electrical Tape or approved equal.

## Part 3 - Execution

### 3.01 Installing Pipe

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#### A. General Installation

1. Do not install gas lines under buildings, structures, or in crawl spaces.
2. Install a schedule 40 steel sleeve on all risers passing through asphalt or concrete slabs. Allow at least 1 inch of radial clearance between sleeve and riser. Fill void with pea gravel.
3. Burial depth: Plastic piping must be buried a minimum depth of 36 inches, unless noted otherwise.

#### B. Trenching

1. Trench width: Width must be wide enough to provide at least 6 inches clearance on both sides of the pipe. Trench width must 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.

#### C. Avoiding Unnecessary Strains

Do not subject plastic pipe to unnecessary strains such as bending or twisting at any time, and handle pipe with care as it is lowered into the trench. Lay the pipe on the trench bottom so it snakes from one side of the trench to the other with one cycle approximately every 40 feet. The pipe must be laid and continuously supported on undisturbed or well-compacted soil.

1. Underground clearance: Each distribution line must be installed with at least 12 inches of radial clearance from any other underground structure not associated with the distribution line. Sandia Delegated Representative (SDR) approval is necessary if this dimension requirement is unattainable. In addition, all plastic pipe and plastic service lines must be installed with sufficient clearance, or must be insulated from any heat source to prevent the heat from impairing the serviceability of the pipe.
2. Bends: Do not bend or deflect the pipe to more than the minimum radius recommended by the manufacturer. Bends must be free of buckles, cracks, or other evidence of damage. Changes in direction that cannot be made by bends must be made with elbow or tee fittings. Do not trim elbow or tee fittings to fit. Miter joints are not permitted.
3. Obstructions in the pipe: The open ends of the pipeline must be closed at all times, and must not be reopened until the next joint of pipe is to be connected. This closure must prevent the entrance of small animals or the introduction of foreign material of any nature (water included) into the line.
  - a. After the pipe has been strung along the right-of-way, each length must be swabbed before being welded into the pipeline. The swab must be a soft cloth. Visually inspect each length internally before use.

- b. Exercise care when joining the sections of pipe to minimize the possibility of any foreign material being in the line after the joining is complete. The Contractor must remove any obstructions in the pipeline caused by foreign material.
- c. After the pipeline (or measured portions) is complete, the Contractor must run a polyurethane pipeline pig through the line twice to displace any foreign material introduced during construction. Before starting the pigging operations, a "pig catcher" must be installed on the end of the pipeline to prevent an uncontrolled release during pressurization. The pig must be moved by air pressure only. The use of gas pressure in the pigging operation is prohibited.

#### **D. Backfill**

1. In warm weather, backfilling must be performed during the coolest part of the day whenever possible. Backfill material must be soft dirt or sand free of stones or debris that could cut or otherwise damage the pipe. Clean backfill material must surround the pipe at least 4 inches or one pipe diameter (whichever is greater) in all directions. Backfill must be placed level from one wall of the trench to the other and must not be mounded over the pipe.
2. Place backfill with a maximum of 8-inch lifts, and perform tamping with the proper equipment, such as a mechanical tamper. The pipe must not be damaged during compaction. Flooding of the trench is not allowed. Compaction with heavy equipment is not permitted unless the pipe has 24 inches of cover and the pipe's internal pressure exceeds 15 psig.

#### **E. Location Device**

Install an electrically conductive 12-gauge copper wire with yellow insulation. The tracer wire must be installed at a distance of 4 inches to 6 inches adjacent to the pipe. The wire and all of its connections must be insulated to prevent corrosion. The wire and locating tape must be installed as shown on the "Warning Tape and Tracer Wire Detail" drawing detail. The detectable warning tape must have a foil core and be reinforced with a total thickness of 5 mil.

#### **F. Tie-In to Other Lines**

After lowering the pipe into the trench, and before joining installed sections or making tie-ins to other lines, sufficient time must be allowed for contraction as the pipe assumes ground temperature. Tie-ins to existing lines must be performed in an atmosphere absent of gas. Tie-ins or connections to all existing lines must be made using the appropriate electrofusion couplings. Hot tie-ins are permitted only when using electrofusion-tapping tee and after providing documentation of procedures to be used and obtaining written authorization from Infrastructure Gas System Engineer. Tie-in planning and procedure must incorporate the SNL/NM Planned Outages Process (PCS.128) and be performed in the presence of SNL Utilities Maintenance personnel.

#### **G. Pipe Squeeze-Off**

Pipe squeeze-off is permitted only using a squeeze tool meeting ASTM F1563 and following procedures meeting ASTM F1041. Contractor is allowed to perform squeeze-off operation only after providing documentation of procedures to be used and obtaining written authorization from the Infrastructure Gas System Engineer. This action cannot be performed more than once at the same point on the pipe. Procedure must be performed in the presence of SNL Utilities Maintenance personnel.

#### **H. Static Discharge Protection**

Whenever performing work on or near gas lines that could potentially contain combustible gas, the Contractor must evaluate the potential for static discharge. Work is permitted only after providing documentation of procedures to be used and obtaining written authorization from the Infrastructure Gas System Engineer. Procedure must be performed in the presence of SNL Utilities Maintenance personnel.

### **3.02 Joining Polyethylene Plastic Pipe**

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#### **A. General**

The Contractor's personnel who perform thermal-fusion joining on distribution facilities must be qualified by the pipe manufacturer's qualifying representative before starting any work. The Contractor can, at his or her discretion, submit a list of previously qualified candidates to the SCO in lieu of retesting. The list must include the date of qualification and the name of the qualifying representative who was present for the test.

#### **B. Thermal-Fusion Joining**

Thermal-fusion joining must not be performed when the quality of the joining may be adversely affected by weather conditions. Rain, blowing sand, windstorms, and other inclement weather are cause for the SCO to cease welding operations. Windshields may be used during windy weather if approved by the SCO.

#### **C. Thermal-Fusion Joints**

Heat the mating surfaces to their fusion temperature, compress the mating surfaces together, and hold the mating surfaces together until the joint cools naturally. Directly applying heat using a torch or other open flame is prohibited.

#### **D. Equipment and Tools**

Equipment and tools that are manufactured specifically for the fusion process must be used. The equipment must be designed to hold the heating element firmly against and parallel to the mating surfaces, compress the heated surfaces together, and hold the mating surfaces together firmly in alignment until the joint cools naturally. The heating elements must be electric type, which are thermostatically controlled. The heating tools must be capable of maintaining uniform surface temperature within the melt-temperature range specified by the material manufacturer. The Contractor must use a crayon temperature indicator, or method that has been approved equal, to verify that the heating element temperature is correct before making each joint. The temperature crayon mark must not be applied to the part of the heater face that comes in direct contact with the pipe.

#### **E. Marking of Joints**

Each welder performing heat-fusion joining on a pipeline must place his or her distinctive mark on the pipe with a felt-tip pen near each heat-fusion joint completed. The mark must be the one that appears on the welder's certification card. The color of the pen must be such that the mark is distinguishable from the color of the pipe.

#### **F. Request for Testing**

At any time during the assembly process, the SCO may request that a joint be tested by nondestructive or destructive methods.

### **3.03 Handling Material and Repairing Defects**

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#### **A. Loading and Unloading Pipe**

When loading or unloading plastic pipe, the pipe must be placed in the desired position without damage. The pipe must not be allowed to drop freely from the truck bed to the ground. The pipe must be strung onto terrain free from rocks or other projections that might damage the pipe. The pipe must not be dragged over rocks or other abrasive material.

#### **B. Protecting Pipe from Damage**

Plastic pipe must be protected from fire, excessive heat, and harmful chemicals and must be free of ultraviolet and weather damage caused by extended outdoor storage. Cleaning solutions, detergents, solvents, alcohols, and the like must not be allowed to contact the pipe.

#### **C. Inspecting Materials**

The Contractor must visually inspect each length of pipe and all components, both inside and out, at the site of installation to ensure they have not sustained damage that could impair their serviceability. A second surface inspection must be made immediately before lowering the pipe into the trench.

#### **D. Damage, Defects, and Repairs**

Any pipe that has cuts, gouges, scratches, or punctures greater than 10% of the pipe wall thickness, or other damage or defects that would impair the serviceability of the pipe, must be repaired by removing the defective section and replacing it with a new section of pipe.

### **3.04 Testing Requirements**

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#### **A. Testing of Line Segments**

The Contractor, in accordance with the following procedure, must test all new segments of line. The SCO must be notified before the start of each test.

#### **B. Test Procedure**

1. The test media must be dry air. The air used in testing must be free of contaminants.
2. The temperature of the compressed air or any other source must not cause the plastic material to exceed 100°F. Do not test if the temperature of the pipe surface is greater than or equal to 100°F
3. The minimum test pressure must be 1.5 times the maximum operating pressure, or 60 psig (whichever is greater). Typical distribution pressure at SNL/NM is 20 psig, so required test pressure for distribution system is typically 60 psig.
4. Tie-in joints, which are not included in the test, must be soap tested at the operating pressure. After the soap test, all of the soap must be removed from the pipe by washing it thoroughly with water.

5. Because of the possibility of static electric discharge, polyethylene pipe or other plastic tubing must not be used as vent lines in testing or purging operations.

### C. Test Duration

The pressure must be maintained at or above the minimum test pressure for the periods shown in the following tables. Time begins when the pressure in the system has stabilized. The test periods listed below may be increased on a test-to-test basis at the discretion of the Infrastructure Gas System Engineer to improve test sensitivity.

1. 3-Inch Pipe or Smaller

Pipe Length	Time in Hours
100 feet or fewer	1
101 feet to 500 feet	2
501 feet to 2,000 feet	3
2,001 feet to 10,000 feet	4
More than 10,000 feet	12

2. 4-Inch Pipe to 6-Inch Pipe

Pipe Length	Time in Hours
100 feet or fewer	1
101 feet to 500 feet	2
501 feet to 2,000 feet	6
2,001 feet to 10,000 feet	16
More than 10,000 feet	24

3. 8-Inch Pipe or Larger

Pipe Length	Time in Hours
100 feet or fewer	2
101 feet to 500 feet	6
501 feet to 2,000 feet	16
2,001 feet to 10,000 feet	32
More than 10,000 feet	48

### D. Test Criteria

Any leakage in the line is cause for failure of the test. If the test is failed, the Contractor must repair the defective line and retest at no additional cost to SNL. Any pressure drop in the system that is measured within the readability and uncertainty of the pressure test gauge, after compensation for the change in temperature, must be interpreted as leakage, and the pipe must be repaired and retested. A retest can be performed, upon approval from the Infrastructure Gas System Engineer, in the case where faulty test equipment is suspected to be the cause of test failure. An 8-hour minimum relaxation period, during which the pipe is completely depressurized, is required between tests if multiple tests are required.

### E. Compensation for Change in Temperature

The temperature must be monitored throughout the test duration. Temperature monitoring can be done using pipe surface temperature measurement or inserting a thermocouple probe into the test media. If the pipe surface temperature has a high level of variation it is advisable to use a thermocouple probe inside of the pipe to measure test media temperature for greater accuracy. Using surface temperature in a situation with large temperature swing may cause the test to fail erroneously. Losses because of change in temperature must be calculated with the following equation:

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

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

#### F. Pressure Gauges

For test pressures of 10 psig or less, gauge must have increments of 1/10th psi or less. For pressures greater than 10 psig, gauges must have increments of 1 psi or less. The maximum scale on the gauge must be no more than twice the test pressure applied.

#### G. Safety during Test

Every reasonable precaution must be taken to protect workers and the general public during testing. No direct connections are permitted from the new line to any existing gas lines unless they are physically separated. Suitable steps must be taken to keep persons not involved in the test procedure out of the testing area during the test.

#### H. Test Records

The Exterior Gas Piping System Test Record (Appendix A) must be prepared as part of the test procedure. The completed form must be submitted to the SCO for final approval.

**END OF SECTION**

## **Appendix A: Exterior Gas Piping System Test Record**



Exterior Gas Piping System Test Record			
Check the boxes as you complete each line.			
<input type="checkbox"/>	Project number:		Project title:
<input type="checkbox"/>	Test conducted by:	Name:	
		Company:	
<input type="checkbox"/>	SNL Mechanical Inspector:		
<input type="checkbox"/>	Attach qualifications of individual conducting test.		
<input type="checkbox"/>	Pipe size:	<input type="checkbox"/> 3-inch pipe or smaller	<input type="checkbox"/> 4-inch pipe to 6-inch pipe
			<input type="checkbox"/> 8-inch pipe or larger
<input type="checkbox"/>	Total length of pipe:		feet
<input type="checkbox"/>	Test duration required:		
<input type="checkbox"/>	Test duration used:		
<input type="checkbox"/>	Maximum operating pressure (MOP):		psig
<input type="checkbox"/>	1.5 times MOP =		psig
<input type="checkbox"/>	Required test pressure = greater of 60 psig or 1.5 x MOP =		psig
<input type="checkbox"/>	Temperature at start of test:		(°F)
<input type="checkbox"/>	Test pressure at start of test:		psig
<input type="checkbox"/>	Temperature at end of test:		(°F)
<input type="checkbox"/>	Test pressure at end of test:		psig
<input type="checkbox"/>	+12.2=		psia
<input type="checkbox"/>	Temperature correction factor = $\frac{\text{starting temperature (°F)} + 460}{\text{ending temperature (°F)} + 460}$		
<input type="checkbox"/>	Corrected pressure at end of test = pressure at end of test (psia) x temperature correction factor =		psia
<input type="checkbox"/>	-12.2 =		psig
<input type="checkbox"/>	Any leaks or failures (if any) noted and disposition:		
<input type="checkbox"/>			
	SCO Signature		Date