SOUTHWEST GAS CORPORATION

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ENGINEERING STAFF

MATERIAL SPECIFICATION

Prepared By: Engineering Staff LM

Approved By: Kevin Lang

PIPE AND TUBING

High Density Polyethylene Pipe and Tubing

1. SCOPE

This specification covers high density polyethylene pipe and tubing in nominal diameters of ½" CTS, 1" CTS, 1 ¼" IPS, 2" IPS, 3" IPS, 4" IPS, 6" IPS and 8" IPS intended for use in natural gas distribution systems. All values indicated in this specification will be in English units.

2. APPLICABLE DOCUMENTS

2.1 ASTM International (ASTM) D1238, "Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer."

2.2 ASTM International (ASTM) D1505, "Standard Test Method for Density-Gradient Technique."

2.3 ASTM International (ASTM) D1599, "Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings."

2.4 ASTM International (ASTM) D2513, "Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings" and its references.

2.5 ASTM International (ASTM) D3350, "Standard Specification for Polyethylene Plastics Pipe and Fittings Materials."

2.6 ASTM International (ASTM) D2897, "Standard Specification for Tracking and Traceability Encoding System of Natural Gas Distribution Components (Pipe, Tubing, Fittings, Valves, and Appurtenances)"

2.7 Plastic Pipe Institute (PPI) TR-4, "PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe"

2.8 Title 49, Code of Federal Regulations, Part 192, "Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards" (49 CFR 192).

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2. APPLICABLE DOCUMENTS (Cont'd)

NOTE: Unless otherwise specified, the editions of the document incorporated in whole or in part by 49 CFR 192 are applicable. The above documents, and parts of documents (including annexes), not incorporated by 49 CFR 192 are incorporated by this Material Specification and will be the most recent edition. If a conflict exists between the applicable documents and/or this Material Specification, the requirements of 49 CFR 192 shall govern, and in the event of all other conflicts, the more stringent requirement shall govern.

3. TERMINOLOGY

3.1 General

3.1.1 "Southwest Gas," "Southwest" or "SWG" wherever used in this specification and other related documents will refer exclusively to Southwest Gas Corporation.

3.1.2 The terms "approved," "as approved," "satisfactory," "as directed," "or equal" or other similar terms wherever used in this specification and other related documents, will mean "as determined by Southwest Gas," unless specifically stated otherwise.

3.1.3 "Product Information Package" or "PIP" wherever used in this specification and other related documents will mean the required technical product information that a manufacturer must submit to SWG to determine if the product is suitable for use by SWG, unless specifically stated otherwise.

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4. MATERIALS AND MANUFACTURING

4.1 The resins from which the high-density polyethylene pipe is extruded will be bi-modal PE 4710 and will have the current listing published by the Plastics Pipe Institute (PPI). The manufacturer must supply a PPI listing number for each resin used in the manufacture of pipe for Southwest Gas. The resins currently approved by Engineering Staff include:

- Marlex H516 (Performance Pipe only)
- Dow 2490 (All Dura-Line GDB50 and Performance Pipe 8300 used as pups in risers, EFV's, as connection points for fittings).

4.2 All pipe will be made from virgin material.

4.3 The pipe will be uniform in physical and chemical properties (including antioxidants), and free of cracks, holes, foreign inclusions, areas of unpigmented polymer ("windows"), or other injurious defects.

4.4 The pipe will be clean and internally free of paint, dirt, sand and other debris.

4.5 The pipe will contain suitable ultraviolet stabilizers so that its physical properties will not be adversely affected by exposure to natural ultraviolet light in locations throughout Southwest's service area for at least three (3) years from the date of manufacture for yellow shell and ten (10) years for black pipe with yellow stripe per D2513.

4.6 The pipe will contain suitable antioxidants, which protect against changes in molecular weight and enable heat fusion joining of the system components.

4.7 The pipe will be joinable by heat fusion using standard Southwest Gas joining procedures and tools, without affecting the strength or the pressure rating of the assembly.

4. MATERIALS AND MANUFACTURING (Cont'd)

4.8 The pipe will be joinable to and compatible with all the various types and grades of high-density PPI Nos. PE 3406, PE 3408, and PE 4710 that is being purchased and/or exists in Southwest Gas distribution network that Southwest has installed since 1970. Southwest Gas will use its standard heat fusion joining procedures and tools. Each manufacturer must provide Southwest with procedures for fusing these materials to their product when requested.

4.9 Any cross section of uncoiled or straight length pipe will be sufficiently roundable so that fittings can be completely heat fused to the pipe by Southwest Gas procedures without affecting the pressure rating of the pipe or assembly.

4.10 Qualification Testing

4.10.1 As required by 49 CFR 192, all polyethylene pipe and tubing considered for qualification by Southwest Gas will be tested using the requirements outlined in ASTM D2513. Tests will include minimum hydrostatic burst pressure and sustained pressure.

4.10.2 Additional test or the use of expanded testing environment may be utilized by SWG as a part of the material qualification process.

4.10.3 Material qualification will be retained if the material passes periodic acceptance testing.

4.10.4 Any changes in the resin and/or revisions to the pipe design or processing by the manufacturer after the initial testing require immediate notification to Southwest Gas and retesting of the product to assure this material specification is met.

4. MATERIALS AND MANUFACTURING (Cont'd)

4.11 Continuous In-Line Pipe Wall Thickness Monitoring

4.11.1 During the production of all PE pipe, continuous in-line pipe wall thickness monitoring equipment shall be in place and functioning properly. The system may be designed to automatically cut out and segregate defective material; or have alarms to notify the operator to cut-out and segregate defective material; or simply record data for review and segregation of defective materials after the pipe is produced. Ultrasonic wall thickness monitoring is preferred.

4.11.1.1 Equipment shall monitor and record amperage consumption data, screw rotational speed, puller speed, temperature, and other data. Such data shall be provided to SWG upon request in a mutually agreed upon format that facilitates understanding of the data and integration into CSV or similar database structures.

4.11.2 Manufacturer shall utilize a system to inspect and approve or reject pipe identified by the in-line wall monitoring equipment as Out-of-Specification.

4. MATERIALS AND MANUFACTURING (Cont'd)

Continuous In-Line Pipe Wall Thickness Monitoring (Cont'd)

4.11.3 Records shall be maintained for pipe identified as out-of-spec during each production run.

4.11.3.1 Documentation of all out-of-spec pipe identified by the in-line wall monitoring equipment shall allow for traceability to the production run as well as the time and duration the pipe was out-of-spec during the production run.

4.11.3.2 The inspection results of the out-of-spec pipe identified by the in-line wall monitoring equipment must also be documented. The inspection documentation must include, but is not limited to, the footage of pipe approved and rejected and the reasons for each approval or rejection.

4.11.3.3 For rejected pipe, the root cause of the rejection and corrective action shall also be documented.

4.11.3.4 This process shall also be audited by the manufacturer on a routine basis to ensure compliance and the results of such audits provided to SWG upon request.

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5. PERFORMANCE REQUIREMENTS

5.1 Plastic pipe will be suitable for operating in natural gas distribution systems in all class locations for a minimum of 50 years at pressures up to 100 psig (690 kPa) and at sustained temperatures, cyclical temperatures, or both, from 20°F (-7°C) to 140°F (60°C), in either direct buried installations or in above-ground or subsurface sleeving installations. All plastic pipe must be capable of operating at 60 psig and 140°F (60°C) simultaneously. All product features must be acceptable to SWG.

5.2 The pipe will be designed and fabricated so that no harmful or hazardous substances will be released into the gas and/or ground for a minimum of 50 years.

5.3 The pipe will be designed and fabricated so that oils and other agents and debris commonly found in natural gas pipelines will not adversely affect the product serviceability for a minimum of 50 years.

5.4 The pipe will be designed and manufactured so that it is able to withstand squeezing and subsequent reopening to control gas flow at pressures of up to 1.5 times the maximum design pressure as defined in 49 CFR 192.121.

5.4.1 The HDB of pipe shall not be reduced as a result of pipe squeezing operations.

5.4.2 The manufacturer shall specify the minimum gap, squeeze bar profiles of the equipment and release rates to be used for squeeze.

5.5 The polyethylene material used in the manufacture of pipe and tubing shall be tested per ASTM D1238, Condition 190/21.6, and comply with ASTM D2513, Table 4, Melt Index Category E.

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6. DIMENSIONS AND TOLERANCES

Nominal Pipe Size	OD (Inches)		Wall Thickness (Inches)		OOR Range (Inches) (D2513)	Nominal DR	Reference
	Average	Tolerance	Minimum	Tolerance			
½ CTS	0.625	±0.004	0.090	+0.006			D2513
1 CTS	1.125	±0.005	0.101	+0.007			D2513
1 ¼ IPS	1.660	±0.005	0.151	+0.018	0.024	11	D2513
2 IPS	2.375	±0.006	0.216	+0.026	0.024	11	D2513
3 IPS	3.50	±0.008	0.318	+0.038	0.030	11	D2513
4 IPS	4.500	±0.009	0.409	+0.049	0.030	11	D2513
6 IPS	6.625	±0.011	0.602	+0.072	0.070	11	D2513
8 IPS	8.625	±0.013	7.784	+0.094	0.080	11	D2513

NOTE: OOR is expressed as a range (e.g. ±0.012 as a range would be 0.024). This value is the difference between the major and minor measured diameter.

TABLE A-1

Requirement	Value	Reference
Eccentricity (Max.)	12%	D2513
Ovality (Max.) (</+3")	5%	D2513
Toe-In (Max.)	1.5%	D2513
Quick Burst HS (Min. psi)	*	D1599
Ring Tensile HS (Min. psi)	2,520	D2513
Carbon Black (Min.%)	2.0	D3350
Carbon Black (Max.%)	*	
Melt Index (Min.-Max.)	*	D2513
Density (g/cm3)	*	D1505

TABLE A-2

NOTE: * Special values per manufacturer in Section 13.

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6. DIMENSIONS AND TOLERANCES (Cont'd)

6.3 Straight lengths of 2" thru 8" IPS pipe will be between 39.8 feet and 40.6 feet. Straight length will consist of a single continuous length of pipe without joints and/or couplings.

7. INSPECTION

7.1 Successful review of the Product Information Package (PIP), as well as any future reference by SWG to the manufacturer's part number or internal code number in any future contract or purchase, will mean only that no conflict with the specification was found, and will not relieve the Seller from meeting all the requirements of this specification.

7.2 Manufacturer agrees that SWG shall have the right, at its discretion and expense, to inspect the manufacture and testing of all materials, products and systems referenced in this specification that are sold to SWG.

7.3 Southwest will make appropriate inspections and tests of all materials, products or systems supplied to this specification. SWG will have the right, at its option, to reject any material which fails to conform to this specification. Any such rejection may take place at the manufacturer's facility; the supplier's warehouse, or any subsequent delivery location, before or after Southwest assumes possession. Notice of rejection will be made promptly thereafter by SWG. The defective product will be replaced or returned for credit at the manufacturer's expense.

7.4 Any changes in the manufacturing of previously approved materials, products or systems described in this material specification for sale to SWG, must be approved in advance by SWG's Engineering Staff prior to fulfilling any orders placed by SWG. **Failure to obtain SWG's approval may be cause for rejection**.

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8. CERTIFICATION

The manufacturer's or supplier's certification for the manufactured products will be furnished to Southwest. This certification will state that samples representing each lot have been manufactured, tested and inspected in accordance with this specification and that all requirements have been met. When requested or specified in the purchase order or contract, a report of test results will be provided.

Upon the request of Southwest, the manufacturer shall permit Southwest to conduct at the manufacturing facility, at Southwest's expense, these required certifications by an independent third-party indicating conformance to these specifications.

9. SAFETY DATA SHEETS

In accordance with law, the Seller will supply Safety Data Sheets for all applicable items supplied under this specification to the following:

1) The Receiving Location

2) Engineering Staff

3) Southwest Gas Corporation
Corporate Safety
Mail Station LVA-120
P.O. Box 98512
Las Vegas, NV 89193-8512

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10. PRODUCT MARKING

10.1 As required by 49 CFR 192, pipe and tubing shall be marked in accordance with ASTM D2513. The markings shall consist of:

- Pipe material designation code
- Manufacturer's lot code (Includes date of manufacture in some cases)
- Elevated temperature code
- The word "GAS"
- The designation ASTM "D2513"
- The manufacturer's name or trademark
- The nominal pipe or tubing size (Including the sizing system used such as IPS, CRS or OD)
- The DR or nominal wall thickness
- The markings shall be spaced at intervals of no more than 2 feet
- Additional information, including date of manufacture, coil number sequential footage, third party certification mark, etc.

10.2 The pipe and tubing shall be marked with additional code letters to identify the temperature rating and the hydrostatic design basis (HDB). The temperature rating marking will be in accordance with ASTM D2513, which consists of, at a minimum, a two-letter coding (i.e." CE"). The first code letter is to identify the high temperature rating, and the second code letter is to identify the HDB rating at that high temperature rating. A third code letter may be included which signifies melt index. The first code letter must have a minimum of a "C" rating which signifies a temperature rating of 140°F (60°C). The second code letter pertaining to the HDB rating must be a minimum of an "E" rating which signifies an HDB rating of 1000 psig.

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10. PRODUCT MARKING (Cont'd)

10.3 All polyethylene pipe extensions (pups) must have the pipe manufactured date visibly indicated on the pipe by print line, label or another method that is clearly and completely readable.

11. PACKAGING AND PACKAGE MARKING

11.1 Seller will adequately prepare all pipe and tubing for shipment including furnishing and installing necessary covers to protect the pipe from sunlight, excessive heat, photochemical smog, rain, hail, wind, dust, etc. The pipe will be adequately sealed and protected during shipment to prevent entrance of foreign matter and possible damage from rough handling during transit.

NOTE: For shipments with tarps, the pipe and tubing must be protected to prevent damage from the smoke tarps and full tarping is required for the first 1/3 of the truck.

11.2 Pallets must be at least as large as the coil OD.

11.3 The ends of pipe and tubing shall be covered to prevent entry of dirt or debris.

11.4 Packaging will facilitate its safe handling and its reshipment between the stocking and use locations.

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11. PACKAGING AND PACKAGE MARKING (Cont'd)

11.5 Pipe and tubing coils or bundles will be firmly banded to the pallet.

11.5.1 For coils of 3" IPS and smaller not coiled through an automatic process, including tubing, the bottom coil will be banded to the pallet. Banding shall be black nylon or colored polyester.

11.5.2 Each coil, not coiled through an automatic process, shall be banded to the coil above. Banding shall be alternated in location from coil to coil to increase stability of the silo.

11.5.3 Coils of 4" and 6" pipe shall be mounted upright on a platform and secured to the platform with banding.

11.6 Bundle Packaging Standards:

11.6.1 For encasing all straight lengths of pipe and tubing 2.375" OD and smaller, all hard-side bundles must be constructed from hardwood/softwood 2"x4" (3 ½" wide) or 2" x 6" (5 ½" wide) lumber on all four (4) sides.

11.6.2 For encasing all straight lengths that are 3/5" OD to 8.625" OD, all soft-sided bundles utilize lumber only on the bottom.

11.6.3 The bottom boards must be between 3 ½" wide (3"x4") or 5 ½" wide (2"x6"). No steel strapping shall be used to affix the product to the platform. Banding shall be black nylon or colored polyester.

11.6.4 Straight lengths of 40' pipe must be encased at six (6) equidistant locations.

11.6.5 Straight lengths of 20' pipe must be encased at three (3) equidistant locations.

11.7 Wood skids used for shipment of bundled pipe (i.e. pipe joints) must be on wooden strips between 3 ½ inches to 5 ½ inches wide.

11.8 All products covered in this specification will be packaged in a manner to prevent damage during transportation and storage.

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12. STOCK CLASSIFICATION DESCRIPTION

PIPE, 8100, _____-INCH IPS BY SDR _____, HIGH DENSITY POLYETHYLENE PIPE 4710, FOR USE IN _____PSIG SYSTEM MAXIMUM, _____-FOOT JOINTS OR COILS.

TUBING, 8100, _____-INCH CRS, HIGH DENSITY POLYETHYLENE PIPE 4710, FOR USE IN _____PSIG SYSTEM MAXIMIM, _____-FOOT JOINTS OR COILS.

PIPE, XXXX, _____-INCH IPS BY SDR _____, HIGH DENSITY POLYETHYLENE PIPE 4710, FOR USE IN _____PSIG SYSTEM MAXIMIM, _____-FOOT JOINTS OR COILS.

TUBING, XXXX, _____-INCH CRS, HIGH DENSITY POLYETHYLENE PIPE 4710, FOR USE IN _____PSIG SYSTEM MAXIMIM, _____-FOOT COILS.