REGISTERED No. M - 302
L - 7646

The Gazette *Of Pakistan*

EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, MONDAY, AUGUST 9, 2004

PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN

OIL AND GAS REGULATORY AUTHORITY

NOTIFICAT ION

Islamabad, the 5th August, 2004

SRO No. 674(I)/2004:—In exercise of the powers conferred by Section 42 of the Oil and Gas Regulatory Authority Ordinance, 2002 (Ordinance XVII of 2002) the Oil and Gas Regulatory Authority is pleased to make the following regulations namely: -

1. Short title and Commencement: (1) These Regulations may be called the Natural Gas Distribution Technical Standards Regulations, 2004.

(2) They shall, come into force at once.

2. Applicability.- These regulations shall be applicable to all such licensees undertaking the regulated activity of transmission of natural gas including design**,** construction, testing, operation, maintenance and abandonment of a regulated activity.

3. Definitions.- (1) In these regulations, unless there is any thing repugnant in the subject or context,-

[649(2004)/Ex. Gaz.]

(i) **"Casing"** means a conduit through which a pipeline passes. The conduit is meant to protect the pipeline from external load and to facilitate the installation and removal of that section of the pipeline;

(ii) **"Cathodic Protection"** means a technique to prevent the corrosion of metal by making that metal, the cathode of an electrochemical cell;

(iii) **"Company"** means a licensee carrying out regulated activity of distribution of natural gas**;**

(iv) **"Component"** means any physical part of a pipeline;

(v) **"Corrosion Stray Current"** means corrosion resulting from direct current flow through paths other than the intended circuit;

(vi) **"Defect"** means a discontinuity or imperfection of sufficient magnitude to warrant rejection on the basis of the requirements;

(vii) **"Dent"** means a depression in the external surface of the pipe caused by mechanical damage that produces a visible irregularity in the curvature of the pipe wall without reducing the wall thickness (as opposed to a scratch or gouge, which reduces the pipe wall thickness);

(viii) **"Design Pressure"** means the theoretical pressure determined by the applicable design formula;

(ix) **"Distribution Line"** means a pipeline in a distribution system that transports gas to individual service lines or other distribution lines;

(x) **"Distribution System"** means the pipelines and associated facilities and equipment used by the licensee from time to time for undertaking the distribution and sales of natural gas;

(xi) **"District Regulating Station"** means a smaller capacity pressure regulating station that reduces pressure from supply mains and/or feeder mains to small diameter feeder mains operated at relatively lower pressures and having services tapped them;

(xii) **"Electrical Isolation"** means the condition of being electrically separated from other metallic structures or the environment;

(xiii) **"Electro fusion"** It is a method of joining plastic pipe and fittings, in

which heating, melting and bonding of pipe / or fitting takes place automatically, after an electro fusion fitting that has an electrical coil embedded in it is energized by a controlled and timed current passing through the coil;

(xiv) **"Fitting"** means a component, including the associated flanges, bolts and gaskets used to join pipes, to change the direction or diameter of a pipeline, to provide a branch, or to terminate a pipeline;

(xv) **"Foreign Structure"** means any structure that is not part of the pipeline system;

(xvi) **"Heat Fusion Joint"** means a joint made in thermoplastic piping by heating the parts sufficiently to permit fusion of the material when the parts are pressed together;

(xvii) **"Holiday"** means a discontinuity of the protective coating that exposes the metal surface to the environment;

(xviii) **"Hoop Stress"** means circumferential stress acting perpendicular to the longitudinal axis of the pipe, arises from internal pressure;

(xix) **"Hot Tap"** means a connection made to a pressurized pipeline;

(xx) **"Hydrostatic Testing"** means the applications of internal pressure above the normal or maximum operating pressure to a segment of pipeline, under no-flow conditions, for a fixed period of time, utilizing a liquid test medium.

(xxi) **"Imperfection"** means a material discontinuity or irregularity that is detectable by inspection;

(xxii) **"Impressed Current"** means direct current supplied by a device employing a power source external to the electrode system;

(xxiii) **"Inert gas"** means a non-reactive and non-toxic gas such as argon, helium or nitrogen;

(xxiv) **"Location Class"** means an area classified according to its general geographic and demographic characteristics;

(xxv) **"Low Stress Level"** means a stress level up to 6000 psi.

(xxvi) **"Lower Explosive Limit" (LEL)** means the lowest concentration of combustible gas in air that can explode;

(xxvii) **"Maximum Operating Pressure" (MOP)** is the highest pressure at which a pipeline system is operated during a normal operating cycle;

(xxviii) **"Maximum Allowable Operating Pressure" (MAOP)** means the maximum pressure at which a pipeline may be operated or has been qualified;

(xxix) **"Miter Joint"** means two or more straight sections of pipe matched and joined on a line bisecting at the angle of junction so as to produce a change in direction;

(xxx) **"Nominal Wall Thickness"** means the thickness of the wall of a pipe that is nominated for its manufacture, ignoring the manufacturing tolerance;

(xxxi) **"NPS"** means nominal pipe size; used in conjunction with a non-dimensional number to designate the nominal size of valves, fittings and flanges;

(xxxii) **"Person"** includes any individual or any legal entity including any partnership, firm, company, trust or corporation;

(xxxiii) **"Piping"** means an assembly of pipes, valves and fittings connecting auxiliary and ancillary components associated with a pipeline. This terminology is usually used for above ground pipe, but may sometimes be used for buried pipe also;

(xxxiv) **"Plastic"** means a material which contains as an essential ingredient an organic substance of high to ultra-high molecular weight, is solid in its finished state, and at some stage of its manufacture or processing, can be shaped by flow;

(xxxv) **"Private Rights-of-Way"** means rights-of-way not located on roads, streets, or highways used by the public, or on railroad rights-of-way;

(xxxvi) **"Sales Meter Station"** means an installation that reduces high pressure gas from transmission system to the distribution system at permissible limits of distribution pressure. It may also measure volume of gas being injected into the distribution system and contain equipment/arrangements for odorization of Natural Gas

passed through it;

(xxxvii) **"Service"** means pipe that delivers gas from a main to a customer's gas meter;

(xxxviii) **"Specified Minimum Tensile Strength"** means the minimum tensile strength prescribed by the specification under which pipe is purchased from the manufacturer;

(xxxix) **"Specified Minimum Yield Strength" (SMYS)** means the minimum yield strength prescribed by the specification under which pipe is purchased from the manufacturer, abbreviated as SMYS;

(xl) **"Station Pipe-Work"** means those parts of a pipeline within a station (e.g. pump station, compressor station, metering station) that begin and end where the pipe material specification changes to that for the mainline pipe-work;

(xli) **"Stray Direct Current"** means current flowing through paths other than the intended circuit;

(xlii) **"Strength Test"** means a pressure test that confirms that the pipeline has sufficient strength to allow it to be operated at maximum allowable operating pressure (MAOP);

(xliii) **"Supply Main"** means a pipeline to carry gas from Sales Meter Station (SMS) at the transmission line to the inlet of the Town Border Station/District Regulating Stations;

(xliv) **"Telescoped Pipeline"** means a pipeline that is made up of more than one diameter or MAOP, tested as a single unit;

(xlv) **"Tensile Strength"** means the stress obtained by dividing the maximum load applied in a conventional tensile test by the original cross-sectional area of the test sample;

(xlvi) **"Thermoplastic"** - means plastic, which is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature;

(xlvii) **"Trepanning"** means cutting a disk or cylindrical core from the metal;

(xlviii) **"Town Border Station" (TBS)** - means a pressure regulating installation that reduces gas from high-pressure supply mains into feeder mains, which have services tapped from them;

(xlix) **"Up Rating"** means qualifying of an existing pipeline to a higher maximum allowable operating pressure;

(l) **"Upper Explosive Limit" (UEL)** - means the highest concentration of gas in air that can explode;

(li) **"Vault"** means an underground structure, which is designed to contain piping and other components such as valves or pressure regulators;

(lii) **"Yield Strength"** means the stress at which a material exhibits the specified limiting offset or produces a specified total elongation under load, in a tensile test, as specified in the specification or standard under which the material is purchased;

(2) The words and expressions used in these regulations, but not defined herein shall have the same meanings as are assigned to them in the Ordinance.

4. Technical Standards for Distribution

Detailed natural gas distribution technical standards, specified by the Authority are given in the schedule to these regulations.

5. Compliance Compulsory

1) All such licensees, carrying out the regulated activity of distribution of natural gas, shall comply with the technical standards provided in these regulations.

2) The Authority in consultation with the licensee, may review, rescind, change, alter or vary any technical standard specified in these regulations.

BRIG. (RETD.) TARIQ MAHMUD,
Secretary,
Oil and Gas Regulatory Authority

SCOPE

This Standard covers the design, construction, operation and maintenance of natural gas pipeline distribution system. The scope of this Standard is limited to portions of pipeline system starting from the outlet of sale meter station (SMS) at the transmission line to the outlet of the customers meters but not including piping downstream of the customers meters. The distribution system pressure is not to exceed 300 psig. Maximum allowable operating pressures above 300 psig shall be classified as transmission pressures. However, it is not the intention of this categorization to limit a Company to operate only in a single category. Figure 1 describes the limits of Distribution System.

Fabricated assemblies, pressure vessels, LPG and LNG installations and piping for design temperature below –20 ^{0}F or above 450 ^{0}F are not covered by this Standard.

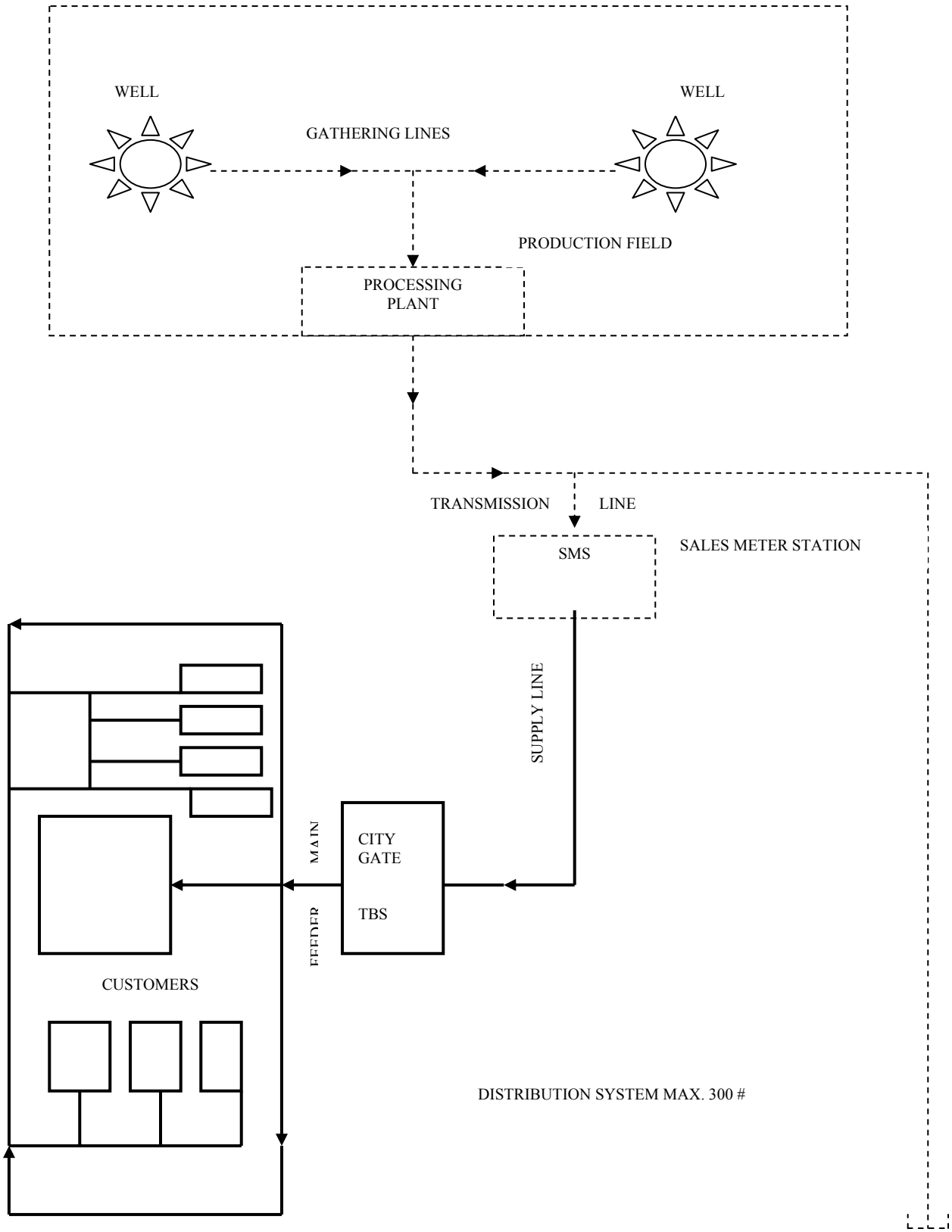

FIG. 1 – DISTRIBUTION SYSTEM SHOWN IN SOLID LINES

ABBREVIATIONS

AGA	American Gas Association
API	American Petroleum Institute
ASME	The American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BS	British Standards
CSA	Canadian Standards Association
CGA	Canadian Gas Association, also for Compressed Gas Association of USA
DIN	Deutsches Institut for Normung (German National Standards)
DOT	Department of Transportation, USA
ISO	International Organization for Standardization
MSS	Manufacturers Standardization Society
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration, USA
PE	Polyethylene
RP	Recommended Practice
SP	Standard Practice

1. DESIGN

1.1. Pipe Design

Pipe must be designed with sufficient wall thickness, or must be installed with adequate protection, to withstand anticipated external pressure and loads that will be imposed on the pipe after installation.

1.2. Design Formula for Steel Pipe

The design pressure for steel pipe is determined in accordance with the following formula:

P= (2St/D)x FxExT

Where:

P= Design pressure in pounds per square inch gauge

S= Yield strength in pounds per square inch

D= Nominal wall thickness of the pipe in inches

t= Nominal wall thickness of the pipe in inches. Pipe wall thickness must be equal or greater than minimum wall thickness given in Table 1.2

F= Design factor

E= Longitudinal joint factor – see Table 1.1

T= Temperature derating factor

(Ref: U.S. Department of Transportation 191-192)

Yield Strength Determination

Some of the commonly used pipe are listed below.

API 5L	Steel pipe
ASTM A 53	Steel pipe

ASTM A 106	Steel pipe
ASTM A 333/M	Steel pipe
ASTM A 381	Steel pipe
ASTM A 671	Steel pipe
ASTM A 672	Steel pipe
ASTM A 691	Steel pipe

The yield strength to be used in design formula is the SMYS, stated in the pertinent listed specification.

For pipe that is manufactured in accordance with a specification not listed, or whose specification or tensile properties are unknown, the yield strength to be used in design formula is one of the following:

a) If the pipe is tensile tested, the lower of the following:
   - eighty (80) percent of the average yield strength determined by the tensile tests.
   - the lowest yield strength determined by the tensile tests.

b) If the pipe is not tensile tested, use 24000 psi.

1.4. Nominal Wall Thickness

a) If the nominal wall thickness for steel pipe is not known, it is to be determined by measuring the thickness of each piece of pipe at quarter points on one end.

b) If the pipe is of uniform grade, size, and thickness, and there are more than 10 lengths, measure only 10 percent of the individual lengths, but not less than 10 lengths. The thickness of the lengths that are not measured must be verified by applying a gauge set to the minimum thickness found by the measurement. The nominal wall thickness to be used in the design formula is the next wall thickness found in commercial specifications that is below the average of all the measurements taken. However, the nominal wall thickness used may not be more than 1.14 times the smallest measurement taken on pipe less than 20 inches (508 millimeters) in outside diameter, nor more than 1.11 times the smallest measurement taken on pipe 20 inches (508 millimeters) or more in outside diameter.

1.5. Design Factor (F)

The design factor is dependent on location classes that are given in Table 1.3. However, for distribution lines, a design factor of 0.4 shall be used irrespective of location class.

1.6. Longitudinal Joint Factor (E)

The longitudinal joint factor to be used in the design formula is determined in accordance with Table 1.1.

TABLE 1.1

LONGITUDINAL JOINT FACTORS FOR STEEL PIPE

Specification	Pipe Class	Longitudinal joint Factor (E)
ASTM A 53	Seamless	1.00
	Electric resistance welded	1.00
	Furnace butt welded	0.60
ASTM A 106	Seamless	1.00
ASTMA 333	Seamless	1.00
	Electric resistance welded	1.00
ASTM A 381	Double submerged arc welded	1.00
ASTM A 671	Electric-fusion-welded	0.8
ASTM A 672	Electric-fusion-welded	0.8
ASTM A 691	Electric-fusion-welded	1.00
API 5 L	Seamless	1.00
	Electric resistance welded	1.00
	Electric flash welded	1.00
	Submerged arc welded	1.00
	Furnace butt welded	0.60
Other	Pipe over NPS 4	0.80
Other	Pipe NPS 4 and smaller	0.60

1.7. Temperature Derating Factor (T)

The temperature derating factor 1.00 shall be used in the design formula.

1.8. Valves

a) Except for cast iron and plastic valves, each valve must meet the minimum requirements, of **API 6D** or equivalent. A valve may not be used under operating conditions that exceed the applicable pressure and temperature ratings contained in those requirements.
b) Each valve must be able to meet the anticipated operating conditions.
c) No valve having pressure-containing parts made of ductile iron may be used in the gas pipe components of compressor stations.

1.9. Flanges and Flange Accessories

a) Flange or flange accessories must meet the minimum requirements of ANSI B16.5, MSS SP-44, or the equivalent.
b) Flange assembly must be able to withstand the maximum pressure at which the pipeline is to be operated and to maintain its physical and chemical properties at any temperature that it might be subjected to.
c) Each flange on a flanged joint in cast iron pipe must conform in dimensions, drilling, face and gasket design to ASME B16.1, and be cast integrally with the pipe, valve, or fitting.
d) ASTM A126 – specification for gray iron casting for valve, flanges and pipe fittings.

1.10. Standard Fittings

a) The minimum metal thickness of threaded fittings may not be less than specified for the pressure and temperatures in the applicable standards referenced in this part, or their equivalent.
b) Each steel butt-welding fitting must have pressure and temperature ratings based on stresses for pipe of the same or equivalent material. The actual bursting strength of the fitting must at least equal the computed bursting strength of pipe of the designated material and wall thickness, as determined by a prototype that was tested to at least the pressure required for the pipeline.

1.11. Welded Branch Connection

Welded branch connection made to pipe in the form of a single connection, or in a header or manifold as a series of connections, must be designed to ensure that the strength of the pipeline system is not reduced, taking into account the stresses in the remaining pipe wall due to the opening in the pipe or header, the shear stresses produced by the pressure acting on the area of the branch opening, and any external loadings due to thermal movement, weight and vibration.

1.12. Flexibility

Each pipeline must be designed with enough flexibility to prevent thermal expansion or contraction from causing excessive stress in the pipe or unusual loads at joints, or undesirable forces or moments at points of connection to equipment, or at anchorage or guide points.

1.13. Support and Anchors

a) Each pipeline and its associated equipment must have enough anchors or supports to:
   - prevent undue strain on connected equipment
   - resist longitudinal forces caused by a bend or offset in the pipe
   - prevent or dampen excessive vibration.

b) Each exposed pipeline must have enough supports or anchors to protect the exposed pipe joints from the maximum end force caused by internal pressure and any additional forces caused by temperature expansion or contraction or by the weight of the pipe and its contents.

c) Each support or anchor on an exposed pipeline must be made of durable, noncombustible material and must be designed and installed as follows:

   - Free expansion and contraction of the pipeline between supports or anchors may not be restricted.
   - Provision must be made for the service conditions involved.
   - Movement of the pipeline must not cause disengagement of the support equipment.

d) Each support on an exposed pipeline operated at a stress level of 50 percent or more of SMYS must comply with the following:
   - A structural support may not be welded directly to the pipe.
   - The support must be provided by a member that completely encircles the pipe.
   - If an encircling member is welded to a pipe, the weld must be continuous and cover the entire circumference.

e) Each underground pipeline that is connected to a relatively unyielding line or other fixed object must have enough flexibility to provide for possible movement, or it must have an anchor that will limit the movement of the pipeline.

f) Each underground pipeline that is being connected to new branches must have a firm foundation for both the header and the branch to prevent detrimental lateral and vertical movement.

1.14. Pressure Control Guidelines

Under normal operation, pressure on the outlet side of the regulating station or a customer service regulator should not exceed the following limits:

a) Sales Meter Station
   300 psig (Supply Line Max. Pressure)

b) City gate, Town Border Station or DRS
   150 psig (Feeder Main Max. Pressure)

c) Residential Customer
   8" w.c., but no more than 2 psig.

d) Commercial Customer
   As per contract, normally 8" w.c. to 5 psig.

e) Institutional and Industrial Customer
   As per contract, normally between 2-20 psig.

1.15. Control Of Pressure Of Gas Delivered from Distribution Feeder Mains

a) If the maximum actual operating pressure of the distribution system is under 60psig (414 kPa) and a service regulator having the following characteristics is used, no other pressure limiting device is required:

- A regulator capable of reducing distribution line pressure to pressures recommended for household appliances.

- A single-port valve with proper orifice for the maximum gas pressure at the regulator inlet.

- A valve seat made of resilient material designed to withstand abrasion of the gas, impurities in gas, cutting by the valve, and to resist permanent deformation when it is pressed against the valve port.

- Pipe connections to the regulator not exceeding NPS 2 (50 millimeters) in diameter.

- A regulator that, under normal operating conditions is able to regulate the downstream pressure within the necessary limits of accuracy, and to limit the build-up of pressure under no-flow conditions to prevent a pressure that would cause the unsafe operation of any connected and properly adjusted gas utilization equipment.

- A self contained service regulator with no external static or control lines.

b) If the maximum operating pressure of the distribution system is 60 p.s.i. (414 kPa) gage, or less, and a service regulator that does not have all of the characteristics listed in this section is used, or if the gas contains materials that seriously interfere with the operation of service regulators, there must be suitable protective devices to prevent unsafe over pressuring of the customer's appliances in the event that the service regulator fails.

c) If the maximum actual operating pressure of the distribution system exceed 60 p.s.i. (414 kPa) gage, one of the following methods must be used to regulate and limit, to the maximum safe value, the pressure of gas delivered to the customer:

- A service regulator having the characteristics listed in paragraph (1) of this section, and another regulator located upstream from the service regulator. The upstream regulator may not be set to maintain a pressure higher than 60 p.s.i. (414 kPa) gage. A device must be installed between the upstream regulator and the service regulator to limit the pressure on the inlet of the service regulator to 60 p.s.i. (414 kPa) gage or less in case the upstream regulator fails to function properly. This device may be either a relief valve

or an automatic shutoff that shuts, if the pressure on the inlet of the service regulator exceeds the set pressure [60 p.s.i. (414 kPa) gage or less] and remains closed until manually reset.

- A service regulator and a monitoring regulator set to limit, to a maximum safe value, the pressure of the gas delivered to the customer.

- A service regulator with a relief valve vented to the outside atmosphere, with the relief valve set to open so that the pressure of gas going to the customer does not exceed a maximum safe value. The relief valve may either be built into the service regulator or it may be a separate unit installed downstream from the service regulator. This combination may be used alone only in those cases where the inlet pressure on the service regulator does not exceed the manufacturer's safe working pressure rating of the service regulator and may not be used where the inlet pressure on the service line exceeds 100 p.s.i. (690 kPa) gage.

- A service regulator and an automatic shutoff device that closes upon a rise in pressure downstream from the regulator and remains closed until manually reset.

1.16. Design of Pressure Relief And Limiting Devices

Pressure-control systems shall be installed where supply from any source makes it possible to pressurize the piping above its maximum operating pressure. Such pressure-control systems shall be set to operate at or below the maximum operating pressure. Except for rupture discs, each pressure relief or pressure limiting device must:

a) be constructed of materials such that the operation of the device will not be impaired by corrosion.
b) have valves and valve seats that are designed not to stick in a position that will make the device inoperative.
c) be designed and installed so that it can be readily operated to determine if the valve is free, can be tested to determine the pressure at which it will operate, and can be tested for leakage when in the closed position.
d) have support made of noncombustible material.

e) have discharge stacks, vents, or outlet ports designed to prevent accumulation of water, ice, or snow, located where gas can be discharged into the atmosphere without undue hazard.
f) be designed and installed so that the size of the openings, pipe, and fittings located between the system to be protected and the pressure relieving device and the size of the vent line, are adequate to prevent hammering of the valve and to prevent impairment of relief capacity.
g) where installed at a district regulator station to protect a pipeline system from over pressuring, be designed and installed to prevent any single incident such as an explosion in a vault or damage by a vehicle from affecting the operation of both the overpressure protective device and the district regulator;
h) except for a valve that will isolate the system under protection from its source of pressure, be designed to prevent unauthorized operation of any stop valve that will make the pressure relief valve or pressure limiting device inoperative.
i) Where appropriate, protected with rain caps to prevent the entry of water.

1.17. Required Capacity of Pressure Relieving and Limiting Stations

Each pressure relief station or pressure limiting station or group of those stations installed to protect a pipeline must have enough capacity, and must be set to operate to ensure the following:

a) the pressure must not cause the unsafe operation of any connected and properly adjusted gas utilization equipment.
b) Where failure of the pressure-control system, or other causes, could result in the maximum operating pressure of the piping being exceeded by more than 10% or by 5 psig (35kPa) whichever is the greater.

1.18. Instrument, Control, Sampling Pipe and Components

a) This section applies to the design of instrument, control and sampling pipe and components. It does not apply to permanently closed systems, such as fluid-filled temperature-responsive devices.

b) All materials employed for pipe and components must be designed to meet the particular conditions of service and the following:

- Each takeoff connection and attaching boss, fitting, or adapter must be made of suitable material, be able to withstand the maximum service pressure and temperature of the pipe or equipment to which it is attached, and be designed to satisfactorily withstand all stresses without failure by fatigue.
- Except for takeoff lines that can be isolated from sources of pressure by other valving, a shutoff valve must be installed in each takeoff line as near as practicable to the point of takeoff. Blowdown valves must be installed where necessary.
- Pipe or components that may contain liquids must be protected by heating or other means from damage due to freezing.
- Pipe or components in which liquids may accumulate must have drains or drips.
- Pipe or components subject to clogging from solids or deposits must have suitable connections for cleaning.
- The arrangement of pipe, components, and supports must provide safety under anticipated operating stresses.
- Each joint between sections of pipe, and between pipe and valves or fittings, must be made in a manner suitable for the anticipated pressure and temperature condition. Slip type expansion joints must not be used. Expansion must be allowed for by providing flexibility within the piping itself.
- Each control line must be protected from anticipated causes of damage and must be designed and installed to prevent damage to any one control line from making both the regulator and the over-pressure protective device inoperative.
- Suitable precautions shall be taken to protect against corrosion.

1.19. Vaults

1.20. Structural Design Requirements

a) Each underground vault or pit for valves, pressure relieving, pressure limiting, or pressure regulating stations, must be able to meet the loads which may be imposed upon it, and to protect installed equipment.

b) There must be enough working space so that all of the equipment required in the vault or pit can be properly installed, operated and maintained.
c) Each pipe entering, or within a regulator, vault or pit must be of steel, for sizes NPS 10 and less, except that control and gage piping may be stainless steel. Where pipe extends through the vault or pit structure, provision must be made to prevent the passage of gasses or liquids through the opening, and to avert strains in the pipe.

1.21. Accessibility

Each vault must be located in an accessible location and, so far as practical, away from:

a) street intersections or points where traffic is heavy or dense
b) points of minimum elevation, catch basins, or places where the access cover will be in the course of surface waters
c) water, electric, steam, or other facilities.

1.22. Sealing, Venting, and Ventilation

Each underground vault or closed-top pit containing either a pressure regulating or reducing station, or a pressure limiting or relieving station must be sealed, vented or ventilated as follows:

a) When the internal volume exceeds 200 cubic feet (6 cubic meters):
    - The vault or pit must be ventilated with two ducts, each having at least the ventilating effect of NPS 4 pipe.
    - The ventilation must be enough to minimize the formation of combustible atmosphere in the vault or pit.
    - The ducts must be high enough above grade to disperse any gas-air mixtures that might be discharged. The recommended height is 8’ (2m) from grade.

b) When the internal volume is more than 75 cubic feet (2.1 cubic meters) but less than 200 cubic feet (6 cubic meters):
    - If the vault or pit is sealed, each opening must have a tight fitting cover without open holes through which an explosive mixture might be ignited, and there must be means for testing the internal atmosphere before removing the cover.
    - If the vault or pit is vented, there must be a means of preventing external sources of ignition from reaching the vault atmosphere.

1.23. Drainage and Water Proofing

a) Each vault must be designed so as to minimize entrance of water.

b) A vault containing gas piping may not be connected by means of a drain connection to any other underground structure.

c) Electrical equipment in vaults must conform to the applicable requirements of Class 1, Group D, of U.S. National Electrical Code, ANSI/NFPA 70.

(Ref: U.S. Department of Transportation 191-192)

Table 1.2
Least Nominal Wall Thickness for Steel Carrier Pipe for Gas Pipeline Systems

	Least nominal wall thickness for steel carrier pipe (in.)			
	Plain End Pipe			Threaded Pipe*
NPS	Class 1 location	Class 2 location	Class 3 or 4 location	All Class locations
3/8	.091	.091	.091	.091
½	.083	.083	.083	.110
¾	.083	.083	.083	.113
1	.083	.083	.083	.133
1¼	.083	.083	.083	.140
1 1/2	.083	.083	.083	.145
2	.083	.083	.083	.154
2 1/2	.083	.087	.087	.204
3	.083	.098	.098	.216
3 1/2	.083	.106	.106	.224
4	.083	.118	.118	.236
5	.083	.125	.125	
6	.083	.134	.154	
8	.125	.134	.173	
10	.154	.165	.188	
12	.173	.173	.204	
14	.188	.188	.208	
16	.188	.188	.219	
18	.188	.188	.250	
20	.188	.188	.250	
22, 24, 26	.219	.219	.250	
28, 30	.219	.250	.281	
32, 34, 36	.219	.250	.311	
38-54 inclusive	.250	.250	.311	

Note:

*The least nominal wall thickness of threaded pipe using National Pipe Threads (NPT) shall be as given in Table 1.2 for threaded pipe, but not less than that specified for plain end pipe. Where threads other than NPT are used, the thickness under the last engaged thread (based on nominal dimensions) shall be at least 0.5 times the nominal wall thickness of the pipe, but in no case shall the nominal wall thickness be less than that specified for plain end pipe.

TABLE 1.3

LOCATION CLASSES

a) **Location Class 1.** A Location Class 1 is any 1 mile long section ¼ mile wide containing the gas pipe in the middle that has 10 or fewer buildings intended for human occupancy. A Location Class 1 is intended to reflect areas such as wasteland, deserts, mountains, grazing land, farmland and sparsely populated areas.

b) **Location Class 2.** A Location Class 2 is any 1 mile section ¼ mile wide containing the gas pipe in the middle that has more than 10 but fewer than 46 buildings intended for human occupancy. A Location Class 2 is intended to reflect areas where the degree of population is intermediate between Location Class 1 and Location Class 3 such as fringe areas around cities and towns, industrial areas, ranch or country estates, etc.

c) **Location Class 3.** A Location Class 3 is any 1 mile section ¼ mile wide containing the gas pipe in the middle that has 46 or more buildings intended for human occupancy. A Location Class 3 is intended to reflect areas such as suburban housing developments, shopping centers, residential areas, industrial areas and other populated areas not meeting Location Class 4 requirements.

d) **Location Class 4.** Location Class 4 includes areas where multistorey buildings are prevalent and where traffic is heavy or dense and where there may be numerous other utilities underground. Multistorey means 4 or more floors above ground including the first or ground floor. The depth of basements or number of basement floors is immaterial.

2. CONSTRUCTION

This section prescribes minimum requirements for constructing distribution lines.

2.1. Compliance With Specification and Standards

Each distribution line must be constructed in accordance with comprehensive written specifications or standards that are consistent with this document.

2.2. Inspection

Construction inspection provisions for pipelines and related facilities shall be adequate to assure compliance with the material, construction, welding, assembly and testing requirements of this Standard.

2.3. Qualification of Inspectors

a) Inspection personnel shall be qualified by training and experience. Such personnel shall be capable of performing the following inspection services:-
   - right of way and grading
   - ditching
   - line up and pipe surface inspection
   - welding
   - coating
   - tie-in and lowering
   - backfilling compaction and clean up
   - pressure testing
   - Special services for testing and inspection of facilities, such as station construction, river crossings, electrical installation, radiography, corrosion control, etc., as may be required.

(Ref: ASME B 31.8- 99)

2.4. Construction Requirements

Inconvenience to the residents should be a minimized and safety of the public shall be given prime consideration.

In constructing pipeline crossings of railroads, highways, streams, lakes, rivers, etc, safety precautions such as sign, light, guard rails, etc., shall be, maintained in the interest of public safety. The crossing shall comply with the applicable rules, regulations, and restrictions of regulatory bodies having jurisdiction.

2.5. Handling, Hauling, Stringing and Storing

Care shall be exercised in the handling or storing of pipe, casing, coating materials, valves, fittings and other materials to prevent damage. When applicable, railroad transportation of pipe shall meet the requirements of API RP 5L1. In the event pipe is yard coated or mill coated, adequate precautions shall be taken to prevent damage to the coating when hauling, lifting, and placing on the right of way. Pipe shall not be allowed to drop and strike objects, which will distort, dent, flatten, gouge or notch the pipe or damage the coating, but shall be lifted or lowered by suitable and safe equipment.

(Ref: ASME B 31.8-99)

2.6. Ditching

a) Depth of ditch shall be appropriate for the route location, surface use of the land, terrain features, and loads imposed by roadways and railroads. All buried pipelines shall be installed with a minimum cover not less than that specified in this Standard, where the cover provisions cannot be met, pipe may be installed with less cover if additional protection is provided to withstand anticipated external forces.

b) Width and grade of ditch shall provide for lowering of the pipe into the ditch to minimize damage to the coating and to facilitate fitting the pipe to the ditch.

c) Location of underground structures intersecting the ditch route shall be determined in advance of construction activities to prevent damage to such structures. A minimum clearance of 12 in. (0.3 m) shall be provided between the outside of any buried pipe or component and the extremity of any other underground structures, except for drainage tile which shall have a minimum clearance of 2 in. (50 mm).

d) Ditching operations shall follow good pipeline practice and consideration of public safety. **API RP 1102** provides information on rail road and highway crossings.

2.7. Installation Of Pipe In The Ditch

On pipelines operating at stresses of 20% or more of the specified minimum yield strength, it is important that stresses induced into the pipeline by construction be minimized. The pipe shall fit the ditch without the use of external force to hold it in place until the backfill is completed. When long sections of pipe that have been welded alongside the ditch are lowered in, care shall be exercised so as not to jerk the pipe or impose any strains that may kink or put a permanent bend in the pipe. Slack loops are not prohibited by this paragraph where laying conditions render their use advisable.

(Ref: ASME B 31.8 - 99)

2.8. Protection from Hazards

The operator must take all practicable steps to protect each distribution line or main from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipeline to move or to sustain abnormal loads.

2.9. Underground Clearance

a) Each distribution line must be installed with at least 12 inches (300 millimeters) of clearance from any other underground structure not associated with the

distribution line. If this clearance cannot be attained, the distribution line must be protected from damage that might result from proximity to other structure.

b) Each line must be installed with enough clearance from any other underground structure to allow proper maintenance and to protect against damage that might result from proximity to other structures.

(Ref: U.S. Department of Transportation 191-192)

2.10. Backfilling

a) Backfilling shall be performed in a manner to provide firm support under the pipe.

b) If there are large rocks in the material to be used for backfill, care shall be taken to prevent damage to the coating by such means as the use of rock shield material, or by making the initial fill with rock-free material sufficient to prevent damage.

c) Flooding of trench as a method to consolidate is not allowed, unless the pipe is adequately anchored to stop it from floating.

2.11. Cover Requirements

Buried pipeline shall be installed with a cover not less than that shown in the following table:

COVER

Location	For Normal Excavation (in)	Rock Excavation (in)	
		Pipe Size NPS 20 and Smaller	Pipe Size Larger Than NPS 20
Class 1 & 2	30	12	18
Class 3 and 4	30	24	24
Drainage Ditch at Public Roads	36	24	24
Highway	48	NA	NA
Railroad Crossings Uncased			
Primary Tracks	72	NA	NA
Industry Tracks	54	NA	NA
Railroad Crossing Cased	48	NA	NA
Waterways	48	NA	NA
Service lines any location	18	12	NA

Note: *Rock excavation is excavation that requires blasting

Where these cover provisions cannot be met or where external loads may be excessive, the pipeline shall be encased, bridged, or specially designed to withstand anticipated external load

2.12. Steel Pipelines Crossing Railroads and Highways Provision for Safety

The applicable regulations of federal, provincial, municipal, or other regulatory bodies having jurisdiction over the pipeline or facility to be crossed shall be observed for the installation of a crossing. Pipeline must cross the railroad or highway perpendicularly or as close perpendicularly as possible. Uncased crossings are preferred. Whether cased or uncased, there should be no void between the line (or the casing) and the soil. Installed casing must slope towards one end with a minimum slope of 1 : 100. Table 2.1 gives the minimum wall thickness allowed for casing pipe and for uncased carrier pipe crossing highways and railways. Where the requirements of railways, highways, or the design calculations stipulate higher values, they must be used. Particular attention should be given to other governmental codes such as the Mineral Gas Safety Rules, 1960.

TABLE 2.1

Least Nominal Wall Thickness for Steel Casing Pipe in Cased Crossings and Carrier Pipe in Uncased Crossing*

Least Nominal Wall Thickness (in)		
Pipe NPS	**Highways**	**Railways**
3	.125	.125
4	.125	.125
6	.188	.188
8	.188	.188
10	.188	.188
12	.188	.188
14	.188	.219
16	.188	.219
18	.188	.250
20	.188	.281
22	.220	.312
24	.250	.344
26	.250	.375
28	.250	.406
30	.250	.406
32	.250	.438
34	.250	.469
36	.250	.469
38	.312	.500
40	.312	.500
42	.312	.500
44	.312	.578
46	.312	.625
48	.326	.625
50	.344	.625

* For uncased crossings under Railways and Highways, the carrier pipe D/t ratio must not exceed the figures given in Table 2.2

Table 2.2

Maximum Pipe Diameter to Wall Thickness (D/t) Ratio for Uncased Railway and Highway Crossings

Maximum D/t ratio								
Maximum Operating Pressure (psi)	Steel pipe grade							
	35	42	46	52	56	60	65	70
2000	15	20	22	25	27	29	32	34
1900	16	21	23	26	29	31	33	36
1800	17	22	25	28	30	32	35	38
1700	18	24	26	30	32	34	37	40
1600	18	25	28	32	34	36	40	43
1500	19	27	30	34	36	39	42	45
1400	21	29	32	36	39	42	45	49
1300	22	31	34	39	42	45	49	53
1200	23	34	37	42	45	49	53	57
1100	25	37	41	46	50	53	58	62
1000	26	40	45	51	55	59	64	68
900	28	43	50	56	61	65	71	76
800	31	46	56	64	68	73	80	85
700	33	50	63	73	78	85	85	85
600	36	55	70	85	85	85	85	85
500	39	61	79	85	85	85	85	85
400	43	67	85	85	85	85	85	85
300	48	80	85	85	85	85	85	85
200	55	85	85	85	85	85	85	85
100	71	85	85	85	85	85	85	85

Notes:

a) For intermediate operating pressures, the D/t ratio may be interpolated.

b) D/t ratio means the OD divided by the nominal wall thickness.

c) Design conditions are the following:

3.1 6’ (2.0 m) minimum depth of cover;

3.2 130 °F (55° C) temperature differential;

3.3 maximum hoop stress of 50% SMYS;

3.4 maximum combined circumferential stress of 72% SMYS;

3.5 maximum combined equivalent tensile stress of 90% SMYS;

3.6 E-80 rail loading criteria with an impact factor of 1.4 at the surface, reducing linearly to 1.0 at 10’ (3.0m);

3.7 fluctuating stress limitation of 10 psi (69 MPa) based upon 2 000 000 cycles; and

3.8 maximum D/t ratio of 85.

2.13. Approval for Crossings

Prior to the construction of a pipeline crossing, arrangement should be made with the pertinent authority of the facility to be crossed.

2.14. Railroad and Highways Crossing Existing Pipelines

a) When an existing pipeline is to be crossed by a new road or railroad, the operating company shall reanalyze the pipeline in the area to be crossed in terms of the new anticipated external loads. If the sum of the circumferential stresses caused by internal pressure and newly imposed external loads exceeds 0.72 SMYS (specified minimum yield strength) the operating company shall install mechanical reinforcement, structural protection, or suitable pipe to reduce the stress or redistribute the external loads acting on the pipeline. The line may also be considered for lowering or rerouting. API RP 1102 provides methods which may be used to determine the total stress caused by internal pressure and external loads.

b) Adjustments of existing pipelines in service at a proposed railroad or highway crossing shall conform to details contained in API RP 1102. If casing is used, coated carrier pipe shall be independently supported at each end of the casing and insulated from the casing throughout the cased section, and casing ends shall be sealed using a durable, electrically nonconductive material.

2.15. Loads

A carrier pipe at an uncased crossing will be subjected to both internal load from pressurization and external loads from earth forces (dead load) and train or highway traffic (live load). An impact factor should be applied to the live load in accordance with API RP 1102.

2.16. Cased Crossing

Suitable materials for casings are new or used line pipe, grade 35 or better. Where cased crossings are installed, the design shall be in accordance with the following requirements:

a) Carrier pipe shall be designed in accordance with the applicable requirements of Design Section, Chapter 1.

b) For carrier pipe smaller than NPS 6, the outside diameter of the casing pipe shall be at least 2" greater than the outside diameter of the carrier pipe. For carrier pipe NPS 6 or larger, the outside diameter of the casing pipe shall be at least 3" greater than the outside diameter of the carrier pipe.

c) Carrier pipe shall be held clear of the casing pipe by properly designed support, insulators, or centering devices, so installed as to minimize external loads transmitted to the carrier pipe.

d) The ends of the casings shall be suitably sealed to the outside of the carrier pipe. Venting of sealed casings is not mandatory; however, where vents are installed, they shall be protected from the weather to prevent water from entering the casing. Where casing seals of a type that will retain more than 5 psig pressure between the casing and the carrier pipe are installed and vents are not used, provision shall be made to relieve the internal pressure before carrying out maintenance work.

e) Casing pipe under roads shall be of sufficient length to absorb all of the external loading from the road bed at the point of crossing.

f) Casing pipe under railways shall extend to the greatest of the following distances, measured at right angles to the centerline of the track:

- 25’ each side from the centerline of the outside track
- 3’ beyond the toe of slope; and
- 3’ beyond the ditch line or area that may be affected by normal ditch cleaning operations.
- The nominal wall thickness for steel casing pipe shall be not less than the applicable least nominal wall thickness given in Table 2.1.

2.17. Casing Vents

If casing vents are provided, they shall extend 2’ from ground and shall be min. NPS 2, one at each end of the casing. Vent pipes shall terminate with goosenecks, facing down. The vent pipe at the lower end of the casing shall be connected to the bottom of the casing, while the vent pipe at the higher end of the casing shall be connected to the top of the casing.

2.18. Inspection and Testing

Before installation, the section of carrier pipe used at the crossing should be inspected visually for defects. All girth welds should be inspected by radiographic or other nondestructive methods. After a cased crossing is installed, a test should be performed to determine that the carrier pipe is electrically isolated from the casing pipe.

2.19. Cathodic Protection

Cathodic protection systems at cased crossings should be reviewed carefully. Casing may reduce or eliminate the effectiveness of cathodic protection. The introduction of a casing creates a more complicated electrical system than would prevail for uncased crossings, so there may be difficulties in securing and interpreting cathodic protection measurement at cased crossings. Test stations with test leads attached to the carrier pipe and casing pipe should be provided at each cased crossing.

(Ref: API RP 1102 -93)

2.20. Line Markers

a) Line marker must be placed and maintained as close as practical over each buried main and distribution line:

- at each crossing of a public highway and railroad
- wherever necessary to identify the location of the distribution line or main to reduce the possibility of damage or interference.

b) Line markers must be placed and maintained along each section of a main and distribution line that is located above ground in an area accessible to the public.

c) At any other location where it is necessary as a warning for public safety.

d) The following must be written legibly on a background of sharply contrasting color on each line marker.

- The world “warning” “Caution” or “Danger” followed by the words “Gas (or name of gas transported) Pipeline” all of which, except for markers in heavily developed urban areas, must be in letters at least 1 inch (25 millimeters) high with ¼ inch (6.4 millimeters) stroke.
- The name of the company and the telephone number (including area code) where the company can be reached at all times.

3. WELDING

3.1. Welding Techniques

This covers arc welding of butt, fillet, and socket welds in carbon and low- alloy steel piping used in the compression, pumping, and transmission of petroleum products, fuel gases and welding on distribution systems. The welding may be done by a shielded metal- arc welding, sub-merged arc welding using manual or semiautomatic technique.

3.2. Equipment

Welding equipment shall be of a size and type suitable for the work and shall be maintained in a condition that ensures acceptable welds, continuity of operation and safety of personnel. Arc welding equipment shall be operated within the amperage and voltage ranges given in qualified welding procedures.

3.3. Materials

This applies to the welding of pipe and fittings that conform to the following specifications:

- API specification 5L
- Applicable ASTM specification

3.4. Filler Metal

All filler metals shall conform to one of the following specifications:

- AWS A5.1
- AWS A5.2
- AWS A5.5
- AWS A5.17
- AWS A5.18
- AWS A5.20
- AWS A5.28
- AWS A5.29

(Ref: API 1104 - 94)

3.5. Procedure Qualification

Before production welding is started, a detailed procedure specification shall be established and qualified to demonstrate that welds with suitable mechanical properties and soundness can be made by the procedure. The quality of the welds shall be determined by destructive testing.

The details of each qualified procedure shall be recorded. The record shall be maintained as long as the procedure is in use.

(Ref: API 1104 - 94)

3.6. Procedure Specification

The procedure specification shall include the following information:

a) Process

The specific process or combination of processes used shall be identified. The use of a manual, semiautomatic or automatic welding process or any combination of these shall be specified.

b) Pipe and Fitting Materials

The material to which the procedures applies shall be identified

c) Diameters and Wall Thickness

The ranges of diameters and wall thickness over which the procedure is applicable shall be identified.

d) Joint Design

The specification shall include a sketch or sketches of the joint that show the angle of bevel, the size of the root face and the root opening or the space between abutting members. The shape and size of fillet welds shall be shown. If a backup is used, the type shall be designated.

e) Filler Metal and Number of Beads

The sizes and classification number of the filler metal and the minimum number and sequence of beads shall be designated.

f) Electrical Characteristics

The current and polarity shall be designated, and the range of voltage and amperage for each electrode, rod, or wire shall be shown.

g) Position

The specification shall designate roll or position welding.

h) Direction of Welding

The specification shall designate whether the welding is to performed in an uphill or downhill direction.

i) Time between Passes

The maximum time between the completion of the root bead and the start of the second bead, as well as the maximum time between the completion of the second bead and the start of other beads, shall be designated.

j) Type and Removal of Lineup Clamp

The specification shall designate whether the lineup clamp is to be internal or external or if no clamp is required. If a clamp is used, the minimum percentage of root-bead welding that must be completed before the clamp is released shall be specified.

k) Cleaning and/or Grinding

The specification shall indicate whether power tools or hand tools are to be used for cleaning, grinding, or both.

l) Pre-and Post-Heat Treatment

The methods, temperature, temperature-control methods and ambient temperature range for pre-and post-heat treatment shall be specified.

m) Speed of Travel

The range for speed of travel, in inches per minute, shall be specified for each pass.

(Ref: API 1104 - 94)

3.7. Essential Variables

A welding procedure must be reestablished as a new procedure specification and must be completely requalfied when any of the essential variables listed below are changed.

a) Welding Process

A change from the welding process or method of application established in the procedure specification constitutes an essential variable.

b) Base Material

A change in base material constitutes an essential variable. For the purposes of this standard, all materials shall be grouped as follows:

- specified minimum yield strength less than or equal to 42,000 pounds per square inch (290 MPa).

- specified minimum yield strength greater than 42,000 pounds per square inch (290 MPa), but less than 65,000 pounds per square inch (448 MPa).

- for materials with a specified minimum yield strength greater than or equal to 65,000 pounds per square inch (448 MPa), each grade shall receive a separate qualification test.

c) Joint Design

A major change in joint design (for example, from V groove to U groove) constitutes an essential variable. Minor changes in the angle of bevel or the land of the welding groove are not essential variables.

d) Position

A change in position from roll to fixed, or vice versa constitutes an essential variable.

e) Wall Thickness

A change from one wall-thickness group to another constitutes an essential variable.

f) Filler Material

Changes in filler metal constitute essential variables.

g) Electrical Characteristics

A change from DC electrode positive to DC electrode negative or vice versa or a change in current from DC to AC or vice versa constitutes an essential variable.

h) Time Between Passes

An increase in the maximum time between completion of the root bead and the start of the second bead constitutes an essential variable.

i) Direction of Welding

A change in the direction of welding from vertical down-hill to vertical uphill, or vice versa, constitutes an essential variable.

j) Speed of Travel

A change in the range for speed of travel constitutes an essential variable.

3.8. Qualification of Welders

The purpose of the welders qualification test is to determine the ability of welders to make sound butt or fillet welds using previously qualified procedures. Before any production welding is performed, welders shall be qualified according to the applicable requirements.

A welder who has successfully completed the qualification test described in Section 3 of API 1104 (Latest Edition) shall be qualified within the limits of the essential variables described below. If any of the following essential variables are changed, the welder using the new procedure shall be requalified:

- A change from one welding process to another welding process or combination of processes.
- A change in the direction of welding from vertical uphill to vertical downhill or vice versa.
- A change of filler-metal classification.
- A change from one outside-diameter group to another.

These groups are defined as follows:

  - Outside diameter less than 2 ⅜ inches (60.3 millimeters).
  - Outside diameter from 2 ⅜ inches (60.3 millimeters) through 12 ¾ (323.8 millimeters).
  - Outside diameter greater than 12 ¾ (323.8 millimeters).

- A change from one wall-thickness group to another. These groups are defined as follows:
  - Nominal pipe wall thickness less than 3/16 inch (4.78 millimeters).
  - Nominal pipe wall thickness from 3/16 inch (4.8 millimeters) through ¾ inch (19 millimeters).
  - Nominal pipe wall thickness greater than ¾ inch (19 millimeters).

- A change in position from that for which the welder has already qualified (for example, a change from rolled to fixed or a change from vertical to horizontal or vice versa). A welder who successfully passes a butt-weld qualification test in the fixed position with the axis inclined 45 degrees from the horizontal plane shall be qualified to do butt welds in all positions.
- A change in the joint design (for example, the use of a backing strip or a change from V bevel to U bevel).

(Ref: API 1104 - 94)

3.9. Limitation of Welders

a) No welder whose qualification is based on nondestructive testing may weld compressor station pipe and components.

b) No welder may weld with a particular welding process unless, within the preceding 6 calendar months, he has been engaged in welding with that process.

c) A qualified welder:
   - may not weld on pipe to be operated at a pressure that produces a hoop stress of 20 percent or more of SMYS unless within the preceding seven calendar months the welder has had one weld tested and found acceptable under API Standard 1104.
   - may not weld on pipe to be operated at a pressure that produces a hoop stress of less than 20 percent of SMYS unless the welder is tested in accordance with API Standard 1104.

d) A qualified welder may not weld unless:
   - Within the preceding fifteen calendar months, but at least once each calendar year, the welder has requalified.
   - Within the preceding seven calendar months, but at least twice each calendar year, the welder has had---
     - o A production weld cut out, tested, and found acceptable in accordance with the qualifying test; or
     - o For welders who work only on service lines NPS 2 inches (50 mm) or smaller in diameter, two sample welds tested and found acceptable.

(Ref: U.S. Department of Transportation 191-192)

3.10. Miter Joint

a) Except for miter joints of up to 3º, it is preferable to use other acceptable methods of change of direction, such as the use of welding elbows or induction bending.

b) A miter joint on steel pipe to be operating at a pressure less than 100 psig may not deflect the pipe more than 12.5º and must be at a distance equal to one pipe diameter or more away from any other miter joint, as measured from the crotch of each joint.

c) Miter joints on pipe with MAOP greater than 100 psig are not allowed.

3.11. Preparation of A Joint for Production Welding

Piping shall be welded by qualified welders using qualified procedures. The surfaces to be welded shall be smooth, uniform, and free from laminations, tears, scale, slag, grease, paint, and other deleterious material that might adversely affect the welding.

a) Alignment

The alignment of the abutting ends shall minimize the off-set between surfaces. For pipe ends of the same nominal wall thickness, the off-set shall not exceed 1/16" (1.6mm). If a larger off-set is caused by dimensional variations, it shall be equally distributed around the circumference of the pipe. Hammering of the pipe to obtain proper lineup should be kept to a minimum.

b) Use of Lineup Clamp for Butt Welds

Lineup clamps shall be used for butt welds in accordance with the procedure specification. When it is permissible to remove the lineup clamp before the root bead is completed, the completed part of the bead shall be in approximately equal segments spaced equally around the circumference of the joint. However, when an internal lineup clamp is used and conditions make it difficult to prevent movement of the pipe or if the weld will be unduly stressed, the root bead shall be completed before clamp tension is released. Root bead segments used in connection with external clamps shall be uniformly spaced around the circumference of the pipe and shall have an aggregate length of at least 50 percent of the pipe circumference before the clamp is removed.

c) Mill Bevel

All mill bevels on pipe ends shall conform to the joint design used in the procedure specification.

d) Field Bevel

Pipe ends should be field beveled by machine tool or machine oxygen cutting. If necessary, manual oxygen cutting may also be used. The beveled ends shall be reasonably smooth and uniform and dimensions shall be in accordance with the procedure specification.

e) Weather Conditions

Welding shall not be done when the quality of the completed weld would be impaired by the prevailing weather conditions, including but not limited to airborne moisture, blowing sands, or high winds. Windshields shall be used when necessary.

f) Clearance

When the pipe is welded above ground, the working clearance around the pipe at the weld should not be less than 16 inches (40 millimeters). When the pipe is welded in a trench, the bell hole shall be large enough to provide the welder or welders with ready access to the joint.

g) Cleaning Between Beads

Scale and slag shall be removed from each bead and groove. Power tools shall be used when called for in the procedure specification; otherwise, cleaning may be with either hand or power tools.

When automatic or semiautomatic welding is used, surface porosity clusters, bead starts, and high points shall be removed by grinding before weld metal is deposited over them.

h) Position Welding

All position welds shall be made with the parts to be joined secured against movement and with adequate clearance around the joint to allow the welder or welders space in which to work.

i) Filler and Finish Beads

For position welding, the number of filler and finish beads shall be such that the completed weld has a substantially uniform cross section

around the entire circumference of the pipe. At no point shall crown surface be below the outside surface of the pipe, nor should it be raised above the parent metal by more than 1/16" (1.6mm).

Two beads shall not be started at the same location. The face of the completed weld should be approximately 1/8" (3.2mm) wider than the width of the original groove. The completed weld shall be thoroughly brushed and cleaned.

j) Identification of Welds

Each welder shall identify his work in the manner prescribed by the procedure.

k) Pre-And Post Heat Treatment

The procedure specification shall specify the pre-and post-heat treatment practices to be followed when materials or weather conditions make either or both treatments necessary.

(Ref: API 1104 - 94)

3.12. Inspection and Testing Of Production Welds

a) Visual inspection of welding must be conducted to ensure that:
   - The welding is performed in accordance with the welding procedure.
   - The weld is acceptable under section 6 of API Standard 1104.

b) The welds on a pipeline to be operated at a pressure that produces a hoop stress of 20 percent or more of SMYS must be Nondestructively tested on a percentage basis as given below under Nondestructive Testing.

3.13. Acceptance Standards For Nondestructive Testing

The acceptability of discontinuities located by Radiographic, magnetic particle, liquid penetrant and ultrasonic test method is determined according to the section 6 of API Standard 1104.

3.14. Nondestructive Testing for Lines with MAOP Greater Than 20% SMYS

a) Nondestructive testing of welds must be performed by any process, other than trepanning, that will clearly indicate defects that may affect the integrity of the weld.

b) Nondestructive testing of welds must be performed:
   - In accordance with written procedures.
   - By persons who have been trained and qualified in the established procedures and with the equipment employed in testing.

c) Procedures must be established for the proper interpretation of each nondestructive test of a weld to ensure the acceptability of the weld.

d) When nondestructive testing is required, the following percentages of each day's field butt welds, selected at random by the operator, must be nondestructively tested over their entire circumference:
   - In Class 1 locations at least 10 percent.
   - In Class 2 locations at least 15 percent.
   - In Class 3 and Class 4 locations, 100%, unless impracticable, in which case at least 90 percent at crossings of major or navigable rivers, offshore and within railroad or public highway rights-of-way, including tunnels, bridges and overhead road crossings.
   - At pipeline tie-ins, including tie-ins of replacement sections, 100 percent.

e) Except for a welder whose work is isolated from the principal welding activity, a sample of each welder's work for each day must be nondestructively tested, when non destructive testing is required.

f) When nondestructive testing is required, each company must retain, for the life of the pipeline, a record showing by milepost, engineering station, or by geographic feature, the number of girth welds made, the number nondestructively tested, the number rejected and the disposition of the rejects.

g) If any piece from a percentage sample fails, another percentage sample will be taken. If another sample fails, all the work from that welder shall be non destructively tested and the welder be asked to take a requalification test before being allowed to weld on pressurized piping.

3.15. Non-Destructive Testing For Line Operating At Less Than 20% SMYS.

- All welds shall be visually inspected by a qualified welding inspector.
- At the discretion of the Company, a percentage of the production welds and all tie-in welds may be non-destructively tested.

3.16. Repair And Removal Of Defects

a) Each weld that is repaired must have the defect removed down to sound metal and the segment to be repaired must be preheated if conditions exist which would adversely affect the quality of the weld repair. After repair, the segment of the weld that was repaired must be inspected to ensure its acceptability.

b) Cracks in circumferential butt welds and in fillet welds shall be completely removed by cutting out cylinders containing such cracks except that it shall be permissible to repair such welds using a documented and proven crack repair procedure.

3.17. Qualification Of Welders

a) Basic test:

The test is made on size NPS 12 or less in diameter. The test weld must be made with the pipe in a horizontal fixed position so that the test weld includes at least one section of overhead position welding. The beveling, root opening, and other details must conform to the specifications of the procedure under which the welder is being qualified. Upon completion, the test weld is cut into four coupons and subjected to a root bend test. If, as a result of this test, two or more of the four coupons develop a crack in the weld material, or between the weld material and base metal, that is more than 1/8 inch (3.2 millimeters) long in any direction, the weld is unacceptable. Cracks that occur on the corner of the specimen during testing are not considered.

b) Additional tests for welders of service line connections to mains

A service line connection fitting is to be welded to a pipe section with the same diameter as a typical main. The weld is to be made in the same position as it is made in the field. The weld is unacceptable if it shows a serious undercutting or if it has rolled edges. The weld is tested by attempting to break the fitting off the run pipe. The weld is unacceptable if it breaks and shows incomplete fusion, overlap, or poor penetration at the junction of the fitting and run pipe.

c) Periodic tests for welders of small service lines:

Two samples of the welder's work, each about 8 inches (200 mm) long with the weld located approximately in the center, are to be cut from steel service line and tested as follows:

- One sample is centered in a guided bend testing machine and bent to the contour of the die for a distance of 2 inches (50 mm)

on each side of the weld. If the sample shows any breaks or cracks after removal from the bending machine, it is unacceptable.

- The ends of the second sample are flattened and the entire joint subjected to a tensile or in the weld metal, the weld is unacceptable. If a tensile strength test. If failure occurs adjacent to or in the weld metal, the weld is unacceptable. If a tensile strength testing machine is not available, this sample must also pass the bending test prescribed in this section.

(Ref: U.S. Department of Transportation 191-192)

4. MATERIALS

4.1. Materials And Equipment:

All materials and equipment that will become a permanent part of any piping system shall be suitable and safe for the conditions under which they are to be used.
This section prescribes minimum requirements for the selection and qualification of pipe and components for use in pipelines.
Materials for pipe and components must be:

- able to maintain the structural integrity of the pipeline under it design conditions
- chemically compatible with the fluid that is to be transported through it.

(Ref: U.S. Department of Transportation 191-192)

4.2. Steel Pipe

Steel pipe manufactured in accordance with the following standards may be used:

- API 5L Line Pipe
- ASTM A 53 Welded and Seamless Pipe
- ASTM A 106 Seamless Pipe
- ASTM A 134 Electric-Fusion (Arc)-Welded Pipe
- ASTM A 135 Electric-Resistance-Welded Pipe
- ASTM A 139 Electric-Fusion (Arc)-Welded Pipe

- ASTM A 333 Seamless and Welded pipe for Low-Temperature Service
- ASTM A 381 Metal-Arc-Welded Pipe
- ASTM A 671 Electric-Fusion-Welded Pipe
- ASTM A 672 Electric-Fusion-Welded Pipe
- CSA Z 245.1-98 Steel Line Pipe

(Ref: ASME B 31.8 - 99)

4.3. Reuse Of Steel Pipe

Removal of a portion of an existing steel line and reuse of the pipe in the same line, or in a line operating at the same or lower pressure, is permitted subject only to the following restrictions:

Used steel pipe or, unidentified new steel pipe may be used for low-stress (hoop stress less than 6,000 psi) level service where no close coiling or close bending is to be done, provided careful visual examination indicates that it is in good condition and free from split seams or other defects that would cause leakage and provided further that if the pipe is to be welded and is of unknown specification or ASTM A120, it shall satisfactorily pass weldability tests.

Minimum remaining wall thickness or the nominal thickness whichever is lower shall be used for determining the MAOP.

(Ref: ASME B 31.8 - 99)

4.4. Determination Of Wall Thickness

Unless the nominal wall thickness is known with certainty, it shall be determined by measuring the thickness at quarter points on one end of each piece of pipe. If the lot pipe is known to be of uniform grade, size, and nominal thickness, measurement shall be made on not less than 10% of the individual length, but not less than 10 lengths; thickness of the other lengths may be verified by applying a gage set to the minimum thickness. Following such measurement, the nominal wall thickness shall be taken as the next commercial wall thickness below the average of all the measurements taken, but in no case greater than 1.14 times the least measured thickness for all pipe under NPS 20, and no greater than 1.11 times the least measured thickness for all pipe NPS 20 and larger.

(Ref: ASME B 31.8 - 99)

4.5. Surface Defects

All pipes shall be examined for gouges, grooves and dents. All harmful defects of this nature must be eliminated or repaired.

4.6. S Value:

For pipe of unknown specification, the yield strength to be used as S in the formula:- ***P= (2St/D)xFxExT** in lieu of the specified minimum yield strength, shall be 24,000 psi, or determined as follows:

Determine the average value of all yield strength tests for a uniform lot. The value of S shall then be taken as the lesser of the following:

- 80% of the average value of the yield strength tests;
- the minimum value of any yield strength test, provided, however, that in no case shall S be taken as greater than 52,000 psi.

(Ref: ASME B 31.8 - 99)

Where

P = Design pressure in pounds per square inch gauge.
S = Yield strength in pounds per square inch gauge.
D = Nominal outside diameter of the pipe in inches (millimeter).
t = Nominal wall thickness of the pipe in inches (millimeters).
F = Design factor.
E = Longitudinal joint factor.

4.7. Hydrostatic Test

New or used pipe of unknown specification and all used pipe the strength of which is impaired by corrosion of other deterioration, shall be retested hydrostatically either length by length in a mill type test or in the field after installation before being placed in service. The test pressure used shall establish the maximum allowable operating pressure.

The pipe must be tested at least 1.25 times the maximum allowable operating pressure if it is to be installed in a class 1 and 2 locations and to at least 1.5 times the maximum

allowable operating pressure if it is to be installed in a class 3 or 4 location. The test pressure must be maintained for at least 24 hours.

4.8. Bending Properties

For pipe NPS 2 and smaller, a length of pipe must be cold bent through at least 90 degrees around a cylindrical mandrel that has a diameter 12 times the diameter of the pipe, without developing cracks at any portion and without opening the longitudinal weld.

Pipe larger than NPS 2 must meet the requirements of the flattening tests set forth in Appendix H, ANSI B31.8-99.

4.9. Weldability

A girth weld must be made in the pipe by a welder who is qualified. The weld must be made under the most severe conditions under which welding will be allowed in the field and by means of the same procedure that will be used in the field. On pipe more than NPS 4, at least one test weld must be made for each 400 lengths of pipe. The weld must be destructively tested in accordance with API Standard 1104.

4.10. Inspection

The pipe must be clean enough to permit adequate inspection. It must be visually inspected to ensure that it is reasonably round and straight and there are no defects which might impair the strength or tightness of the pipe.

4.11. Tensile Properties

If the tensile properties of the pipe are not known, the minimum yield strength may be taken as 24,000 p.s.i. (165 MPa) or less, or the tensile properties may be established by performing tensile tests as set forth in API Specification 5L.

(Ref: U.S. Department of Transportation 191-192)

4.12. Used Piping Components And Equipment

Used piping components such as fittings, elbows, bends, intersections, couplings, reducers, closures, flanges, valves, and equipment may be reused. However, such components and equipment shall be cleaned and examined; reconditioned, if necessary, to insure that they meet all requirements for the intended service; and sound and free of defects.

In addition, reuse shall be contingent on identification of the specification under which the item was originally produced. Where the specification cannot be identified, use shall be restricted to a maximum allowable operating pressure based on a yield strength of 24,000 psi (165 MPa) or less.

(Ref: ASME B 31.4 - 99)

4.13. Transportation Of Pipe

In a pipeline to be operated at a hoop stress of 20 percent or more of SMYS, an operator may not use pipe having an outer diameter to wall thickness ratio of 70 to 1 or more, that is transported by railroad unless the transportation is performed in accordance with **API RP 5L1.** (The recommendations provided herein apply to the transportation on railcars of API Specification 5L steel line pipe in sizes NPS2 and larger, in lengths longer than single random. These recommendations cover coated or uncoated pipe, but they do not encompass loading practices designed to protect pipe coating from damage).

(Ref: U.S. Department of Transportation 191-192)

4.14. Marking Of Materials

a) Each valve, fitting, length of pipe, and other component must be marked:
   - as prescribed in the specification or standard to which it was manufactured.
   - to indicate size, material, manufacturer, pressure rating, and temperature rating and as appropriate, type, grade and model.

b) Surfaces of pipe and components that are subject to stress from internal pressure may not be field die stamped.

c) If any item is marked by die stamping, the die must have blunt or rounded edges that will minimize stress concentrations.

(Ref: U.S. Department of Transportation 191-192)

Note:

All material and components ,e.g., steel pipe, flanges, valves, gaskets, bolting, etc must conform to the specifications listed in **Appendix 4.1.** This is not an exhaustive list of materials and specifications. The Gas Distribution Company, may at its own discretion, choose an equivalent or superior specification to suit the application.

APPENDIX 4.1.

Standards and Specifications For Various Functions Api :- (American Petroleum Institute)

a) API 5L – Line pipe

The Purpose of this specification is to provide standards for pipe suitable for use in conveying gas, water and oil in both the oil and natural gas industries. This specification covers seamless and welded steel line pipe. It includes plain-end, threaded-end, and belled-end pipe, as well as through-the-flowline (TFL) pipe and pipe with ends prepared for use with special couplings. Although the plain-end line pipe meeting this specification is primarily intended for field makeup by circumferential welding, the manufacturer will not assume responsibility for field welding.

b) API RP 5L1 - Recommended Practice for Railroad Transportation of Line Pipe

The recommendation provided herein apply to the transportation on railcars of API Specification 5L steel line pipe in sizes NPS2 and larger in lengths longer than single random. These recommendations cover coated or uncoated pipe, but they do not encompass loading practices designed to protect pipe coating from damage.

c) API 1104 – Standard for Welding of Pipelines and Related Facilities

This standard covers the gas and arc welding of butt, fillet and socket welds in carbon and low-alloy steel piping transmission of crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen and where applicable, covers welding on distribution systems. It applies to both new construction and in-service welding.This standard also covers the procedures for radiographic, magnetic particle, liquid penetrant, and ultrasonic testing as well as the acceptance standards to be applied to production welds tested to destruction or inspected by radiographic, magnetic particle, liquid penetrant, ultrasonic and visual testing methods.

d) API 1107 - Recommended Pipeline Maintenance Welding Practices

This document covers recommended maintenance welding practices which may be used when making repairs to or installing appurtenances on piping system which are or have been in-service in the compression, pumping

and transmission of crude petroleum, petroleum products or fuel gases and where applicable to distribution piping systems for these products.

e) API 6D - Piping Valves

This International Standard specifies requirements and gives recommendations for the design, manufacturing, testing and documentation of ball, check, gate and plug valves for application in pipeline systems. Valve for pressure ratings exceeding PN 420 (Class 2500) are not covered by this International Standard. App. A of Spec 6D provides guidelines to assist the purchaser with valve type selection and specification of specific requirements when ordering valves.

f) API 1102 - Steel pipelines Crossing Railroads and Highways

Gives primary emphasis to provisions for public safety. It covers the design, installation, inspection and testing required to ensure safe crossings of steel pipelines under railroads and highways.

ASME - American Society of Mechanical Engineers

a) ASME B 31.8 – Gas Transmission and Distribution Piping Systems

This Code covers the design, fabrication, installation, inspection, testing and safety aspects of operation and maintenance of gas transmission and distribution systems, including gas pipelines, gas compressor stations, gas metering and regulation stations, gas mains and service lines up to the outlet of the customers meter set assembly. Included within the scope of this code are gas transmission and gathering pipelines, including appurtenances, that are installed offshore for the purpose of transporting gas from production facilities to onshore locations; gas storage equipment of the closed pipe type, fabricated or forged from pipe or fabricated from pipe and fittings and gas storage lines.

b) ASME B 16.5

Pipe flanges and flanged fittings

c) ASME B 16.33

Manually Operated Metallic Gas Valves For Use In Gas Piping Systems Up to 125 Psig, Size 1/2-2

d) ASME B 16.34

Valves Flanged Threaded And Welding End

e) ASME B 16.38

Large Metallic Valves For Gas Distribution (Manually Operated NPS-2 1/2 to 12, 125 Psig Max.)

f) ASME B 16.40

Manually Operated Thermoplastic Gas Shutoffs And Valves In Gas Distribution Systems

ASTM – AMERICAN SOCIETY FOR TESTING AND MATERIALS

- A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- A 105 Forgings, Carbon Steel, for piping Components
- A 106 Seamless Carbon Steel Pipe for High-Temperature Service
- A 120 Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Use
- A 134 Electric-Fusion (Arc)-Welded Steel Plate pipe (Sizes 16 in. and Over)
- A 135 Electric-Resistance-Welded Steel Pipe
- A 139 Electric-Fusion (Arc)-Welded Steel Plate Pipe (Sizes 4 in. and Over)
- A 193 Alloy-Steel and Stainless Steel Blots for High-Pressure and High-Temperature Service
- A 194 Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-temperature Service
- A 211 Spiral-Welded Steel or Iron Pipe
- A 307 Carbon Steel Externally Threaded Standard Fasteners
- A 320 Alloy Steel Bolting Materials for Low-Temperature Service
- A 333 Seamless and Welded Steel Pipe for Low-Temperature Service
- A 354 Quenched and Tempered Alloy Steel Bolts, Studs and other Externally Threaded Fasteners
- A 372 Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels

- A 381 Metal-Arc-Welded Steel Pipe for Use With High pressure Transmission Systems
- A 395 Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
- A 449 Quenched and Tempered Steel Bolts and Studs
- A 671 Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperature
- A 672 Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures
- D 2513 Thermoplastic Gas Pressure Pipe, Tubing and Fittings
- D 2517 Reinforced Epoxy Resin Gas Pressure Pipe and Fittings

- CSA Canadian Standards Association
- B 137.0 Definitions, general requirements and methods of testing for Thermo plastic Pressure Piping.
- B 137.4 Polyethylene Piping Systems for Gas Service

2245.1 Steel Line Pipe

5. TESTING

5.1. Hydrostatic Testing

Hydrostatic testing is defined as the applications of internal pressure above the normal or maximum operating pressure to a segment of pipeline, under no-flow conditions, for a fixed period of time, utilizing a liquid test medium.

5.2. New Construction And The Replacement Of Existing Pipeline Facilities

The hydrostatic testing of newly constructed pipelines and replaced segments of existing pipeline facilities should be performed before they are placed in service in accordance with the requirements set forth in this document.

The qualification of existing piping systems for an operating pressure higher than the previously established operating pressure should be performed in accordance with requirements of ASME B31.8 and applicable governmental regulations, if any.

5.3. Test Medium

The hydrostatic test should be conducted with water.

5.4. Equipment For A Hydrostatic Test

Equipment for the hydrostatic test should suit the conditions and be in good working order.

5.5. Test Plan And Procedure

A hydrostatic test plan and procedure diagram with explanatory notes and data should be prepared prior to testing and should indicate in a detailed fashion the following:

- The length and location of the test segment
- Test medium to be used.
- Procedures for cleaning and filling the line.
- Procedures for the pressurization of the test segment including the location of the injection points and the specified minimum and maximum test pressures.
- Minimum test duration for test segment
- Procedures for removal and disposal of test medium.
- Safety precautions and procedures.

A specified test pressure is defined as the minimum test pressure which should be applied to the most elevated point in the test segment. A detailed analysis of the profile to determine static and dynamic pressures while the pipeline is being tested should be performed so that the pipeline will not be over pressured at points which are at low elevations.

5.6. Conducting Hydrostatic Test

5.7. Pressurization

Personnel conducting the test should maintain continuous surveillance over the operation and ensure that it is carefully controlled.

The test segment should be pressurized at a moderate and constant rate. When approximately 70 percent of the specified test pressure is reached, the pumping rate should be regulated to minimize pressure variations and to ensure that increments of no greater than 100kpa (14.5 psi) may be accurately read and recorded. A pressure recording gauge should be installed in parallel with a deadweight tester and should be checked at regular intervals through the testing period by the deadweight tester. The bourdon tube type pressure gauge is used only for approximation of pressure and its readings need not be recorded. Pipe connections should be periodically checked for leaks during pressurization.

(Ref: API RP 1110)

5.8. Hydrostatic Test Record

Each operator shall record test information and will retain it for the useful life of the pipeline. The record must contain at least the following information:

- The name of the company and the employee responsible for making the test, and the name of any testing company used.
- Test medium used.
- Test pressure.
- Test duration.
- Pressure recording charts, or other record of pressure readings.
- Elevation variations, whenever significant for the particular test.
- Leaks and failures noted and their disposition.
- Ambient and ground temperatures at start & end of test.

5.9. Displacement Of Test Medium

Water should be displaced with spheres, squeegees and/or other pigging devices. Water should be disposed off at approved locations in a manner that will cause minimal environmental effects.

(Ref: API RP 1110)

5.10. Strength Test For Lines With MAOP Producing Greater Than 20% SMYS

Strength test to be followed by a leak test is required. Fuel gas is not allowed for this test.

a) Strength Test

MEDIUM	LOCATION CLASS	PRESSURE (MIN)	DURATION (MIN HRS)	REMARKS
Water	1,2	1.25 MAOP	24	Limit stress to 90% SMYS during test
Water	3,4	1.4 MAOP	24	-Do-
Air or inert gas	Any	1.1 MAOP	24	Limit stress during test to: 40% SMYS-for class 4 50% SMYS –for class 3 57% SMYS – for class 1 & 2

b) Leak Test

If air on inert gas is used for strength test, a separate leak test is not required provided all exposed joints and field welds are checked for leaks. Otherwise a separate leak test using air or inert gas must be used for the leak test, at a minimum pressure of 150 psig or at 110% MAOP whichever is greater. Duration of test shall be 24 hours.

5.11. Field Pressure Test For Lines With MAOP Of 100 PSIG to 20% SMYS

a) Strength Test

Same conditions as for above 20% SMYS stress level pipe apply, except that natural gas may also be used, in which case the following limitations would apply:

- Limit test pressure to 1.1 MAOP
- Limit stress level to 20% SMYS during test.

b) Leak Test

If a gaseous medium is used for strength test, a separate leak test is not required, providing all exposed joints and field welds are checked for leaks, using leak detection liquid and / or instrument. Otherwise, a separate leak test using air, inert gas or natural gas must be used for the leak test at a minimum pressure of 150 psig or one that produces a stress level of 20% SMYS, whichever is greater. Test duration shall be 8 hours.

5.12. Field Pressure Test for Steel And Plastic Lines Including Service Lines With MAOP Less Than 100 PSIG

For all class locations, leak test with air, inert gas or natural gas for ½ hour at the design pressure or minimum 50 psig whichever is more. It is recommended that a test pressure of 150 psig be used in all cases, in order to qualify all lines, steel and plastic, to MAOP of 100 psig.

5.13. Safety During Test

All testing of pipelines and mains after construction shall be done with due regard for the safety of employees and the public during the test. When air or gas is used, suitable steps shall be taken to keep persons not working on the testing operations out of the testing area during the period in which the hoop stress is first raised from

50% of the specified minimum yield strength to the maximum test stress, and until the pressure is reduced to the maximum operating pressure.

6. CORROSION

6.1. Corrosion Control

This section prescribes minimum requirements and procedures for the protection of metallic pipelines and components from external, internal and atmospheric corrosion for new and existing piping system.

a) External and internal corrosion shall be controlled consistent with condition of the piping system and the environment in which the system is located.
b) Each operating company shall establish procedures to implement its corrosion control program to achieve the desired objectives.
c) NACE RP-01-69/NACE RP-06-75, NACE RP–02-75 may be referred for guidance.

6.2. External Corrosion Control For Buried Or Submerged Pipeline

6.3. New Installations

All new pipelines and service lines and pipe-type and bottle-type holders installed shall be externally coated and cathodically protected unless it can be demonstrated by test and experience that the materials are resistant to corrosion in the environment in which they are installed. However, within twelve months after installation, the operating company shall electrically inspect the buried or submerged system. If the electrical inspection indicates that a corrosive condition exists, the piping system shall be cathodically protected. If cathodic protection is not installed, the piping system shall be electrically inspected at intervals not exceeding five years and the system shall be cathodically protected if electrical inspection indicates that a corrosive condition exists.

Ref: ASME B 31.8

6.4. Coating System

The performance of the coating system is dependent on surface preparation, coating material application methods and testing methods. Factory applied coating is preferred for all pipeline components to ensure adequate surface preparation and

coating application under controlled condition. Pipe coating shall be inspected, both visually and by an electric holiday detector just prior to lowering pipe into ditch. Any holiday or other damage to the coating detrimental to effective corrosion control shall be repaired and reinspected. The backfilling operation shall be inspected for quality, compaction and placement of material to prevent damage to pipe coating.

6.5. Protective Coatings And Surface Preparation

External protective coating, applied for the purpose of external corrosion control must:

- have surface preparation compatible with the coating to be applied. The pipe surface shall be free of deleterious materials such as rust, scale, moisture, dirt, oils, lacquers, and varnish. The surface shall be inspected for irregularities which could protrude through the coating. Any such irregularities shall be removed. Further information can be obtained from NACE RP-02-75, (Application of Organic Coatings to the External Surface of Steel Pipe for Underground Service).
- have sufficient adhesion to the metal surface to effectively resist under-film migration of moisture;
- be sufficiently ductile to resist cracking;
- have sufficient strength to resist damage due to handling and soil stress;
- have properties compatible with any supplemental cathodic protection.

b) Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.

c) Each external protective coating must be inspected just prior to lowering the pipe into the ditch and backfilling and any damage to coating must be repaired.

d) Each external protective coating must be protected from damage resulting from adverse ditch conditions or damage from supporting blocks.

e) If coated pipe is installed by boring, driving, or other similar method, precautions must be taken to minimize damage to the coating during installation.

The integrity of the coating shall be tested as soon as the pipeline has been fully installed. Repair should be effected with approved material and procedure at any defects in the coating.

(Ref: U.S. Department of Transportation 191-192)

6.6. Cathodic Protection System

The objective of using cathodic protection is to control the corrosion of metallic surfaces in contact with electrolyte.

a) A cathodic protection system provided by a galvanic anode or impressed current anode system shall be installed that will mitigate corrosion and contain a method of determining the degree of cathodic protection achieved on the buried or submerged piping system.
b) A cathodic protection system shall preferably be installed at the same time as the construction but no later than 1 year after completion of construction.
c) Cathodic protection shall be controlled so as not to damage the protective coating, pipe, or components.
d) Owners of known underground structures which may be affected by installation of a cathodic protection system shall be notified of said installation and where necessary, joint bonding surveys shall be conducted by parties involved.
e) Electrical installations shall be made in accordance with the U.S. National Electrical Code, ANSI/NFPA 70, API RP 500C.
f) The cathodic protection system shall be compatible with coating used on the pipeline.

ASME B 31.4 - 99

6.7. Criteria For Cathodic Protection

6.8. Steel Structures

a) A negative (cathodic) voltage of at least 0.85 volt as measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the electrolyte. Determination of this voltage is to be made with the protective current applied.

b) A minimum negative (cathodic) voltage shift of 300 millivolts, produced by the application of protective current. The voltage shift is measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the electrolyte. The criterion of voltage shift applies to structures not in contact with dissimilar metals.

c) A minimum negative (cathodic) polarization voltage shift of 100 millivolts measured between the structure surface and a saturated copper-copper sulfate reference electrode contacting the electrolyte. This polarization voltage shift is to be determined by interrupting the protective current and measuring the polarizing decay. When the current is initially interrupted, an immediate voltage shift will occour. The voltage reading after the immediate shift, shall be used as the base reading from which to measure polarization decay.

d) A net protective current from the electrolyte into the structure surface as measured by an earth current technique applied at predetermined current discharge (anodic) points of the structure.

Ref: ASME B 31.8

6.9. Electrical Isolation

a) Each buried or submerged pipeline must be electrically isolated from other underground metallic structures, unless the pipeline and the other structures are electrically interconnected and cathodically protected as a single unit.

b) One or more insulating devices must be installed where electrical isolation of a portion of a pipeline is necessary to facilitate the application of corrosion control.

c) Except for unprotected copper inserted in ferrous pipe, each pipeline must be electrically isolated from metallic casings that are a part of the underground system. However, if isolation is not achieved because it is impractical, other measures must be taken to minimize corrosion of the pipeline inside the casing.

d) Inspection and electrical tests must be made to assure that electrical isolation is adequate.

e) An insulating device may not be installed in an area where a combustible atmosphere is anticipated unless precautions are taken to prevent arcing.

e) Where a pipeline is located in close proximity to electrical transmission tower footings, ground cables or counterpoise, or in other areas where fault currents or unusual risk of lighting may be anticipated, it must be provided with protection against damage due to fault currents or lightning and protective measures must also be taken at insulating devices.

(Ref: U.S. Department of Transportation 191-192)

6.10. Test Station

Each pipeline under cathodic protection required by this subpart must have sufficient test stations or other contact points for electrical measurement to determine the adequacy of cathodic protection.

6.11. Test Leads

a) Each test lead wire must be connected to the pipeline so as to remain mechanically secure and electrically conductive.

b) Each test lead wire must be attached to the pipeline so as to minimize stress concentration on the pipe.

c) Each bare test lead wire and bare metallic area at point of connection to the pipeline must be coated with an electrical insulating material compatible with the pipe coating and the insulation on wire.

6.12. Interference Currents

a) Each operator whose pipeline system is subjected to stray currents shall have in effect a continuing program to minimize the detrimental effects of such currents.

b) Each impressed current type cathodic protection system or galvanic anode system must be designed and installed so as to minimize any adverse effects on existing adjacent underground metallic structures.

(Ref: U.S. Department of Transportation 191-192)

6.13. Existing Piping System

The operating company shall establish procedures for determining the external condition of its existing buried or submerged piping systems and take action appropriate for the conditions found, including, but not limited to, the following:

a) Examine and study records available from previous inspections and conduct additional inspections where the need for additional information is indicated. The type, location, number and frequency of such factors as knowledge of the condition of the piping system and environment and public or employee safety in the events of leakage. Corrective measures shall be taken accordingly.

b) Install cathodic protection on all buried or submerged piping systems that are coated with an effective external surface coating material. All buried or submerged piping at compressor stations and terminals shall be electrically inspected and cathodic protection installed or augmented where necessary.

c) Operating pressures on bare piping systems shall not be increased until they are electrically inspected and other appropriate actions are taken regarding condition of pipe and components.

Ref: ASME B 31.4 – 99

6.14. Monitoring

a) Each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements.

b) Each cathodic protection rectifier or other impressed current power source must be inspected four times each calendar year, but with intervals not exceeding 3.5 months, to ensure that it is operating.

c) Each reverse current switch, each diode, and each interference bond whose failure would jeopardize structure protection must be electrically checked for proper performance four (4) times each calendar year, but with intervals not exceeding 3.5 months.

d) Each operator shall take prompt remedial action to correct any deficiencies indicated by the monitoring.

e) Each Company shall, at intervals not exceeding 3 years, reevaluate its unprotected pipelines and cathodically protect them in accordance with this section in areas in which active corrosion is found. The Company shall determine the areas of active corrosion by electrical survey, or where electrical survey is impractical, by the study of corrosion and leak history records, by leak detection survey, or by other means.

(Ref: U.S. Department of Transportation 191-192)

6.15. Corrective Measures

a) If corrosion exits, which, unless controlled, could result in a condition that is detrimental to public or employee safety, appropriate corrective measures shall be taken to mitigate further corrosion on the piping system. Corrective measures shall continue to maintain a safe operating system. Appropriate corrective measures may include the following:

- Provisions for proper and continuous operation of cathodic protection facilities
- Application of protective coating
- Installation of galvanic anode
- Application of impressed current
- Electrical isolation
- Stray current control
- Other effective measures
- Any combination of the above

Ref: ASME B 31.8

6.16. Atmospheric Protection

6.17. New Installation

Pipe and components that are exposed to the atmosphere shall be protected from external corrosion by use of corrosion resistant steel or application of protective

coating or paint unless the operating company can demonstrate by test, investigation, or experience in area of application that a corrosive atmosphere does not exist. Protective coating or paint shall be applied to a clean surface and shall be suitable material to provide adequate protection from the environment.

6.18. Existing Piping System

Pipe and components in existing piping system that are exposed to the atmosphere shall be inspected in accordance with a planned schedule and corrective measures shall be taken.

6.19. Monitoring

Protective coating or paint used to prevent corrosion of pipe and components exposed to the atmosphere shall be maintained in a serviceable condition, and such protective coating or paint, as well as bare pipe and components not coated or painted shall be inspected at intervals not exceeding 18 months, but at least once every calendar year.

6.20. Internal Corrosion

The interior surface of a pipeline conveying a corrosive or potentially corrosive fluid shall be protected against corrosion.

Corrosion inhibitors and biocides or internal lining are some of the possible measures to mitigate internal corrosion.

The operating company shall establish procedures for determining the corrosive effect of the gas and the internal condition of its existing piping system and take appropriate action for the condition found.

(Ref: U.S. Department of Transportation 191-192)

6.21. Corrective Measures

a) In the case of external corrosion of buried or submerged piping, cathodic protection shall be installed or augmented to mitigate the external corrosion.
b) In the case of internal corrosion of piping, steps shall be taken or augmented to mitigate the internal corrosion.

c) In the case of external corrosion of piping exposed to the atmosphere, protective coating or paint shall be repaired or applied to mitigate the external corrosion.
d) Pipe that is replaced because of external corrosion shall be replaced with coated pipe if buried or submerged, and with corrosion resistant steel pipe or coated or painted pipe if exposed to the atmosphere.
e) If a portion of the piping system is repaired, reconditioned, or replaced, or operating pressure is reduced because of external or internal corrosion, the need for protection of that portion from such corrosion deterioration shall be considered and any indicated steps taken to control the corrosion.

6.22. Records

a) Records and maps showing the location of cathodically protected piping, cathodic protection facilities and neighboring structures affected by or affecting the cathodic protection system shall be maintained and retained for as long as the piping system remains in service.
b) Results of tests, surveys and inspections required to indicate the adequacy of corrosion control measures shall also be maintained for the service life of the piping systems, as well as records relating to routine or unusual inspections such as internal or external line conditions when cutting line or hot tapping shall be retained for at least 5 years.

7. LEAK DETECTION AND ODORIZATION

7.1. Foot Patrol

Lines that are installed in locations where abnormal physical movements or abnormal external loadings could cause failure or leakage shall be patrolled periodically, with the patrol frequencies determined by the severity of the conditions that could cause failure or leakage and the consequent hazards to safety.

7.2. Leakage Surveys

Operating company having distribution systems shall establish in their operating and maintenance procedure, provision for regular surveys for detecting leaks. Suitable combinations of methods such as gas detector surveys, corrosion surveys, vegetation surveys, barhole surveys or surface detection surveys may be employed.

Leak located by leakage surveys detected by smell or reported by public shall be investigated promptly, but no later than 24 hours. Repair record shall be kept for the life of the line.

Where repaired or abandoned piping is reactivated, it shall be tested to confirm that it is gas-tight.

a) Each company shall conduct periodic leakage surveys in accordance with this section.

b) The type and scope of the leakage control program must be determined by the nature of the operations and the local conditions, but it must meet the following minimum requirements:

- A leakage survey with leak detector equipment must be conducted in business districts, including tests of the atmosphere in gas, electric, telephone, sewer and water system manholes, at cracks in pavement and side walks, and at other locations providing an opportunity for finding gas leaks, at intervals not exceeding 15 months, but at least once each calendar year.
- A leakage survey with leak detector equipment must be conducted outside business districts as frequently as necessary, but at intervals not exceeding 5 years. However, for unprotected distribution lines, survey intervals must not exceed 3 years.
- In addition to all above requirements, every service line must be visually inspected for signs of leakage, such as dead vegetation and gas smell in the air from buried pipe or above ground piping at the meter, at the time of every meter reading by the Meter Reader. All suspected leaks shall be reported to the Company the same day.

7.3. Methods & Equipment

There are a variety of leakage survey and test methods to be carried out in the field, used singly or in combination depending on the circumstances (history, location, etc.). These types include the following:

a) Surface Gas Detection Survey

This type of survey entails continued sampling of the atmosphere, at or near ground level, with gas detector. This is the most widely used survey in the gas pipeline network.

The equipment used for this type of survey may be portable or may be vehicle mounted.

b) Sub-Surface Gas Detection Survey

A sub surface survey is used in conjunction with a surface detection survey to pinpoint the source of escaping gas in soil. This procedure involves the sampling of the atmosphere below ground level using Combustible Gas Indicator (GCI) or any other device capable of reading 0.5% gas in air. To pinpoint the leak, barholes over the pipeline area are tested for gas level readings. The locations of the barholes are adjusted to identify the source of leak as accurately as possible.

c) Pressure Drop Survey

This type of survey is performed on isolated section of piping to determine any pressure losses due to leakage. Test pressures and durations are defined by various operating modes. The amount of pressure drop is dependent upon the volume of the line under test, the temperature stabilization of the test medium and the sensitivity of the instrument.

d) Soap Test

Above ground fittings, valves and exposed piping can be tested for leaks with Soap/Water mixture. Leaks are indicated by the formation of bubbles. This test may be performed on all leak repairs and all 'tie-in' points.

e) Vegetation Survey

A visual examination of the vegetation above or adjacent to a buried gas line for indication of dead or dying vegetation.

f) Ultrasonic Leakage Test

The testing of exposed piping facilities is carried out with an instrument capable of detecting the ultrasonic energy generated by escaping gas. The instrument used should be suitable for the pressure involved.

The ultrasonic test may be used for the testing of exposed piping facilities. However, if the ultrasonic background level produces a full scale meter reading when the gain is set at mid range, the facility should be tested by some other survey method.

(Ref: ASME B 31.8 Edd: 1995)

7.4. Odorization

Any gas distributed through distribution system or used for domestic purposes in a compressor plant, which does not naturally possess a distinctive odor, shall be odorized with a suitable gas odorant in sufficient continuous quantity to make the gas detectable by the sense of smell at gas concentration of 20% of lower explosive limit (20% LEL).
Odorization is not required for:

- gas in underground or other storage
- gas used for further processing
- gas used in lease or field operations.

Each operating company shall use odorization equipment designed for the type and injection rate of odorant being used.

Odorant concentration tests shall be conducted by each operating company of the gas supplied through its facilities which requires odorization. Test points shall be remotely located from the odorizing equipment so as to provide data representative of gas at all points of the system.
In the concentrations in which an odorant is used in the gas, it must comply with the following:

a) The odorant may not be deleterious to persons, materials, or pipe.
b) The products of combustion from the odorant may not be toxic when breathed nor may they be corrosive or harmful to those materials to which the products of combustion will be exposed.
c) The odorant may not be soluble in water to an extent greater than 2.5 parts to 100 parts by weight.
d) Equipment for odorization must introduce the odorant without wide variations in the level of odorant.
e) Each company shall conduct periodic sampling of combustible gases to assure the proper concentration of odorant in accordance with this section.

(Ref: U.S. Department of Transportation 191-192)

8. OPERATION AND MAINTANANCE

8.1. Procedural Manual For Operations, Maintenance and Emergencies

Each operator shall prepare and follow for each pipeline, a manual of written procedures for conducting operations and maintenance activities and for emergency response. For distribution lines, the manual must also include procedures for handling abnormal operations. This manual must be reviewed and updated by the company at intervals not exceeding 15 months, but at least once each calendar year. This manual must be prepared before operation of a pipeline system commences. This manual must be kept at locations where operations and maintenance activities are conducted, and it should be made available to appropriate engineering and operating staff. This manual or manuals must include at least all the topics covered in this Standard, with particular emphasis on:

a) controlling corrosion in accordance with the operations and maintenance requirements of this standard.
b) making construction records, maps, and operating history available to appropriate operating personnel.
c) starting up and shutting down any part of the pipeline in a manner designed to assure operation within the MAOP limits prescribed, plus the build-up allowed for operation of pressure-limiting and control devices.

8.2. Emergency Plans

a) Each company shall establish written procedures to minimize the hazard resulting from a gas pipeline emergency. As a minimum, the procedures must provide for the following:

- Receiving, identifying and classifying notices of events which require immediate response by the company.
- Establishing and maintaining adequate means of communication with appropriate fire, police and other public officials.
- Prompt and effective response to a notice of each type of emergency, including the following:
-
    - gas detected inside or near a building.
    - fire located near or directly involving a pipeline facility.

- explosion occurring near or directly involving a pipeline facility.
- natural disaster.

- The availability of personnel, equipment, tools, and materials, as needed at the scene of and emergency.
- Actions directed toward protecting people first and then property.
- Emergency shutdown and pressure reduction in any section of the company pipeline system necessary to minimize hazards to life or property.
- Making safe any actual or potential hazard to life or property.
- Notifying appropriate fire, police and other public officials of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency.
- Safely restoring any service outage.
- Beginning action if applicable, as soon after the end of the emergency as possible.

b) Each company shall:
- furnish its supervisors who are responsible for emergency action a copy of that portion of the latest edition of the emergency procedures established under paragraph (a) of this section as necessary for compliance with those procedures.
- train the appropriate operating personnel to assure that they are knowledgeable of the emergency procedures and verify that the training is effective.
- review employee activities to determine whether the procedures were effectively followed in each emergency.

c) Each company shall establish and maintain liaison with appropriate fire, police and other public officials, and:-

- learn the responsibility and resources of each government organization that may respond to a gas pipeline emergency.

- acquaint the officials with the company's ability in responding to a gas pipeline emergency.
- identify the types of gas pipeline emergencies of which the company notifies the officials.
- plan how the company and officials can engage in mutual assistance to minimize hazards to life or property.

8.3. Public Education

Each company shall establish a continuing educational program to enable customers, the public, appropriate government organizations and persons engaged in excavation related activities to recognize a gas pipeline emergency for the purpose of reporting it to the company or the appropriate public officials. The program and the media used must be as comprehensive as necessary to reach all areas in which the company transports gas. The program must be conducted in English/Urdu and in other regional languages commonly understood by a significant number and concentration of the non-English acquainted population.8.4. Purging Lines

a) When a pipeline is being purged of air by use of gas, the gas must be introduced into one end of the line in a moderately rapid and continuous flow. If gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the gas.

b) When a pipeline is being purged of gas by use of air, the air must be injected into one end of the line in a moderately rapid and continuous flow. If air cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the air.

8.5. Patrolling

a) The frequency of patrolling mains must be determined by the severity of the conditions which could cause failure or leakage and the consequent hazards to public safety.

b) Mains in places or on structures where anticipated physical movement or external loading could cause failure or leakage must be patrolled.

- In business districts at intervals not exceeding 4 ½ months, but at least four times each calendar year; and
- Outside business districts, at intervals not exceeding 7 ½ months, but at least twice each calendar year.

8.6. Leakage Survey

Each company shall conduct periodic leakage surveys in accordance with this section. The type and scope of the leakage control program must be determined by the nature of the operations and the local conditions, but it must meet the following minimum requirements:

a) A leakage survey with leak detector equipment must be conducted in business districts, including tests of the atmosphere in gas, electric, telephone, sewer, and water system manholes, at cracks in pavement and side walks and at other locations providing an opportunity for finding gas leaks, at intervals not exceeding 15 months, but at least once each calendar year.

b) A leakage survey with leak detector equipment must be conducted outside business districts as frequently as necessary, but at intervals not exceeding 5 years. However, for cathodically unprotected distribution lines on which electrical surveys for corrosion are impractical, survey intervals may not exceed 3 years.

8.7. General Requirements For Repair Procedures:-

Each company shall take immediate temporary measures to protect the public whenever a leak, imperfection, or damage that impairs its serviceability is found in the gas pipeline system. If it is not feasible to make a permanent repair at the time of discovery, temporary repairs shall be done promptly to be followed by permanent repairs within a reasonable time.

8.8. Permanent Field Repair Of Imperfections And Damages

Each imperfection or damage that impairs the serviceability of a segment of gas pipeline system may be repaired by any one of the methods:

a) If it is feasible to take the segment out of service, the imperfection or damage may be removed by cutting out a cylindrical piece of pipe and replacing it with pipe of similar or greater design strength.

b) If it is not feasible to take the segment out of service, a full encirclement welded split sleeve of appropriate design may be applied over the imperfection or damage.
c) If the segment is not taken out of service, the operating pressure may be reduced to a safe level during the repair operations.
d) Lines may be repaired by mechanical repair fitting of appropriate design.
e) Fillet welding of steel patch for repair on pipe grade 46 and lower is allowed as a permanent repair method. Such patches should have rounded corners and their thickness should be at least equal to the normal thickness of the pipe. The dimensions of the patch shall be at least twice the dimensions of the defect and the patch shall be centered over the defect.

8.9. Permanent Fields Repair Of Welds

Each weld that is unacceptable must be repaired as follows:

a) If it is feasible to take the segment of line out of service, the weld must be repaired in accordance with the applicable requirements as prescribed in welding procedure.
b) A weld may be repaired in place in accordance with welding procedure.
c) Grinding of the defective area can be limited so that the least nominal wall thickness per Table 1.2. remains.
d) A defective weld which cannot be repaired must be repaired by installing a full encirclement welded split sleeve of appropriate design.

8.10. Valve Maintenance

Each valve, the use of which may be necessary for the safe operation of a distribution system, must be checked and serviced at intervals not exceeding 15 months, but at least once each calendar year.

8.11. Vault Maintenance

a) Each vault housing pressure regulating or pressure limiting equipment and with internal volume of 200 cubic feet (6 cubic meters) or more,

must be inspected at intervals not exceeding 15 months, but at least once each calendar year, ensuring it is in good physical condition and is adequately ventilated.

b) If gas is found in the vault, the equipment in the vault must be inspected for leaks, and any leaks found must be repaired.

c) The ventilating equipment must also be inspected to determine that it is functioning properly.

d) Each vault cover must be inspected to assure that it does not present a hazard to public safety.

8.12. Prevention Of Accidental Ignition

Each company shall take steps to minimize the danger of accidental ignition of gas in any structure or area where the presence of gas constitutes a hazard of fire or explosion, including the following:

a) When a hazardous amount of gas is being vented into open air, each potential source of ignition must be removed from the area and a fire extinguisher must be provided.

b) Gas or electric welding or cutting must not be performed on pipe or on pipe components that contain a combustible mixture of gas and air in the area of work.

c) Post warning signs, where appropriate.

8.13. Abandonment Or Deactivation Of Facilities

a) Each operator shall conduct abandonment or deactivation of pipelines in accordance with the requirements of this section.

b) Each pipeline abandoned in place must be disconnected from all sources of gas.

c) Except for service lines, each inactive pipeline that is not being maintained must be disconnected from all sources of gas.

d) Whenever service to a customer is discontinued, one of the following must be compiled with:

- The valve that is closed to prevent the flow of gas to the customer must be provided with a locking device or other means designed

to prevent the opening of the valve by persons other than those authorized by the company.

- A mechanical device or fitting that will prevent the flow of gas must be installed in the service line or in the meter assembly.
- The customer's piping must be physically disconnected from the gas supply and the open pipe ends sealed.

e) If air is used for purging, the operator shall insure that a combustible mixture is not present after purging.

f) Each abandoned vault must be filled with a suitable compacted material.

8.14. Record Keeping

Each operator shall maintain the following records for distribution lines:-

a) The date, location and description of each repair made to pipe must be retained for as long as pipe remains in service.

b) A record of each patrol, survey, inspection must be retained for at least 5 years or until the next patrol, survey, inspection, or test is completed, whichever is longer.

(Ref: U.S. Department of Transportation 191-192)

8.15. Customer Meter And Regulators Installation

8.16. Location For Customers' Meter and Regulators Installation

a) Customers' meters and regulators may be located either inside or outside of building, depending upon local condition, except that on service lines requiring series regulation, the upstream regulator shall be located outside of the building.

b) When installed within a building, the service regulator shall be in a readily accessible location near the point of service line entrance and, whenever practicable, the meters shall be installed at the same location. Meters shall not be installed under combustible stairway or in unventilated or inaccessible places, or closer than 3' to source of ignition, including furnaces and water heaters. On service lines supplying large industrial customers or installations where gas is

utilized at higher than standard service pressure, the regulators may be installed at other readily accessible locations.

c) When located outside of building, meters and service regulators shall be installed in readily accessible and safe location. When outside meters and service regulators are installed in locations that do not afford reasonable protection from accidental damage, such protection shall be provided.

d) Regulators requiring vents for their proper and effective operation shall be vented to the outside atmosphere.

8.17. Operating Pressure For Customers Meter Installation

Iron or aluminum case meters shall not be used at a maximum operating pressure higher than the manufacture's rating for the meter. New tinned steel case meters shall not be used at a pressure in excess of 50% of the manufacturer's test pressure. Rebuilt tinned steel case meters shall not be used at a pressure in excess of 50% of the pressure used to test the meter after rebuilding.

8.18. Protection Of Customers' Meter And Regulator Installation From Damage

a) Meters and service regulators shall not be located where rapid deterioration from corrosion or other causes is likely to occur.

b) A suitable protective device, such as back-pressure regulator or a check valve shall be installed downstream of the meter as required under the following conditions:

- If the nature of the utilization equipment is such that it may induce a vacuum at the meter, a back-pressure regulator shall be installed downstream from the meter
- A check valve, or equivalent, shall be installed if:

    - the utilization equipment might induce a back-pressure
    - the gas utilization equipment is connected to a source of oxygen or compressed air
    - liquefied petroleum gas or other supplementary gas is used as standby and might flow back into the meter. A three-way valve installed to admit the standby supply and at the

same time shutting off the regulator supply may be substituted for a check valve if desired.

c) All service regulator vents and relief vents where required, shall terminate in the outside air in rain and insect-resistant fittings. The open end of the vent shall be located where, if a regulator failure resulting in the release of gas occurs, the gas can escape freely into the atmosphere and away from any opening into the building. At locations where service regulators might be submerged during floods, either a special anti-flood-type breather vent fitting shall be installed or the vent line shall be extended above the height of the expected flood waters.

d) Vaults and pits housing customers' meters and regulators shall be designed and constructed in accordance with good structural engineering practice to support the loads that may be imposed upon them.

8.19. Avoidance Of Overstress At Customers' Meters and Regulators

All meters and regulators shall be installed in such a manner as to prevent undue stresses upon the connecting piping or the meter. Connections made of material that can be easily damaged, shall not be used. The use of standard-weight close nipples is prohibited.

8.20. Service Lines Installation

a) **Depth.** Each buried service line must be installed with at least 12 inches (300 mm) of cover in private property and at least 18 inches (45 mm) of cover in streets and roads. However, where an underground structure prevents installation at those depths, the service line must be protected to withstand any anticipated external load.

b) **Support and Backfill.** Each service line must be properly supported on undisturbed or well-compacted soil and backfill must be free of materials that could damage the pipe or its coating.

c) **Grading for Drainage.** Where condensate in the gas might cause interruption in the gas supply to the customer, the service line must be graded so as to drain into the main or into drips at the low points in the service line.

d) **Protection Against Piping Strain and External Loading.** Each service line must be installed so as to minimize anticipated piping strain and external loading.

e) **Installation of Service Lines Into Buildings**. Each underground service line installed below grade through the outer foundation wall of a building must:

- In the case of a metal service line, be protected against corrosion
- In the case of a plastic service line, be protected from shearing action and backfill settlement.
- Be sealed at the foundation wall to prevent leakage into the building.

8.21. Valve Requirements

a) Each service line must have a service-line valve that meets the applicable requirements of this standard. A valve incorporated in a meter bar, that allows the meter to be bypassed, is not regarded as a service line valve.

b) A soft seat service line valve may not be used if its ability to control the flow of gas could be adversely affected by exposure to anticipated heat.

c) Each service-line installed above ground or in an area where the blowing of gas would be hazardous, must be designed and constructed to minimize the possibility of the removal of the core of the valve with other than specialized tools.

8.22. Location Of Service Tee

Each service line connection to a main must be located at the top of the main or, if that is not practical, at the side of the main.

8.23. Test Requirements For Restoring/Reinstating Service Lines

a) Except as provided in paragraph (b) of this section, each disconnected service line must be tested in the same manner as a new service line, before being reinstated.

b) Each service line temporally disconnected from the main must be tested from the point of disconnection to the service line valve in the same manner as a new service line, before reconnecting. However, if provisions are made to maintain continuous service, such as by installation of a bypass, it need not be retested.

(Ref: U.S. Department of Transportation 191-192)

9. PLASTIC PIPING

9.1. General

a) New plastic pipe is qualified for use if:
   - It is manufactured in accordance with below listed specification:
     ASTM D 2513 Thermoplastic pipe and tubing;
   - It is resistant to chemicals with which contact may be anticipated.

b) Used plastic pipe is qualified for use if:
   - It was manufactured in accordance with above listed specification.
   - It is resistant to chemicals with which contact may be anticipated.
   - It has been used only in natural gas service.
   - Its dimensions are still within the tolerances of the specification to which it was manufactured.
   - It is free of visible defects.
   - It has not been exposed to ultra light for more than 2 years unless it is certified by the vender or an approved testing lab, to be suitable for further gas service.

9.2. Design Of Plastic Pipe

The design pressure for plastic pipe is determined in accordance with either of the following formula:

$$P = 2S \frac{t}{(D-t)} 0.32 \qquad \text{OR} \qquad P = \frac{2S}{(SDR-1)} 0.32$$

Where:

P= Design pressure, psig.
S= Hydrostatic design basis at 73 ^{0}F (23 ^{0}C).
t= Specified wall thickness (in.)
D=Specified outside diameter (in.)
SDR=Standard dimension ratio, D/t

9.3. Design Limitation For Polyethylene Pipe

a) Maximum design pressure of 100 psig (700 kPa).
b) Polyethylene pipe, tubing and fittings shall not be used at temperatures exceeding 140 ^{0}F (60 ^{0}C), or where the steady state operating temperature of materials will exceed 100 ^{0}F (38 ^{0}C), however, it shall be permissible for service to be operated between 100 ^{0}F (38 ^{0}C) and 60 ^{0}C for short periods of time as a result of ambient conditions.
c) Polyethylene pipe intended for direct burial shall have a minimum wall thickness of 0.09" (2.3 mm) or greater.
d) Polyethylene pipe intended for insertion in casing shall have a minimum wall thickness of 0.062" (1.6 mm) or greater.
e) Pipe on which saddle fusions are do be performed shall have a minimum wall thickness of 0.165" (4.2 mm) or greater.

9.4. Design Pressure Of Fittings

Design pressure of polyethylene fittings shall be not less than the design pressure of the pipe to which they are to be connected.

Note: Table 9.1 gives size information for PE pipe up to NPS 6. Table 9.2 gives information for metric pipe up to 250 mm OD. These Tables are included for information only, and they are not a comprehensive list of pipe availability of all sizes and wall thickness. For current availability list consult vendors. Canadian Standard CSA B137.0 and B137.4 are also good sources of information on PE pipe and tubing

TABLE 9.1
WALL THICKNESS AND STANDARD DIMENSION RATIO FOR THERMOPLASTIC PIPE - NPS

		Minimum Wall Thickness, in.				
Nominal Pipe Size	**Outside Diameter In.**	**Standard Dimension Ratio, R**				
		26	**21**	**17**	**13.5**	**11**
½	0.840	0.062	0.062	0.062	0.062	0.076
¾	1.050	0.090	0.090	0.090	0.090	0.095
1	1.315	0.090	0.090	0.090	0.097	0.119
$1^{1/4}$	1.660	0.090	0.090	0.098	0.123	0.151
$1^{1/2}$	1.660	0.090	0.090	0.112	0.141	0.173
2	2.375	0.091	0.113	0.140	0.176	0.216
$2^{1/2}$	2.875	0.110	0.137	0.169	0.213	….
3	3.500	0.135	0.167	0.206	0.259	….
$3^{1/2}$	4.000	0.154	0.190	0.236	0.296	….
4	4.500	0.173	0.214	0.264	0.333	….
5	5.563	0.224	0.265	0.328	0.413	….
6	6.625	0.225	0.316	0.390	0.491	….

General Notes:

a) Standard Dimension Ratio. The Standard Dimension Ratio System enables the user to select a number of different size of pipe for a piping system, all of which will have the same design pressure. When plastic materials of the same design strengths are used, the same Standard Dimension Ratio may be used for all sizes of pipe instead of calculating a value of t for each size.

b) Wall thickness above the line are minimum values and are not a function of the Standard Dimension Ratio.

Table 9.2

WALL THICKNESS AND STANDARD DIMENSION RATIO FOR METRIC THERMO PLASTIC PIPE –

Wall Thickness, mm

Pipe Size (mm)	Outside Diameter (mm)		Standard Dimension Ratio. R 11	
	Min	Max	Min.	Max.
20	20	20.3	1.9	2.3
25	25	25.3	2.3	2.6
32	32	32.3	3.0	3.4
40	40		3.7	
63	63	63.4	5.8	6.5
90	90	90.6	8.2	9.2
110	110		10.0	
125	125	125.6	11.4	12.7
160	160		14.6	
180	180	181.2	16.4	18.2
200	200	201.2	18.2	20.2
250	250	251.5	22.8	25.2

9.5. Material for Polyethylene Pipe, Tubing, Fitting and Valves

a) Polyethylene pipe and tubing shall be in accordance with the requirements for polyethylene grades as given in CSA Standard CAN/CSA-B137.4 or equal (ASTM D 2513).

b) The specific polyethylene pipe or tubing selected for use shall be adequately resistant to the fluids and chemical atmospheres that might be encountered.

c) Fitting shall be in accordance with the applicable requirements of CSA standard CAN/CSA-B137.4. or equal.

d) Valves made of polyethylene shall be in accordance with the requirements of ASME Standard B16.40.

9.6. Installation

9.7. Installation of Polyethylene Piping

a) Except for steel encased PE/Steel risers, polyethylene piping shall not be installed above ground. Uncased plastic pipe may be temporarily installed above ground level under the following conditions:
   - The Company must be able to demonstrate that the cumulative above ground exposure of the pipe does not exceed the manufacture's recommended maximum period of exposure, or 2 years, whichever is less.
   - The pipe is either located where damage by external forces is unlikely or is otherwise protected against such damage.
   - The pipe adequately resists exposure to ultraviolet light and high and low temperatures.

b) Polyethylene pipe shall not be installed in vaults, unless it is completely encased in gas-tight metal pipe.

c) Polyethylene piping shall be installed in such a way that shear and tensile stresses resulting from installation, backfill, thermal contraction and external loadings are within acceptable levels.

d) Polyethylene pipelines that are not cased with metallic casings shall have electrically conductive wires or other means of locating the pipelines installed with them.

9.8. Inspection and Handling

a) Prior to installation, the pipe shall be carefully inspected for cuts, scratches, gouges and other imperfections. Pipe containing defects shall be rejected or cylindrical pieces containing such defect shall be cut out. No person may carry out the inspection of joints in plastic unless that person has been qualified by appropriate training or experience in evaluating the acceptability of plastic pipe joints made under the applicable joining procedure.

b) The piping shall be inspected during installation for defects such as cuts, scratches, and gouges. Cylindrical pieces containing such defects shall be cut out and replaced.

c) Inspection procedures shall be adequate to confirm that sound joints are being made. Joints shall be checked visually for evidence of poor bonding. Where inspection reveals defective joints, they shall be cut out and replaced.
d) Care shall be exercised to protect polyethylene materials from fire, excessive heat and harmful chemicals.
e) Polyethylene pipe shall be adequately supported during storage. Pipe and fitting shall be protected from detrimental exposure to direct sunlight.

9.9. Direct Burial

a) Polyethylene piping shall be laid on undisturbed or well-compacted soil or otherwise continuously supported and shall not be supported by blocking. Where ledge rock, hardpan, or boulders are encountered, the trench bottom shall be padded, using sand or compacted fine-grained soils.

b) Polyethylene piping shall be installed with provision for possible contraction.

c) Where long sections of polyethylene pipe are lowered into trenches, care shall be exercised to avoid stresses that might buckle the pipe and to avoid imposing excessive stresses on the joints.

d) Backfilling shall be performed in such a manner as to provide firm support around the pipe. The material used for backfilling shall be free of material that might cause damage to the pipe.

e) Where flooding of trenches is used to consolidate the backfill, care shall be exercised so that the pipeline is not floated from its firm bearing on trench bottom.

f) Polyethylene pipe installed by ploughing methods shall not be bent during installation to a radius less than the minimum recommended by the manufacturer for the particular pipe used.

Note: Coiled pipe should not be installed by ploughing when the pipe temperature is less than the minimum recommended by the manufacturer.

9.10. Insertion in Casing

a) Casing pipes shall be prepared to the extent necessary to remove sharp edges, projections and abrasive materials that might damage the pipe during or after insertion.

b) Carrier pipes shall be inserted into casing pipes in such a manner as to protect the carrier pipe during installation. Leading ends of carrier pipes shall be closed before insertion. Care shall be taken to prevent the carrier pipes from bearing on the ends of the casing.

c) Portions of polyethylene carrier pipes exposed due to the removal of sections of casing shall be of sufficient strength to withstand the anticipated external loadings, or they shall be protected with bridging pieces capable of withstanding such loadings.

9.11. Bends and Branches

It shall be permissible to make changes in direction with bends, tees, or elbows, with the following limitations:

a) Pipes shall not be bent to a radius smaller than the applicable minimum recommended by the manufacturer for the particular pipe used.
b) Bends shall be free of buckles, racks and other evidence of damage.
c) Bent portions of pipe shall not contain joints or saddle fusion lateral connections.
d) Where the requirements of Item (1) cannot be met, changes in direction shall be made with fittings.
e) Mitered bends shall not be permitted.
f) Branch connections shall be made only with socket-type tees or other suitable fittings specifically designed for the purpose.

9.12. Drainage

Where there is evidence of condensate in the gas in sufficient quantities to cause interruptions in the gas supply to the customer, service lines shall be sloped in order to drain into the upstream pipeline or to drips at the low points in the service line.

9.13. Installation of Service Line Into or Under Building

Buried polyethylene service lines, where installed under building, shall be encased in gastight conduits. Where such service lines supply the buildings beneath which they are installed, the conduits shall be fire-resistant and extend into normally usable and accessible portions of the buildings and at the points where the conduits terminate, the space between the conduits and the service lines shall be sealed to prevent gas leakage into the building.

9.14. Additional Installation Requirements for Polyethylene Service Lines

a) Particular care shall be exercised to prevent damage to service line piping at connections to the distribution line or other facility. Precautions shall be taken to prevent crushing or sheeting of piping due to external loading or settling of backfill and to prevent damage resulting from thermal expansion or contraction.

b) It shall be permissible for service lines to terminate above ground and outside the building, provided that the:
   - aboveground portion of the service line is completely encased with a metallic sheeting of sufficient strength to provide protection from damage; such metallic sheeting shall extend a minimum of 6" below grade;
   - operating temperature of the service line is in accordance with the Design Limitations for plastic pipe.
   - service line is not subjected to external loading stresses by the customer's meter or its connecting piping.

c) Buried service lines installed through the outer foundations or walls of buildings shall be encased in rigid fire-resistant sleeves with protection from shearing action. Such sleeves shall extend past the outside face of the foundations a sufficient distance to reach undisturbed soil or thoroughly compacted backfill. At points where sleeves terminate inside the foundations or walls, the space between the sleeves and the service lines shall be sealed to prevent leakage into the building. Service lines shall not be exposed inside buildings.

9.15. Trenchless Installation

a) Prior to trenchless installation, underground structures shall be identified and located such that the required clearance will be maintained.

Note: The pipe location should be periodically monitored to determine whether cover and clearance requirements are being met.

b) Personnel shall be protected against electrical hazards.
c) Polyethylene pipe shall not be bent to a radius less than the minimum recommended by the manufacturer.
d) During installation, the longitudinal force applied on the pipe shall be limited in such a way as to prevent permanent deformation of the pipe.
e) Drilling fluids and associated waste material shall be disposed off in such a manner as to minimize environmental impact.
f) After the installation is completed, the exposed end of the pipe that was pulled through the bore shall be inspected for scratches and other imperfections on the coating or the pipe itself. When imperfections are found, they shall be evaluated and if found to be defects, pulling shall continue until defects are not observed.

9.16. Polyethylene Pipe Joints and Connections

a) Polyethylene pipe and fitting shall be joined by heat fusion or electrofusion. Such joining methods shall be compatible with the materials being joined. Threading is not allowed. Methods and specifications for joining polyethylene pipe and components shall comply with the requirements of the procedures recommended by the manufacturer.

b) Joints in polyethylene piping shall be designed and installed to withstand the longitudinal pullout forces caused by contraction of the pipes or by external loadings.

c) Joints in polyethylene piping shall be made by personnel who are qualified in the applicable procedures.

9.17. Joining by Heat Fusion

a) Heat fusion joints shall be made in accordance with documented procedures that have been proven by test. Fusion tools thermostatically controlled and electrically heated must be designed specifically for socket fusion, butt fusion, or saddle fusion and must be used only for the purpose for which they are designed. Direct application of heat using a torch or open flame is prohibited. For each respective joining technique, socket, butt and saddle fusion, procedures should include, but not necessarily be limited to

- the equipment and tooling required
- the joining surface preparation requirements
- the heating tool temperature required
- the heating time requirements for each size and material melt index
- the alignment requirements
- the joining pressure and time requirements
- the clamped cooling time requirements
- the cooling handling time requirements
- the elapsed time required before the joint can be subjected to high stress; and 1.1 cold weather joining techniques

Note: It is recommended that the procedure follows the requirements of ASTM Standard D 2657.

b) Heat fusion joints shall not be made between different grades of polyethylene pipe materials, unless their compatibility is certified by the manufacturers or proven by tests.

9.18. Joining by Electrofusion

a) Electrofusion joints shall be made in accordance with documented procedures that have been proven by tests. Procedures should include, but not necessarily be limited to

- the equipment and tooling required
- the temperature operating range of the equipment
- the joining surface preparation requirements
- the alignment requirements
- the clamped cooling time requirements

- the elapsed time requirements before the joints can be subjected to high stress; and
- cold weather joining techniques.

  Note: It is recommended that the procedures follow the requirements of ASTM Standard F 1290.

b) Electrofusion joints shall be held with clamps or other aligning devices until cooled. The minimum hold time and minimum time prior to exposure to installation stresses shall be stated in the operating procedure.

9.19. Polyethylene Piping Testing

a) Polyethylene piping shall be pressure tested after installation but before being placed into operation, using air, or an appropriate liquid as the pressure-test medium. Tie-in sections and tie-in joints shall be tested for leaks.

b) Pressure testing shall be conducted at material temperatures below 100 ^{0}F (40 ^{0}C).

c) Sufficient time shall be allowed for joints to cool properly before the pressure-test medium is introduced.

d) Testing shall be at a pressure not less than 1.5 times the maximum operating pressure or 50 psig whichever is the greater, except that the test pressure shall not exceed 3 times the design pressure of the pipe.

e) Where exposed joints are to be tested with soaps, detergents, or other liquids, the chemical resistance of the polyethylene to such liquids shall be considered. The piping manufacturers' recommendations or laboratory test data shall be used as a basis for selecting the leak indicator.

f) After test with leak detection liquids, any excess liquid shall be wiped away and the joints rinsed with water where practicable.

g) It shall be permissible to use leak detection tracers to locate leak in buried piping, provided that their effects on the piping have been investigated. Leak detection tracers and odorants in liquid form shall not be used.

9.20. Maintenance And Repair Requirements

9.21. Pinching for Polyethylene Pipe for Pressure-Control Purposes

a) Where applicable, the suitability of polyethylene pipe for pinching and reopening shall be investigated, and tests shall be made to determine that the pipe can be pinched and reopened without causing failure under the conditions that would prevail at the time of the pinching and reopening.

b) Pinching and reopening of polyethylene pipe shall be in accordance with the following:

- The work shall be done utilizing equipment and procedures that have been proven by test to be safe and effective.
- Pinched and reopened areas of the pipe shall be reinforced, unless it has been determined by investigation and test that pinching and reopening does not significantly affect the long-term properties.
- Where reinforcement of the pinched areas is not required after reopening, squeeze points shall be permanently marked and subsequent pinching at such locations shall be avoided.

9.22. Repair of Polyethylene Pipe

a) Pipe containing defects in the form of gouges and grooves shall be repaired by replacing the affected sections or by using repair procedures that have been qualified by test.

b) Note: Gouges and grooves with depths in excess of 10% of the minimum wall thickness of the pipe are considered to be defects.

c) The recommendations of the applicable pipe manufacturer shall be taken into consideration when determining the type of repair to be made.

d) It shall be permissible to repair pipe by fusing properly designed patch repair fittings to the damaged pipe or by using mechanical repair sleeves.

e) Fusion patches shall extend at least beyond the edges of the defects, except that they shall not extend over more than one-third of the

circumference of the damaged pipe. Repair patches shall be at least as thick as the repaired pipe.

f) Where full-encirclement mechanical split repair sleeves are used, the joint lines of the sleeves shall be as far as possible from the defects and in no case closer than one inch (1").

g) Metallic components of repair fittings shall be of materials that are either not susceptible to corrosion or protected against corrosion in accordance with the requirements of Chapter 6 of Standards.

9.23. Static Electricity Dissipation

Where applicable, operating companies shall develop procedures for the dissipation of static electricity and shall include such procedures in their operating and maintenance procedures. Such procedures shall be followed when piping is purged, repaired, replaced, or extended in the presence of, or potential presence of, flammable gas-air mixtures.

SD/ -
BRIG. (RETD.) TARIQ MAHMUD,
Secretary,
Oil and Gas Regulatory Authority

REGISTERED No. M - 302
L - 7646

The Gazette *Of Pakistan*

EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, TUESDAY, FEBRUARY 12, 2008

PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN

OIL AND GAS REGULATORY AUTHORITY

NOTIFICAT ION

Islamabad, the 4th February, 2008

SRO No. 116(I)/2008:—In exercise of the powers conferred by Section 42 of the Oil and Gas Regulatory Authority Ordinance, 2002 (Ordinance XVII of 2002) the Oil and Gas Regulatory Authority is pleased to make the following amendment in the Natural Gas Distribution (Technical Standards) Regulations 2004: -

In the aforesaid regulations, in regulation 4.2, for the words, "*Steel pipe manufactured in accordance with the following standards may be used*" shall be substituted namely: -

"Steel pipe manufactured under internationally recognized accreditation in accordance with the following standards shall be used"

[OGRA-6(1)/2003-Admn.]

BRIG. (RETD.) TARIQ MAHMUD,
Secretary,