ASME B31.8-2012
(Revision of ASME B31.8-2010)

Gas Transmission and Distribution Piping Systems

ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Date of Issuance: January 4, 2013

The next edition of this Code is scheduled for publication in 2014. This Code will become effective 6 months after the Date of Issuance.

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FOREWORD

The need for a national code for pressure piping became increasingly evident from 1915 to 1925. To meet this need, the American Engineering Standards Committee (later changed to the American Standards Association, now the American National Standards Institute) initiated Project B31 in March 1926 at the request of the American Society of Mechanical Engineers and with that Society as sole sponsor. After several years of work by Sectional Committee B31 and its subcommittees, a first Edition was published in 1935 as an American Tentative Standard Code for Pressure Piping.

A revision of the original tentative standard began in 1937. Several more years of effort were given to securing uniformity among sections, eliminating divergent requirements and discrepancies, keeping the Code abreast of current developments in welding technique, calculating stress computations, and including reference to new dimensional and material standards. During this period, a new section added on refrigeration piping was prepared in cooperation with the American Society of Refrigeration Engineers and complemented the American Standard Code for Mechanical Refrigeration. This work culminated in the 1942 American Standard Code for Pressure Piping.

Supplements 1 and 2 of the 1942 Code, which appeared in 1944 and 1947, respectively, introduced new dimensional and material standards, a new formula for pipe wall thickness, and more comprehensive requirements for instrument and control piping. Shortly after the 1942 Code was issued, procedures were established for handling inquires requiring explanation or interpretation of Code requirements and for publishing such inquiries and answers in *Mechanical Engineering* for the information of all concerned.

By 1948, continuing increases in the severity of service conditions combined with the development of new materials and designs to meet these higher requirements warranted more extensive changes in the Code than could be provided from supplements alone. The decision was reached by the American Standards Association and the sponsor to reorganize the sectional committee and its several subcommittees and to invite the various interested bodies to reaffirm their representatives or to designate new ones.

Because of the wide field involved, between 30 and 40 different engineering societies, government bureaus, trade associations, institutes, and similar organizations had one or more representatives on the sectional committee, plus a few "members at large" to represent general interests. Code activities were subdivided according to the scope of the several sections. General direction of Code activities rested with the Standards Committee officers and an executive committee, membership of which consisted principally of Standards Committee officers and section chairmen.

Following its reorganization in 1948, Standards Committee B31 made an intensive review of the 1942 Code that resulted in

(a) a general revision and extension of requirements to agree with present day practice

(b) the revision of references to existing dimensional standards and material specifications and the addition of references to the new ones

(c) the clarification of ambiguous or conflicting requirements

A revision was presented for letter ballot vote of Standards Committee B31. Following approval by this body, the project was approved by the sponsor organization and by the American Standards Association. It was finally designated as an American Standard in February 1951, with the designation B31.1-1951.

Standards Committee B31 at its annual meeting of November 29, 1951, authorized the separate publication of a section of the Code for Pressure Piping addressing gas transmission and distribution piping systems, to be complete with the applicable parts of Section 2, Gas and Air Piping Systems, Section 6, Fabrication Details, and Section 7, Materials — Their Specifications and Identification. The purpose was to provide an integrated document for gas transmission and distribution piping that would not require cross-referencing to other sections of the Code.

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The first Edition of this integrated document, known as American Standard Code for Pressure Piping, Section 8, Gas Transmission and Distribution Piping Systems, was published in 1952 and consisted almost entirely of material taken from Sections 2, 6, and 7 of the 1951 Edition of the Pressure Piping Code.

A new section committee was organized in 1952 to update Section 8 as necessary to address modern materials and methods of construction and operation.

After a review by B31 Executive and Standards Committees in 1955, a decision was made to develop and publish industry sections as separate Code documents of the American Standard B31 Code for Pressure Piping. The 1955 Edition constituted a general revision of the 1952 Edition with a considerably expanded scope. Further experience in the application of the Code resulted in revisions in 1958, 1963, 1966, 1967, 1968, 1969, 1975, and 1982.

In December 1978, the American National Standards Committee B31 was reorganized as the ASME Code for Pressure Piping, B31 Committee. The code designation was also changed to ANSI/ASME B31.

The 1989 Edition of the Code was a compilation of the 1986 Edition and the subsequent addenda issued to the 1986 Edition.

The 1992 Edition of the Code was a compilation of the 1989 Edition, the subsequent three addenda, and the two special Errata issued to the 1989 Edition.

The 1995 Edition of the Code is a compilation of the 1992 Edition and the subsequent three addenda issued to the 1992 Edition.

The 1999 Edition of the Code is a compilation of the 1995 Edition and the revisions that occurred since the issuance of the 1995 Edition.

The 2003 Edition of the Code is a compilation of the 1999 Edition and revisions that occurred since the issuance of the 1999 Edition.

The 2007 Edition of the Code is a compilation of the 2003 Edition and revisions that occurred since the issuance of the 2003 Edition.

The 2010 Edition of the Code is a compilation of the 2007 Edition and revisions that occurred since the issuance of the 2007 Edition.

The 2012 Edition of the Code is a compilation of the 2010 Edition and revisions that have occurred since the issuance of the 2010 Edition. This Edition was approved by the American National Standards Institute on September 14, 2012.

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Code for Pressure Piping

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INTRODUCTION

The ASME Code for Pressure Piping consists of many individually published sections, each an American National Standard. Hereafter, in this Introduction and in the text of this Code Section, B31.8, when the word "Code" is used without specific identification, it means this Code Section.

The Code sets forth engineering requirements deemed necessary for the safe design and construction of pressure piping. Although safety is the basic consideration, this factor alone will not necessarily govern the final specifications of any piping system. The designer is cautioned that the Code is not a design handbook; it does not eliminate the need for the designer or for competent engineering judgment.

To the greatest possible extent, Code requirements for design are stated in terms of basic design principles and formulas. These are supplemented as necessary with specific requirements to ensure uniform application of principles and to guide selection and application of piping elements. The Code prohibits designs and practices known to be unsafe and contains warnings where caution, but not prohibition, is warranted.

This Code Section includes

(a) references to acceptable material specifications and component standards, including dimensional and mechanical property requirements

(b) requirements for designing components and assemblies

(c) requirements and data for evaluating and limiting stresses, reactions, and movements associated with pressure, temperature changes, and other forces

(d) guidance and limitations on selecting and applying materials, components, and joining methods

(e) requirements for fabricating, assembling, and installing piping

(f) requirements for examining, inspecting, and testing piping

(g) procedures for operation and maintenance that are essential to public safety

(h) provisions for protecting pipelines from external and internal corrosion

It is intended that this Edition of Code Section B31.8 not be retroactive. The latest edition issued at least 6 months before the original contract date for the first phase of activity covering a piping system or systems shall be the governing document, unless agreement is specifically made between contracting parties to use another issue, or unless the regulatory body having jurisdiction imposes the use of another issue or different requirements.

Users of this Code are cautioned against making use of revisions without assurance that they are acceptable to any authorities of jurisdiction where the piping is to be installed.

The Code is under the direction of ASME Committee B31, Code for Pressure Piping, which is organized and operates under procedures of The American Society of Mechanical Engineers that have been accredited by the American National Standards Institute. The Committee is a continuing one and keeps all Code Sections current with new developments in materials, construction, and industrial practice.

When no Section of the ASME Code for Pressure Piping specifically covers a piping system, the user has discretion to select any Section determined to be generally applicable; however, it is cautioned that supplementary requirements to the Section chosen may be necessary to provide for a safe piping system for the intended application. Technical limitations of the various Sections, legal requirements, and possible applicability of other Codes or Standards are some of the factors to be considered by the user in determining the applicability of any Section of this Code.

Appendices

This Code contains two kinds of appendices: mandatory and nonmandatory. Mandatory appendices contain materials the user needs to carry out a requirement or recommendation in the main text of the Code. Nonmandatory appendices, which are written in mandatory language, are offered for application at the user's discretion.

Interpretations and Revisions

The Committee has established an orderly procedure to consider requests for interpretation and revision of Code requirements. To receive consideration, inquiries must be in writing and must give full particulars. (See Nonmandatory Appendix O covering preparation of technical inquiries.)

The approved reply to an inquiry will be sent directly to the inquirer. In addition, the question and reply will be published as part of an Interpretation Supplement to the Code Section, issued with the revisions.

Requests for interpretation and suggestions for revision should be addressed to the Secretary, ASME B31 Committee, The American Society of

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Cases

A Case is the prescribed form of reply to an inquiry when study indicates that the Code wording needs clarification or when the reply modifies existing requirements of the Code or grants permission to use new materials or alternative constructions. The Case will be published on the B31.8 Committee Page at http://cstools.asme.org/.

A Case is normally issued for a limited period, after which it may be renewed, incorporated in the Code, or allowed to expire if there is no indication of further need for the requirements covered by the Case. The provisions of a Case, however, may be used after its expiration or withdrawal, provided the Case was effective on the original contract date or was adopted before completion of the work, and the contracting parties agree to its use.

Materials are listed in the Stress Tables only when sufficient usage in piping within the scope of the Code has been shown. Materials may be covered by a Case. Requests for listing shall include evidence of satisfactory usage and specific data to permit establishment of allowable stresses or pressure rating, maximum and minimum temperature limits, and other restrictions. Additional criteria can be found in the guidelines for addition of new materials in the ASME Boiler and Pressure Vessel Code, Section II. [To develop usage and gain experience, unlisted materials may be used in accordance with para. 811.2(b).]

Effective Date

This Edition, when issued, contains new Code provisions. It is a compilation of the 2010 Edition and revisions to the 2010 Edition.

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ASME B31.8-2012
SUMMARY OF CHANGES

Following approval by the B31 Committee and ASME, and after public review, ASME B31.8-2012 was approved by the American National Standards Institute on September 14, 2012.

ASME B31.8-2012 consists of editorial changes, revisions, and corrections identified by a margin note, **(12)**, placed next to the affected area.

Page	*Location*	*Change*
7	805.1.3	(1) Definitions for *dimension ratio (DR)* and *hydrostatic design basis (HDB)* added (2) Definition for *standard dimension ratio (SDR)* revised
	805.1.4	Definitions for *butt joint*, *butt weld*, *tie-in*, and *tie-in weld* added
9	805.2.4	Definitions for *actionable anomaly*, *anomaly*, *anomaly and pipeline data analysis*, *defect*, *discontinuity*, *evaluation*, and *imperfection* added
11–13	805.2.6	Definitions for *engineering assessment* and *engineering critical assessment* added
	807	Added
15	814.1.1(a)	Updated
16	814.1.3	Revised
24	831.2.2(b)	Revised
25	831.2.3	Revised in its entirety
32	833.8	Title revised
37, 38	841.1.1(a)	Cautionary Note added
	841.1.2	Subparagraphs (b) and (c) and Cautionary Note revised
42	841.1.9(k)	Added
48	841.3.2(c)	Reference to 841.321(b) corrected to 841.3.2(b)
51, 52	842.2	Revised
	842.2.1	Revised
	842.2.2	Revised
	842.2.3	Revised
53, 54	842.2.5(a)	Revised
	842.2.9(b)	Subparagraphs (4) and (5) revised
55	Table 842.2.9-1	Revised

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Page	*Location*	*Change*
56, 57	842.3.3(f)	Added
	842.3.4(d)	Revised
	842.3.5	Revised
	842.4.1	Revised
58, 59	843.3.3(a)	Revised
60	843.4.1(a)	Reference to 841.1.1 corrected to Table 841.1.6-2
72	849.4.2(a)	First sentence revised
74	850.2(e)	Last sentence added
76	850.8	Added
77	851.4	First paragraph revised
85, 86	853.1.7	Added
94	860.2(a)	Revised
105	A826.2.1	Revised
	A831.1.1	Revised
108	A842.2.2	(1) Equations (2), (3), (4), and (5) labeled (2) Note revised
109	A842.2.4	Last sentence revised
112	A847.2	Cautionary Note revised
115	A861.1.2(a)	Revised
116	A862.1	Revised
	A862.3	First sentence revised
125–128	Mandatory Appendix A	Updated
130–132	Nonmandatory Appendix C	Updated
133–135	Mandatory Appendix D	(1) Table D-1 revised (2) Table D-2 added
165	Mandatory Appendix K	Footnote 1 added
167	Nonmandatory Appendix L	Revised in its entirety
180	Figure Q-2	Revised

SPECIAL NOTE:

The interpretations to ASME B31.8 are included in this edition as a separate section for the user's convenience.

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GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS

General Provisions and Definitions

801 GENERAL

801.1 Approved Standards and Specifications

Standards and specifications approved for use under the Code and the names and addresses of the sponsoring organizations are shown in Mandatory Appendix A. It is not considered practicable to refer to a specific edition of each of the standards and specifications in the individual Code paragraphs.

801.2 Use of Standards and Specifications Incorporated by Reference

Some standards and specifications cited in Mandatory Appendix A are supplemented by specific requirements elsewhere in this Code. Users of this Code are advised against attempting direct application of any of these standards without carefully observing the Code's reference to that standard.

801.3 Standard Dimensions

Adherence to American National Standards Institute (ANSI) dimensions is strongly recommended wherever practicable. Paragraphs or notations specifying these and other dimensional standards in this Code, however, shall not be mandatory, provided that other designs of at least equal strength and tightness, capable of withstanding the same test requirements, are substituted.

801.4 SI (Metric) Conversion

For factors used in converting U.S. Customary units to SI units, see Nonmandatory Appendix J.

802 SCOPE AND INTENT

802.1 Scope

(a) This Code covers the design, fabrication, installation, inspection, and testing of pipeline facilities used for the transportation of gas. This Code also covers safety aspects of the operation and maintenance of those facilities. (See Appendix Q for scope diagrams.)

This Code is concerned only with certain safety aspects of liquefied petroleum gases when they are vaporized and used as gaseous fuels. All of the requirements of NFPA 58 and NFPA 59 and of this Code concerning design, construction, and operation and maintenance of piping facilities shall apply to piping systems handling butane, propane, or mixtures of these gases.

(b) This Code does not apply to

(1) design and manufacture of pressure vessels covered by the BPV Code[1]

(2) piping with metal temperatures above 450°F (232°C) or below −20°F (−29°C) (For low temperature considerations, see para. 812.)

(3) piping beyond the outlet of the customer's meter set assembly (Refer to ANSI Z223.1/NFPA 54.)

(4) piping in oil refineries or natural gasoline extraction plants, gas treating plant piping other than the main gas stream piping in dehydration, and all other processing plants installed as part of a gas transmission system, gas manufacturing plants, industrial plants, or mines (See other applicable sections of the ASME Code for Pressure Piping, B31.)

(5) vent piping to operate at substantially atmospheric pressures for waste gases of any kind

(6) wellhead assemblies, including control valves, flow lines between wellhead and trap or separator, offshore platform production facility piping, or casing and tubing in gas or oil wells (For offshore platform production facility piping, see API RP 14E.)

(7) the design and manufacture of proprietary items of equipment, apparatus, or instruments

(8) the design and manufacture of heat exchangers (Refer to appropriate TEMA[2] Standard.)

(9) liquid petroleum transportation piping systems (Refer to ASME B31.4.)

(10) liquid slurry transportation piping systems (Refer to ASME B31.11.)

(11) carbon dioxide transportation piping systems

[1] BPV Code references here and elsewhere in this Code are to the ASME Boiler and Pressure Vessel Code.

[2] Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591.

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(12) liquefied natural gas piping systems (Refer to NFPA 59A and ASME B31.3.)

(13) cryogenic piping systems

802.2 Intent

802.2.1 Adequacy for Normal Conditions. The requirements of this Code are adequate for safety under conditions usually encountered in the gas industry. Requirements for all unusual conditions cannot be specifically provided for, nor are all details of engineering and construction prescribed; therefore, activities involving the design, construction, operation, or maintenance of gas transmission, gathering, or distribution pipelines should be undertaken using supervisory personnel having the experience or knowledge to make adequate provision for such unusual conditions and specific engineering and construction details. All work performed within the scope of this Code shall meet or exceed the safety standards expressed or implied herein.

802.2.2 Safety. This Code is concerned with

(a) safety of the general public.

(b) employee safety to the extent that it is affected by basic design, quality of materials and workmanship, and requirements for testing, operations, and maintenance of gas transmission and distribution facilities. Existing industrial safety procedures pertaining to work areas, safety devices, and safe work practices are not intended to be supplanted by this Code.

802.2.3 Retroactive Applications. It is not intended that this Code be applied retroactively to such aspects of existing installations as design, fabrication, installation, and testing at the time of construction. Further, it is not intended that this Code be applied retroactively to established operating pressures of existing installations, except as provided for in Chapter V.

802.2.4 Application to Existing Facilities. Provisions of this Code shall be applicable to operating and maintenance procedures of existing installations, and when existing installations are uprated.

802.2.5 Qualification of Those Performing Inspections. Individuals who perform inspections shall be qualified by training and/or experience to implement the applicable requirements and recommendations of this Code.

802.2.6 Further Information. For further information concerning pipeline integrity, see the nonmandatory supplement ASME B31.8S, Managing System Integrity of Gas Pipelines.

802.3 Offshore Gas Transmission

See Chapter VIII for additional requirements and definitions applicable to offshore gas transmission systems.

803 PIPING SYSTEMS DEFINITIONS

803.1 General Terms and Definitions

carbon dioxide: a heavy, colorless gas that does not support combustion, dissolves in water to form carbonic acid, and is found in some matural gas streams.

environment: the surroundings or conditions (physical, chemical, mechanical) in which a material exists.

gas: as used in this Code, is any gas or mixture of gases suitable for domestic or industrial fuel and transmitted or distributed to the user through a piping system. The common types are natural gas, manufactured gas, and liquefied petroleum gas distributed as a vapor, with or without the admixture of air.

hot taps: branch piping connections made to operating pipelines, mains, or other facilities while they are in operation. The branch piping is connected to the operating line, and the operating line is tapped while it is under pressure.

liquefied natural gas: natural gas liquefied by refrigeration or pressure.

liquefied petroleum gases (LPG): composed predominantly of the following hydrocarbons (either by themselves or as mixtures): butane (normal butane or isobutene), butylene (including isomers), propane, propylene, and ethane. LPG can be stored as liquids under moderate pressures [approximately 80 psig (550 kPa) to 250 psig (1 720 kPa)] at ambient temperatures.

listed specification: a specification listed in Mandatory Appendix A.

operating company or *operator:* as used herein, is the individual, partnership, corporation, public agency, owner, agent, or other entity responsible for the design, construction, inspection, testing, operation, and maintenance of the pipeline facilities.

parallel encroachment: as used in this Code, is the portion of the route of a pipeline or main that lies within, runs in a generally parallel direction to, and does not necessarily cross the rights-of-way of a road, street, highway, or railroad.

petroleum: crude oil, condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, and liquid petroleum products.

pipeline: all parts of physical facilities through which gas moves in transportation, including pipe, valves, fittings, flanges (including bolting and gaskets), regulators, pressure vessels, pulsation dampeners, relief valves, appurtenances attached to pipe, compressor units, metering facilities, pressure regulating stations, pressure limiting stations, pressure relief stations, and fabricated assemblies. Included within this definition are gas transmission and gathering lines, which transport gas from production facilities to onshore locations and gas storage

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equipment of the closed pipe type, that is fabricated or forged from pipe or fabricated from pipe and fittings.

private rights-of-way: as used in this Code, are rights-of-way not located on roads, streets, or highways used by the public, or on railroad rights-of-way.

system or pipeline system: either the operator's entire pipeline infrastructure or large portions of that infrastructure that have definable starting and stopping points.

transportation of gas: gathering, transmission, or distribution of gas by pipeline or the storage of gas.

vault: an underground structure that may be entered and that is designed to contain piping and piping components (such as valves or pressure regulators).

803.2 Piping Systems

component or pipeline component: an individual item or element fitted in line with pipe in a pipeline system, such as, but not limited to, valves, elbows, tees, flanges, and closures.

pipeline facility: new and existing pipelines, rights-of-way, and any equipment, facility, or building used in the transportation of gas or in the treatment of gas during the course of transportation.

pipeline section: a continuous run of pipe between adjacent compressor stations, between a compressor station and a block valve, or between adjacent block valves.

segment: a length of pipeline or part of the system that has unique characteristics in a specific geographic location.

storage field: a geographic field containing a well or wells that are completed for and dedicated to subsurface storage of large quantities of gas for later recovery, transmission, and end use.

transmission line: a segment of pipeline installed in a transmission system or between storage fields.

transmission system: one or more segments of pipeline, usually interconnected to form a network, that transports gas from a gathering system, the outlet of a gas processing plant, or a storage field to a high- or low-pressure distribution system, a large-volume customer, or another storage field.

803.3 Distribution Systems

gas main or distribution main: a segment of pipeline in a distribution system installed to convey gas to individual service lines or other mains.

gas service line: the piping installed between a main, pipeline, or other source of supply and the meter set assembly. [See para. 802.1(b)(3).]

high-pressure distribution system: a gas distribution piping system that operates at a pressure higher than the standard service pressure delivered to the customer. In such a system, a service regulator is required on each service line to control the pressure delivered to the customer.

low-pressure distribution system: a gas distribution piping system in which the gas pressure in the mains and service lines is substantially the same as that delivered to the customer's appliances. In such a system, a service regulator is not required on the individual service lines.

803.4 Gathering Systems

gas storage line: a pipeline used for conveying gas between a compressor station and a gas well used for storing gas underground.

gathering line: a segment of pipeline installed in a gathering system.

gathering system: one or more segments of pipeline, usually interconnected to form a network, that transports gas from one or more production facilities to the inlet of a gas processing plant. If no gas processing plant exists, the gas is transported to the most downstream of one of the following:

(a) the point of custody transfer of gas suitable for delivery to a distribution system

(b) the point where accumulation and preparation of gas from separate geographic production fields in reasonable proximity has been completed

803.5 Miscellaneous Systems

control piping: all piping, valves, and fittings used to interconnect air, gas, or hydraulically operated control apparatus or instrument transmitters and receivers.

gas processing plant: a facility used for extracting commercial products from gas.

instrument piping: all piping, valves, and fittings used to connect instruments to main piping, to other instruments and apparatus, or to measuring equipment.

production facility: piping or equipment used in production, extraction, recovery, lifting, stabilization, separation, treating, associated measurement, field compression, gas lift, gas injection, or fuel gas supply. Production facility piping or equipment must be used in extracting petroleum liquids or natural gas from the ground and preparing it for transportation by pipeline.

sample piping: all piping, valves, and fittings used to collect samples of gas, steam, water, or oil.

803.6 Meters, Regulators, and Pressure-Relief Stations

customer's meter: a meter that measures gas delivered to a customer for consumption on the customer's premises.

meter set assembly: the piping and fittings installed to connect the inlet side of the meter to the gas service line and the outlet side of the meter to the customer's fuel line.

monitoring regulator: a pressure regulator installed in series with another pressure regulator that automatically

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assumes control of the pressure downstream of the station, in case that pressure exceeds a set maximum.

pressure-limiting station: consists of equipment that under abnormal conditions will act to reduce, restrict, or shut off the supply of gas flowing into a system to prevent the gas pressure from exceeding a predetermined value. While normal pressure conditions prevail, the pressure-limiting station may exercise some degree of control of the flow of the gas or may remain in the wide open position. Included in the station are piping and auxiliary devices, such as valves, control instruments, control lines, the enclosure, and ventilating equipment, installed in accordance with the pertinent requirements of this Code.

pressure-regulating station: consists of equipment installed for automatically reducing and regulating the pressure in the downstream pipeline or main to which it is connected. Included are piping and auxiliary devices such as valves, control instruments, control lines, the enclosure, and ventilation equipment.

pressure-relief station: consists of equipment installed to vent gas from a system being protected to prevent the gas pressure from exceeding a predetermined limit. The gas may be vented into the atmosphere or into a lower pressure system capable of safely absorbing the gas being discharged. Included in the station are piping and auxiliary devices, such as valves, control instruments, control lines, the enclosure, and ventilating equipment, installed in accordance with the pertinent requirements of this Code.

service regulator: a regulator installed on a gas service line to control the pressure of the gas delivered to the customer.

803.7 Valves

block or *stop valve:* a valve installed for the purpose of blocking or stopping the flow of gas in a pipe.

check valve: a valve designed to permit flow in one direction and to close automatically to prevent flow in the reverse direction.

curb valve: a stop valve installed below grade in a service line at or near the property line, accessible through a curb box or standpipe, and operable by a removable key or wrench for shutting off the gas supply to a building. This valve is also known as a *curb shutoff* or *curb cock*.

service line valve: a stop valve readily operable and accessible for the purpose of shutting off the gas to the customer's fuel line. The stop valve should be located in the service line ahead of the service regulator or ahead of the meter, if a regulator is not provided. The valve is also known as a *service line shutoff*, *service line cock*, or *meter stop*.

803.8 Gas Storage Equipment

bottle: as used in this Code, is a gas-tight structure completely fabricated from pipe with integral drawn, forged, or spun end closures and tested in the manufacturer's plant.

bottle-type holder: any bottle or group of interconnected bottles installed in one location and used only for storing gas.

pipe-type holder: any pipe container or group of interconnected pipe containers installed at one location and used only for storing gas.

804 PIPING SYSTEMS COMPONENT DEFINITIONS

804.1 Plastic Terms and Definitions

plastic (noun): a material that contains as an essential ingredient an organic substance of high to ultrahigh molecular weight, is solid in its finished state, and at some stage of its manufacture or processing, can be shaped by flow. The two general types of plastic referred to in this Code are thermoplastic and thermosetting.

thermoplastic: a plastic that is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

thermosetting plastic: plastic that is capable of being changed into a substantially infusible or insoluble product when cured under application of heat or chemical means.

804.2 Iron Terms and Definitions

cast iron: shall apply to gray cast iron, that is a cast ferrous material in which a major part of the carbon content occurs as free carbon in the form of flakes interspersed throughout the metal.

ductile iron: sometimes called nodular iron, a cast ferrous material in which the free graphite present is in a spheroidal form, rather than a flake form. The desirable properties of ductile iron are achieved by chemistry and a ferritizing heat treatment of the castings.

804.3 General Terms and Definitions

pipe container: a gas-tight structure assembled in a shop or in the field from pipe and end closures.

proprietary items: items made and marketed by a company having the exclusive or restricted right to manufacture and sell them.

804.4 Pipe Terms and Definitions

cold expanded pipe: seamless or welded pipe that is formed and then cold expanded while in the pipe mill so that the circumference is permanently increased by at least 0.50%.

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miter: two or more straight sections of pipe matched and joined on a line bisecting the angle of junction so as to produce a change in direction.

pipe: a tubular product, including tubing, made for sale as a production item, used primarily for conveying a fluid and sometimes for storage. Cylinders formed from plate during the fabrication of auxiliary equipment are not pipe as defined herein.

804.5 Dimensional Terms and Definitions

diameter or *nominal outside diameter*: the as-produced or as-specified outside diameter of the pipe, not to be confused with the dimensionless NPS (DN). For example, NPS 12 (DN 300) pipe has a specified outside diameter of 12.750 in. (323.85 mm), NPS 8 (DN 200) has a specified outside diameter of 8.625 in. (219.08 mm), and NPS 24 (DN 600) pipe has a specified outside diameter of 24.000 in. (609.90 mm).

length: a piece of pipe of the length delivered from the mill. Each piece is called a length, regardless of its actual dimension. This is sometimes called *joint*, but *length* is preferred.

nominal pipe size (NPS) or *diameter nominal (DN)*: a dimensionless designator of pipe. It indicates a standard pipe size when followed by the appropriate number [e.g., NPS $1\frac{1}{2}$ (DN 40), NPS 12 (DN 300)]. See ASME B36.10M, page 1 for additional information on NPS.

nominal wall thickness, t: the wall thickness computed by or used in the design equation in para. 841.1.1 or A842.2.2(a) in Chapter VIII. Under this Code, pipe may be ordered to this computed wall thickness without adding allowance to compensate for the underthickness tolerance permitted in approved specifications.

804.6 Mechanical Properties

specified minimum elongation: the minimum elongation (expressed in percent of the gage length) in the tensile test specimen, prescribed by the specifications under which the material is purchased from the manufacturer.

specified minimum tensile strength: expressed in pounds per square inch (MPa), is the minimum tensile strength prescribed by the specification under which pipe is purchased from the manufacturer.

specified minimum yield strength (SMYS): expressed in pounds per square inch (MPa), the minimum yield strength prescribed by the specification under which pipe is purchased from the manufacturer.

tensile strength: expressed in pounds per square inch (MPa), the highest unit tensile stress (referred to the original cross section) a material can sustain before failure.

yield strength: expressed in pounds per square inch (MPa), the strength at which a material exhibits a specified limiting permanent set or produces a specified total elongation under load. The specified limiting set or elongation is usually expressed as a percentage of gage length. Its values are specified in the various material specifications acceptable under this Code.

804.7 Steel Pipe

804.7.1 Carbon Steel.[3] By common custom, steel is considered to be carbon steel when no minimum content is specified or required for aluminum, boron, chromium, cobalt, molybdenum, nickel, niobium, titanium, tungsten, vanadium, zirconium, or any other element added to obtain a desired alloying effect; when the specified minimum for copper does not exceed 0.40%; or when the maximum content specified for any of the following elements does not exceed the following percentages:

Element	Percentage
Copper	0.60
Manganese	1.65
Silicon	0.60

In all carbon steels, small quantities of certain residual elements unavoidably retained from raw materials are sometimes found but are not specified or required, such as copper, nickel, molybdenum, chromium, etc. These elements are considered as incidental and are not normally determined or reported.

804.7.2 Alloy Steel.[4] By common custom, steel is considered to be alloy steel when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits:

Element	Percentage
Copper	0.60
Manganese	1.65
Silicon	0.60

or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels:

(a) aluminum
(b) boron
(c) chromium (up to 3.99%)
(d) cobalt
(e) columbium
(f) molybdenum
(g) nickel
(h) titanium
(i) tungsten
(j) vanadium
(k) zirconium

[3] From *Steel Products Manual*, Section 6, American Iron and Steel Institute, August 1952, pp. 5 and 6.

[4] From *Steel Products Manual*, Section 6, American Iron and Steel Institute, January 1952, pp. 6 and 7.

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or any other alloying element added to obtain a desired alloying effect.

Small quantities of certain elements are unavoidably present in alloy steels. In many applications, these are not considered to be important and are not specified or required. When not specified or required, they should not exceed the following amounts:

Element	Percentage
Chromium	0.20
Copper	0.35
Molybdenum	0.06
Nickel	0.25

804.7.3 Pipe Manufacturing Processes. Types and names of welded joints are used herein according to their common usage as defined in AWS A3.0, or as specifically defined as follows:

(a) electric-resistance-welded pipe: pipe produced in individual lengths or in continuous lengths from coiled skelp and is subsequently cut into individual lengths. The resulting lengths have a longitudinal butt joint wherein coalescence is produced by the heat obtained from resistance of the pipe to the flow of electric current in a circuit of which the pipe is a part, and by the application of pressure. Typical specifications are ASTM A53, ASTM A135, ASTM A984, and API 5L.

(b) furnace butt-welded pipe

(1) bell-welded: furnace-welded pipe produced in individual lengths from cut-length skelp. The pipe's longitudinal butt joint forge welded by the mechanical pressure is developed in drawing the furnace-heated skelp through a cone-shaped die (commonly known as a *welding bell*), which serves as a combined forming and welding die. Typical specifications are ASTM A53 and API 5L.

(2) continuous-welded: furnace-welded pipe produced in continuous lengths from coiled skelp and is subsequently cut into individual lengths. The pipe's longitudinal butt joint is forge-welded by the mechanical pressure developed in rolling the hot-formed skelp through a set of round pass welding rolls. Typical specifications are ASTM A53 and API 5L.

(c) electric-fusion-welded pipe: pipe having a longitudinal butt joint wherein coalescence is produced in the preformed tube by manual or automatic electric-arc welding. The weld may be single or double and may be made with or without the use of filler metal. Typical specifications are ASTM A134 and ASTM A139 that permit single or double weld with or without the use of filler metal. Additional typical specifications are ASTM A671 and ASTM A672 that require both inside and outside welds and the use of filler metal.

(1) spiral-welded pipe: also made by the electric-fusion-welded process with either a butt joint, a lap joint, or a lock-seam joint. Typical specifications are ASTM A134, ASTM A139 (butt joint), API 5L, and ASTM A211 (butt joint, lap joint, or lock-seam joint).

(d) electric-flash-welded pipe: pipe having a longitudinal butt joint, wherein coalescence is produced simultaneously over the entire area of abutting surfaces by the heat obtained from resistance to the flow of electric current between the two surfaces, and by the application of pressure after heating is substantially completed. Flashing and upsetting are accompanied by expulsion of metal from the joint. A typical specification is API 5L.

(e) double submerged-arc-welded pipe: pipe having a longitudinal or helical butt joint produced by at least two passes, one of which is on the inside of the pipe. Coalescence is produced by heating with an electric arc or arcs between the bare metal electrode or electrodes and the work. The welding is shielded by a blanket of granular, fusible material on the work. Pressure is not used, and filler metal for the inside and outside welds is obtained from the electrode or electrodes. Typical specifications are ASTM A381, ASTM A1005, and API 5L.

(f) seamless pipe: a wrought tubular product made without a welded seam. It is manufactured by hot-working steel and, if necessary, by subsequently cold-finishing the hot-worked tubular product to produce the desired shape, dimensions, and properties. Typical specifications are ASTM A53, ASTM A106, and API 5L.

(g) laser beam welded pipe: pipe having a longitudinal butt joint made with a welding process that utilizes a laser beam to produce melting of full thickness of edges to be welded, followed by the fusion of those edges. A typical specification is ASTM A1006.

804.8

For *plastic pipe,* see para. 805.1.3.

805 DESIGN, FABRICATION, OPERATION, AND TESTING TERMS AND DEFINITIONS

805.1 General

805.1.1 Area

location class or class location: a geographic area along the pipeline classified according to the number and proximity of buildings intended for human occupancy and other characteristics that are considered when prescribing design factors for construction, operating pressures, and methods of testing pipelines and mains located in the area and applying certain operating and maintenance requirements.

right-of-way (ROW): a strip of land on which pipelines, railroads, power lines, roads, highways, and other similar facilities are constructed. The ROW agreement secures the right to pass over property owned by others. ROW agreements generally allow the right of ingress and egress for the operation and maintenance of the facility, and the installation of the facility. The ROW width can vary with the construction and maintenance requirements of the facility's operator and is usually

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determined based on negotiation with the affected landowner by legal action, or by permitting authority.

805.1.2 Leakage Investigative Terms and Definitions. For definitions of *gas leakage control criteria investigation terms,* see Nonmandatory Appendix M.

(12) **805.1.3 Plastic Terms and Definitions**

adhesive joint: a joint made in plastic piping by the use of an adhesive substance that forms a continuous bond between the mating surfaces without dissolving either one of them.

dimension ratio (DR): the ratio of outside pipe diameter to wall thickness of thermoplastic pipe. It is calculated by dividing the specified outside diameter of the pipe by the specified minimum wall thickness.

heat fusion joint: a joint made in thermoplastic piping by heating the parts sufficiently to permit fusion of the materials when the parts are pressed together.

hydrostatic design basis (HDB): one of a series of established stress values (specified in ASTM D2837) for a plastic compound obtained by categorizing the long-term hydrostatic strength determined in accordance with ASTM D2837. Established HDBs are listed in PPI TR-4.

long-term hydrostatic strength: the estimated hoop stress in pounds per square inch (MPa) in a plastic pipe wall that will cause failure of the pipe at an average of 100,000 hr when subjected to a constant hydrostatic pressure. (See Mandatory Appendix D.)

solvent cement joint: a joint made in thermoplastic piping by the use of a solvent or solvent cement that forms a continuous bond between the mating surfaces.

standard dimension ratio (SDR): the ratio of outside pipe diameter to wall thickness of thermoplastic pipe. It is calculated by dividing the specified outside diameter of the pipe by the specified wall thickness.

(12) **805.1.4 Fabrication Terms and Definitions**

arc welding or arc weld: a group of welding processes that produces coalescence by heating them with an arc. The processes are used with or without the application of pressure and with or without filler metal.

butt joint: a joint between two members aligned approximately in the same plane. See Figs. 1(A), 2(A), 3, 51(A), and 51(B) in AWS A3.0.

butt weld: a nonstandard term for a weld in a butt joint.

cold-springing: where used in the Code, the fabrication of piping to an actual length shorter than its nominal length and forcing it into position so that it is stressed in the erected condition, thus compensating partially for the effects produced by the expansion due to an increase in temperature. Cold-spring factor is the ratio of the amount of cold spring provided to the total computed temperature expansion.

fillet weld: a weld of approximately triangular cross section joining two surfaces approximately at right angles to each other in a lap joint, tee joint, or corner joint.

girth weld: is a complete circumferential butt weld joining pipe or components.

heat treatment: heating and cooling a solid metal or alloy in such a way as to obtain desired properties. Heating for the sole purpose of hot working is not considered heat treatment. If a weldment is heated and cooled in a controlled manner, then the term *postweld heat treatment* is used.

seam weld: the longitudinal or helical seam in pipe, made in the pipe mill for the purpose of making a complete circular cross-section.

stress relieving: heating a metal to a suitable temperature, holding at that temperature long enough to reduce residual stresses, and then cooling slowly enough to minimize the development of new residual stresses.

submerged arc welding: an arc welding process that uses an arc or arcs between a bare metal electrode or electrodes and the weld pool. The arc and molten metal are shielded by a blanket of granular flux on the workpieces. The process is used without pressure and with filler metal from the electrode and sometimes from a supplemental source (welding rod, flux, or metal granules).

tie-in: a connection where a gap is left to divide a pipeline into test sections, or to install a pretested replacement section, or in the continuous line construction at a location such as a river or highway crossing.

tie-in weld: a tie-in connection using a weld, typically a girth weld.

weld: a localized coalescence of metals or nonmetals produced either by heating the materials to the welding temperature, with or without the application of pressure, or by the application of pressure alone and with or without the use of filler material.

welder: one who performs manual or semiautomatic welding.

welding operator: one who operates adaptive control, automatic, mechanized, or robotic welding equipment.

welding procedures: the detailed methods and practices involved in the production of a weldment.

wrinkle bend: a pipe bend produced by a field machine or controlled process that may result in prominent contour discontinuities on the inner radius. The wrinkle is deliberately introduced as a means of shortening the inside meridian of the bend. Note that this definition does not apply to a pipeline bend in which incidental minor, smooth ripples are present.

wrought: metal in the solid condition that is formed to a desired shape by working (rolling, extruding, forging, etc.), usually at an elevated temperature.

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805.2 Design

805.2.1 Pressure Terms and Definitions

design pressure or internal design pressure: the maximum pressure permitted by this Code, as determined by the design procedures applicable to the materials and locations involved. It is used in calculations or analysis for pressure design of a piping component.

hydrostatic test or hydrotest: a pressure test using water as the test medium.

maximum allowable operating pressure (MAOP): the maximum pressure at which a pipeline system may be operated in accordance with the provisions of this Code.

maximum allowable test pressure: the maximum internal fluid pressure permitted by this Code for a pressure test based upon the material and location involved.

maximum operating pressure (MOP): sometimes referred to as maximum actual operating pressure, the highest pressure at which a piping system is operated during a normal operating cycle.

normal operating pressure: the predicted pressure (sum of static head pressure, pressure required to overcome friction losses, and any backpressure) at any point in a piping system when the system is operating under a set of predicted steady state conditions.

overpressure protection: the prevention of the pressure in the system or part of the system from exceeding a predetermined value and is typically provided by a device or equipment installed in a gas piping system.

pressure: unless otherwise stated, expressed in pounds per square inch (kilopascals) above atmospheric pressure (i.e., gage pressure) and is abbreviated as psig (kPa).

pressure test: a means by which the integrity of a piece of equipment (pipe) is assessed, in which the item is filled with a fluid, sealed, and subjected to pressure. It is used to validate integrity and detect construction defects and defective materials.

standard service pressure: sometimes called the normal utilization pressure, the gas pressure a utility undertakes to maintain at its domestic customers' meters.

standup pressure test: a procedure used to demonstrate the leak tightness of a low pressure, gas service line, using air or gas as the test medium.

805.2.2 Temperature Terms and Definitions

ambient temperature: the temperature of the surrounding medium, usually used to refer to the temperature of the air in which a structure is situated or a device operates.

ground temperature: the temperature of the earth at pipe depth.

minimum design temperature: the lowest anticipated material temperature during service. The user of this Code is cautioned that ambient and operating temperature conditions may exist during construction, start-up, or shutdown that require special design considerations or operating restrictions.

temperature: expressed in degrees Fahrenheit (°F) [degrees Celsius (°C)].

805.2.3 Stress Terms and Definitions

bending stress: the force per unit area acting at a point along the length of a member resulting from the bending moment applied at that point.

compressive stress: the applied pushing force divided by the original cross-sectional area.

hoop stress, S_H: the stress in a pipe of wall thickness, t, acting circumferentially in a plane perpendicular to the longitudinal axis of the pipe, produced by the pressure, P, of the fluid in a pipe of diameter, D, and is determined by Barlow's formula:

(U.S. Customary Units)

$$S_H = \frac{PD}{2t}$$

(SI Units)

$$\left(S_H = \frac{PD}{2\,000t}\right)$$

maximum allowable hoop stress: the maximum hoop stress permitted by this Code for the design of a piping system. It depends on the material used, the location of the pipe, the operating conditions, and other limitations imposed by the designer in conformance with this Code.

operating stress: the stress in a pipe or structural member under normal operating conditions.

residual stress: stress present in an object in the absence of any external loading, typically resulting from manufacturing or construction processes.

secondary stress: stress created in the pipe wall by loads other than internal fluid pressure, such as backfill loads, traffic loads, loads caused by natural hazards (see para. 841.1.10), beam action in a span, loads at supports, and at connections to the pipe.

stress: the internal resistance of a body to an externally applied force, expressed in units of force per unit area (psi or MPa). It may also be termed *unit stress*.

stress concentrator or *stress concentration:* : a discontinuity in a structure or change in contour that causes a local increase in stress.

stress level: the level of tangential or hoop stress,usually expressed as a percentage of specified minimum yield strength.

tensile stress: the applied pulling force divided by the original cross-sectional area.

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(12) **805.2.4 Construction, Operation, and Maintenance Terms and Definitions**

abandoned: permanently removed from service.

actionable anomaly: an anomaly that may exceed acceptable limits based on the operator's anomaly and pipeline data analysis.

anomaly: an unexamined deviation from the norm in pipe material, coatings, or welds.

anomaly and pipeline data analysis: the process through which anomaly and pipeline data are integrated and analyzed to further classify and characterize anomalies.

backfill: material placed in a hole or trench to fill excavated space around a pipeline or other appurtenances.

certification: written testimony of qualification.

consequence: the impact that a pipeline failure could have on the public, employees, property, and the environment.

crack: very narrow, elongated defect caused by mechanical splitting into parts.

defect: a physically examined anomaly with dimensions or characteristics that exceed acceptable limits.

dent: a permanent deformation of the circular cross-section of the pipe that produces a decrease in the diameter and is concave inward.

discontinuity: an interruption of the typical structure of a material, such as a lack of homogeneity in its mechanical, metallurgical, or physical characteristics. A discontinuity is not necessarily a defect.

evaluation: a review following the characterization of an actionable anomaly to determine whether the anomaly meets specified acceptance criteria.

examination: the direct physical inspection of a pipeline, which may include the use of nondestructive examination (NDE) techniques or methods.

experience: work activities accomplished in a specific NDT method under the direction of qualified supervision including the performance of the NDT method and related activities but not including time spent in organized training programs.

failure: a general term used to imply that a part in service: has become completely inoperable; is still operable but is incapable of satisfactorily performing its intended function; or has deteriorated seriously, to the point that it has become unreliable or unsafe for continued use.

fatigue: the process of development of, or enlargement of, a crack as a result of repeated cycles of stress.

fracture toughness: the resistance of a material to fail from the extension of a crack.

gouge: mechanically induced metal-loss, which causes localized elongated grooves or cavities in a metal pipeline.

grinding: removal of material by abrasion, usually utilizing a rigid abrasive carrier, such as a disk.

imperfection: an anomaly with characteristics that do not exceed acceptable limits.

inclusion: a nonmetallic phase such as an oxide, sulfide, or silicate particle in a metal pipeline.

indication: a finding of a nondestructive testing technique or method that deviates from the expected. It may or may not be a defect.

in-line inspection (ILI): a steel pipeline inspection technique that uses devices known in the industry as intelligent or smart pigs. These devices run inside the pipe and provide indications of metal loss, deformation, and other defects.

in-service pipeline: a pipeline that contains natural gas to be transported. The gas may or may not be flowing.

inspection: the use of a nondestructive testing technique or method.

integrity: the capability of the pipeline to withstand all anticipated loads (including hoop stress due to operating pressure) plus the margin of safety established by this section.

integrity assessment: a process that includes inspection of pipeline facilities, evaluating the indications resulting from the inspections, examining the pipe using a variety of techniques, evaluating the results of the examinations, characterizing the evaluation by defect type and severity, and determining the resulting integrity of the pipeline through analysis.

leak: an unintentional escape of gas from the pipeline. The source of the leak may be holes, cracks (including propagating and non-propagating, longitudinal, and circumferential), separation or pull-out and loose connections.

mechanical damage: a type of metal damage in a pipe or pipe coating caused by the application of an external force. Mechanical damage can include denting, coating removal, metal removal, metal movement, cold working of the underlying metal, puncturing, and residual stresses.

mitigation: the limitation or reduction of the probability of occurrence or expected consequence for a particular event.

nondestructive examination (NDE) or nondestructive testing (NDT): a testing method, such as radiography,ultrasonic, magnetic testing, liquid penetrant, visual, leak testing, eddy current, and acoustic emission, or a testing technique, such as magnetic flux leakage, magnetic particle inspection, shear-wave ultrasonic, and contact compression-wave ultrasonic.

pig: a device run inside a pipeline to clean or inspect the pipeline, or to batch fluids.

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pig trap or scraper trap: an ancillary item of pipeline equipment, such as a launcher or receiver, with associated pipework and valves, for introducing a pig into a pipeline or removing a pig from a pipeline.

pigging: the use of any independent, self-contained device, tool, or vehicle that moves through the interior of the pipeline for inspecting, dimensioning, cleaning, or drying.

qualification: demonstrated and documented knowledge, skills and abilities, along with documented training, experience, or both, required for personnel to properly perform the duties of a specific job or task.

rupture: a complete failure of any portion of the pipeline that allows the product to escape to the environment.

slug: a volume of liquid or gas, completely filling the cross-section of the pipe.

survey: measurements, inspections, or observations intended to discover and identify events or conditions that indicate a departure from normal operation or undamaged condition of the pipeline.

training: an organized program developed to impart the knowledge and skills necessary for qualification.

ultrasonic: high frequency sound. Ultrasonic examination is used to determine wall thickness and to detect the presence of defects.

uprating: the qualifying of an existing pipeline or main for a higher maximum allowable operating pressure.

805.2.5 Corrosion Control Terms and Definitions

anode: the electrode of an electrochemical cell at which oxidation occurs. Electrons flow away from the anode in the external circuit. Corrosion usually occurs and metal ions enter the solution at the anode.

bracelet anodes: galvanic anodes with geometry suitable for direct attachment around the circumference of a pipeline. These may be half-shell bracelets consisting of two semi-circular sections or segmented bracelets consisting of a large number of individual anodes.

cathodic protection (CP): a technique to reduce the corrosion of a metal surface by making that surface the cathode of an electromechanical cell.

cell or electrochemical cell: a system consisting of an anode and a cathode immersed in an electrolyte so as to create an electrical circuit. The anode and cathode may be different metals or dissimilar areas on the same metal surface.

coating: a liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid protective, decorative, or functional adherent film. Coating also includes tape wrap.

coating system: the complete number and types of coats applied to a substrate in a predetermined order. (When used in a broader sense, surface preparation, pretreatments, dry film thickness, and manner of application are included.)

corrosion: the deterioration of a material, usually a metal, that results from an electrochemical reaction with its environment.

corrosion fatigue: fatigue-type cracking of metal caused by repeated or fluctuating stresses in a corrosive environment and is characterized by shorter life than would be encountered as a result of either the repeated or fluctuating stress alone or the corrosive environment alone.

corrosion inhibitor: a chemical substance or combination of substances that, when present in the environment or on a surface, prevents or reduces corrosion.

corrosion rate: the rate at which corrosion proceeds.

corrosiveness: the tendency of an environment to cause corrosion or the degree to which or rate at which it causes corrosion.

crevice corrosion: localized corrosion of a metal surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity of the metal to the surface of another material.

curing: a chemical process of developing the intended properties of a coating or other material (e.g., resin) over a period of time.

current: a flow of electric charge.

current density: the current to or from a unit area of an electrode surface or through a unit area of a conductor or electrolyte.

depolarization: the removal of factors resisting the current in an electrochemical cell.

dielectric coating: a coating that does not conduct electricity.

dissimilar metals: different metals that could form an anode-cathode relationship in an electrolyte when connected by a metallic path.

electric potential: a voltage difference existing between two points, such as the pipe and its environment.

electrical interference: any electrical disturbance on a metallic structure in contact with an electrolyte caused by stray current(s).

electrical isolation: the condition of being electrically separated from other metallic structures or the environment.

electrode: a conductor used to establish contact with an electrolyte and through which current is transferred to or from an electrolyte.

electrolyte: a medium containing ions that migrate in an electric field.

epoxy: type of resin formed by the reaction of aliphatic or aromatic polyols (like bisphenol) with epichlorohydrin

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and characterized by the presence of reactive oxirane end groups.

erosion: the progressive loss of material from a solid surface due to mechanical interaction between that surface and a fluid, a multicomponent fluid, or solid particles carried with the fluid.

fault current: a current that flows from one conductor to ground or to another conductor due to an abnormal connection (including an arc) between the two. A fault current flowing to ground may be called a ground fault current.

film: a thin, not necessarily visible layer of material.

foreign structure: any metallic structure that is not intended as a part of a system under cathodic protection.

galvanic anode: a metal that provides sacrificial protection to another metal that is more noble when electrically coupled in an electrolyte. This type of anode is the electron source in one type of cathodic protection.

galvanic corrosion: accelerated corrosion of a metal because of an electrical contact with a more noble metal and/or a more noble localized section of the metal or nonmetallic conductor in a corrosive electrolyte.

graphitization: the formation of graphite in iron or steel, usually from decomposition of iron carbide at elevated temperatures. This should not be used as a term to describe graphitic corrosion.

holiday: a discontinuity in a protective coating that exposes unprotected surface to the environment.

hydrogen embrittlement: a loss of ductility of a metal resulting from absorption of hydrogen.

hydrogen stress cracking: cracking that results from the presence of hydrogen in a metal in combination with tensile stress. It occurs most frequently with high-strength alloys.

impressed current: an electric current supplied by a device employing a power source that is external to the electrode system. (An example is direct current for cathodic protection.)

impressed current anode: an electrode, suitable for use as an anode when connected to a source of impressed current, which is generally composed of a substantially inert material that conducts by oxidation of the electrolyte and, for this reason, is not corroded appreciably.

intergranular corrosion: preferential corrosion at or along the grain boundaries of a metal (also known as intercrystalline corrosion).

ion: an electrically charged atom or group of atoms.

metal loss: any of a number of types of anomalies in pipe in which metal has been removed from the pipe surface, usually due to corrosion or gouging.

noble: the positive direction of electrode potential, thus resembling noble metals such as gold and platinum.

overvoltage: the change in potential of an electrode from its equilibrium or steady-state value when current is applied.

paint: a pigmented liquid or resin applied to a substrate as a thin layer that is converted to an opaque solid film after application. It is commonly used as a decorative or protective coating.

pipe-to-soil potential: the electric potential difference between the surface of a buried or submerged metallic structure and the electrolyte that is measured with reference to an electrode in contact with the electrolyte.

pitting: localized corrosion of a metal surface that is confined to a small area and takes the form of cavities called pits.

polarization: the change from the open-circuit potential as a result of current across the electrode/electrolyte interface.

protective coating: a coating applied to a surface to protect the substrate from corrosion or other damage.

resistivity:

(a) the resistance per unit length of a substance with uniform cross-section.

(b) a measure of the ability of an electrolyte (e.g., soil) to resist the flow of electric charge (e.g., cathodic protection current). Resistivity data are used to design a groundbed for a cathodic protection system.

rust: corrosion product consisting of various iron oxides and hydrated iron oxides. (This term properly applies only to iron and ferrous alloys.)

shielding: preventing or diverting the flow of cathodic protection current from its natural path.

stray current: current through paths other than the intended circuit.

stress corrosion cracking (SCC): a form of environmental attack of the metal involving an interaction of a local corrosive environment and tensile stresses in the metal, resulting in formation and growth of cracks.

805.2.6 Engineering Terms and Definitions (12)

brittle fracture: fracture with little or no plastic deformation.

design life: a period of time used in design calculations, selected for the purpose of verifying that a replaceable or permanent component is suitable for the anticipated period of service. Design life may not pertain to the life of a pipeline system because a properly maintained and protected pipeline system can provide service indefinitely.

ductility: a measure of the capability of a material to be deformed plastically before fracturing.

elastic distortion: changes of dimensions of a material upon the application of a stress within the elastic range.

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Following the release of an elastic stress, the material returns to its original dimensions without any permanent deformation.

elastic limit: the maximum stress to which a material may be subjected without retention of any permanent deformation after the stress is removed.

elasticity: the property of a material that allows it to recover its original dimensions following deformation by a stress below its elastic limit.

engineering assessment: a documented assessment using engineering principles of the effect of relevant variables upon service or integrity of a pipeline system and conducted by or under supervision of a competent person with demonstrated understanding of and experience in the application of engineering and risk management principles related to the issue being assessed.

engineering critical assesment: an analytical procedure based upon fracture mechanics that allows determination of the maximum tolerable sizes for imperfections, and conducted by or under supervision of a competent person with demonstrated understanding of and experience in the application of the engineering principles related to the issue being assessed.

modulus of elasticity: a measure of the stiffness or rigidity of a material. It is actually the ratio of stress to strain in the elastic region of a material. If determined by a tension or compression test, it is also called Young's Modulus or the coefficient of elasticity.

probability: the likelihood of an event occurring.

risk: a measure of potential loss in terms of both the incident probability (likelihood) of occurrence and the magnitude of the consequences.

span: a section of the pipe that is unsupported.

strain: the change in length of a material in response to an applied force, expressed on a unit length basis (e.g., inches per inch or mm per mm).

805.2.7 Miscellaneous Terms and Definitions

shall or *shall not:* used to indicate that a provision is mandatory.

should, should not, or *it is recommended:* used to indicate that a provision is not mandatory but recommended as good practice.

806 QUALITY ASSURANCE

Quality Control systems consist of those planned, systematic, and preventative actions that are required to ensure that materials, products, and services will meet specified requirements. Quality Assurance systems and procedures consist of periodic audits and checks that ensure the Quality Control system will meet all of its stated purposes.

The integrity of a pipeline system may be improved by the application of Quality Assurance systems. These systems should be applied to the design, procurement, construction, testing, operating, and maintenance activities in the applications of this Code.

Organizations performing design, fabrication, assembly, erection, inspection, examination, testing, installation, operation, and maintenance application for B31.8 piping systems should have a written Quality Assurance system in accordance with applicable documents. Registration or certification of the Quality Assurance system should be by agreement between the contracting parties involved.

807 TRAINING AND QUALIFICATION OF PERSONNEL (12)

807.1 Program

Each operating company shall have a program to manage the qualification of personnel who perform operating, maintenance, and construction activities that could impact the safety or integrity of a pipeline. The program shall address, at a minimum, the following elements:

(a) Identify those tasks for which the qualification provisions of the program apply. The tasks shall include operating, maintenance, and construction activities that could impact the safety or integrity of a pipeline.

(b) For each task covered by the program, identify abnormal operating conditions, and describe the process used to ensure that individuals who perform these tasks are able to recognize and react to such conditions. An *abnormal operating condition* is defined in ASME B31Q as a condition that may indicate a malfunction of a component or deviation from normal operations that may

(1) indicate a condition exceeding design limits

(2) result in hazard(s) to persons, property, or the environment

(c) Identify training requirements for personnel involved in performing tasks covered by the program.

(d) Describe the evaluation process and critera used to determine

(1) initial qualification

(2) subsequent or ongoing qualification

(3) suspension or revocation of qualifications

(4) reinstatement of qualifications

(e) Establish organizational responsibilities for carrying out each program element.

(f) Establish a process to periodically evaluate the effectiveness of the qualification program, including provisions for updating the program based on the results of effectiveness appraisals.

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(g) Describe how program requirements are communicated to affected individuals and how changes to program requirements are managed and communicated.

(h) Identify the documentation requirements needed to adequately manage the program.

807.2 Operating and Maintenance Functions

In addition to the requirements in para. 807.1, each operating company shall provide training for employees in procedures established for operating and maintenance functions. The training shall be comprehensive and designed to prepare employees for service in their area of responsibility.

807.3 Reference

A useful reference for managing personnel qualifications is ASME B31Q, Pipeline Personnel Qualification.

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Chapter I
Materials and Equipment

810 MATERIALS AND EQUIPMENT

It is intended that all materials and equipment that will become a permanent part of any piping system constructed under this Code shall be suitable and safe for the conditions under which they are used. All such materials and equipment shall be qualified for the conditions of their use by compliance with certain specifications, standards, and special requirements of this Code, or otherwise as provided herein.

811 QUALIFICATION OF MATERIALS AND EQUIPMENT

811.1 Categories

Materials and equipment fall into the following six categories pertaining to methods of qualification for use under this Code:

(a) items that conform to standards or specifications referenced in this Code

(b) items that are important from a safety standpoint, of a type for which standards or specifications are referenced in this Code but specifically do not conform to a referenced standard (e.g., pipe manufactured to a specification not referenced in the Code)

(c) items of a type for which standards or specifications are referenced in this Code, but that do not conform to the standards and are relatively unimportant from a safety standpoint because of their small size or because of the conditions under which they are to be used

(d) items of a type for which no standard or specification is referenced in this Code (e.g., gas compressor)

(e) proprietary items (see definition, para. 804.3)

(f) unidentified or used pipe

811.2 Procedures for Qualification

Prescribed procedures for qualifying each of these six categories are given in the following paragraphs.

811.2.1 Conformance. Items that conform to standards or specifications referenced in this Code [para. 811.1(a)] may be used for appropriate applications, as prescribed and limited by this Code without further qualification. (See section 814.)

811.2.2 Nonconformance (Important Items). Important items of a type for which standards or specifications are referenced in this Code, such as pipe, valves, and flanges, but that do not conform to standards or specifications referenced in this Code [para. 811.1(b)] shall be qualified as described in para. 811.2.2(a) or (b).

(a) A material conforming to a written specification that does not vary substantially from a referenced standard or specification and that meets the minimum requirements of this Code with respect to quality of materials and workmanship may be used. This paragraph shall not be construed to permit deviations that would tend to affect weldability or ductility adversely. If the deviations tend to reduce strength, full allowance for the reduction shall be provided for in the design.

(b) When petitioning the Section Committee for approval, the following requirements shall be met. If possible, the material shall be identified with a comparable material, and it should be stated that the material will comply with that specification, except as noted. Complete information as to chemical composition and physical properties shall be supplied to the Section Committee, and its approval shall be obtained before this material is used.

811.2.3 Nonconformance (Unimportant Items). Relatively unimportant items that do not conform to a standard or specification [para. 811.1(c)] may be used, provided that

(a) they are tested or investigated and found suitable for the proposed service

(b) they are used at unit stresses not greater than 50% of those allowed by this Code for comparable materials

(c) their use is not specifically prohibited by the Code

811.2.4 No Standards or Specifications Referenced. Items of a type for which no standards or specifications are referenced in this Code [para. 811.1(d)] and proprietary items [para. 811.1(e)] may be qualified by the user provided

(a) the user conducts an investigation and tests (if needed) that demonstrate that the item of material or equipment is suitable and safe for the proposed service (e.g., clad or duplex stainless steel pipe); or

(b) the manufacturer affirms the safety of the item recommended for that service (e.g., gas compressors and pressure relief devices).

811.3 Unidentified or Used Pipe

Unidentified or used pipe [para. 811.1(f)] may be used and is subject to the requirements of section 817.

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