ASME B31.4-2019

(Revision of ASME B31.4-2016)

Pipeline Transportation Systems for Liquids and Slurries

ASME Code for Pressure Piping, B31

AN INTERNATIONAL PIPING CODE®

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: November 1, 2019

The next edition of this Code is scheduled for publication in 2022. This Code will become effective 6 months after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Code. Interpretations are published on the Committee web page and under http://go.asme.org/Interpretations. Periodically certain actions of the ASME B31 Committee may be published as Cases. Cases are published on the ASME website under the B31 Committee Page at http://go.asme.org/B31committee as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages of the associated codes and standards to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The B31 Committee Page can be found at http://go.asme.org/B31committee. The associated B31 Committee Pages for each code and standard can be accessed from this main page. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

CONTENTS

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 (ASA)] initiated Project B31 in March 1926 at the request of The American Society of Mechanical Engineers (ASME), and with that society as sole sponsor. After several years' 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 was begun in 1937. Several more years' effort was given to securing uniformity between sections and to eliminating divergent requirements and discrepancies, as well as to keeping the code abreast of current developments in welding technique, stress computations, and references to new dimensional and material standards. During this period, a new section was added on refrigeration piping, prepared in cooperation with The American Society of Refrigeration Engineers (ASRE) and complementing 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 inquiries that require explanation or interpretation of code requirements, and for publishing such inquiries and answers in *Mechanical Engineering* for the information of all concerned.

Continuing increases in the severity of service conditions, with concurrent developments of new materials and designs equal to meeting these higher requirements, had pointed to the need by 1948 for more extensive changes in the code than could be provided by supplements alone. The decision was reached by ASA and ASME 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. Following its reorganization, Sectional Committee B31 made an intensive review of the 1942 code, and a revised code was approved and published in February 1951 with the designation ASA B31.1-1951, which included

(a) a general revision and extension of requirements to agree with practices current at the time

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

(c) clarification of ambiguous or conflicting requirements

Supplement No. 1 to ASA B31.1 was approved and published in 1953 as ASA B31.1a-1953. This Supplement and other approved revisions were included in a new edition published in 1955 with the designation ASA B31.1-1955.

A review by B31 Executive and Sectional Committees in 1955 resulted in a decision to develop and publish industry sections as separate code documents of the American Standard B31 Code for Pressure Piping. ASA B31.4-1959 was the first separate code document for Oil Transportation Piping Systems and superseded that part of Section 3 of ASA B31.1-1955 covering oil transportation piping systems. In 1966, B31.4 was revised to expand coverage on welding, inspection, and testing, and to add new chapters covering construction requirements and operation and maintenance procedures affecting the safety of the piping systems. This revision was published with the designation USAS B31.4-1966, Liquid Petroleum Transportation Piping Systems, since ASA was reconstituted as the United States of America Standards Institute (USASI) in 1966.

USASI changed its name, effective October 6, 1969, to the American National Standards Institute, Inc. (ANSI), and USAS B31.4-1966 was redesignated as ANSI B31.4-1966. The B31 Sectional Committee was redesignated as American National Standards Committee B31 Code for Pressure Piping, and, because of the wide field involved, more than 40 different engineering societies, government bureaus, trade associations, institutes, and the like had one or more representatives on Standards Committee B31, plus a few "Individual Members" to represent general interests. Code activities were subdivided according to the scope of the several sections, and general direction of Code activities rested with Standards Committee B31 officers and an Executive Committee whose membership consisted principally of Standards Committee officers and chairmen of the Section and Technical Specialists Committees.

The ANSI B31.4-1966 Code was revised and published in 1971 with the designation ANSI B31.4-1971.

The ANSI B31.4-1971 Code was revised and published in 1974 with the designation ANSI B31.4-1974.

In December 1978, American National Standards Committee B31 was converted to an ASME Committee with procedures accredited by ANSI. The 1979 revision was approved by ASME and subsequently by ANSI on November 1, 1979, with the designation ANSI/ASME B31.4-1979.

Following publication of the 1979 edition, the B31.4 Section Committee began work on expanding the scope of the Code to cover requirements for the transportation of liquid alcohols. References to existing dimensional standards and material specifications were revised, and new references were added. Other clarifying and editorial revisions were made in order to improve the text. These revisions led to the publication of two addenda to ANSI/ASME B31.4. Addenda "b" was approved and published in 1981 as ANSI/ASME B31.4b-1981. Addenda "c" was approved and published in 1986 as ANSI/ASME B31.4c-1986.

The 1986 edition of ANSI/ASME B31.4 included the two previously published addenda to the 1979 edition.

Following publication of the 1986 edition, clarifying and editorial revisions were made to improve the text. Additionally, references to existing standards and material specifications were revised, and new references were added. These revisions led to the publication of an addenda that was approved and published in 1987 as ASME/ANSI B31.4a-1987.

The 1989 edition of ASME/ANSI B31.4 included the previously published addenda to the 1986 edition.

Following publication of the 1989 edition, clarifying revisions were made to improve the text. Additionally, references to existing standards and material specifications were revised and updated. These revisions led to the publication of an addenda that was approved and published in 1991 as ASME B31.4a-1991.

The 1992 edition of ASME B31.4 included the previously published addenda to the 1989 edition and a revision to valve maintenance. The 1992 edition was approved by ANSI on December 15, 1992, and designated as ASME B31.4-1992 edition.

The 1998 edition of ASME B31.4 included the previously published addenda to the 1992 edition. Also included in the 1998 edition were other revisions and the addition of Chapter IX, Offshore Liquid Pipeline Systems. The 1998 edition was approved by ANSI on November 11, 1998, and designated as ASME B31.4-1998 edition.

The 2002 edition of ASME B31.4 included the previously published addenda to the 1998 edition along with revisions to the maintenance section and updated references. The 2002 edition was approved by ANSI on August 5, 2002, and designated as ASME B31.4-2002.

The 2006 edition of ASME B31.4 contained a new repair section along with revisions to the definitions section, expansion of material standards Table 423.1 and dimensional standards Table 426.1, and updated references. The 2006 edition was approved by ANSI on January 5, 2006, and designated as ASME B31.4-2006.

The 2009 edition of ASME B31.4 contained major revisions to the definitions section; Chapter II, Design; and Chapter VIII, Corrosion Control. The materials standards Table 423.1 and references were revised and updated. The 2009 edition was approved by ANSI on September 14, 2009, and designated as ASME B31.4-2009.

The 2012 edition of ASME B31.4 contained a revised scope and a new chapter to incorporate the requirements from ASME B31.11, Slurry Transportation Piping Systems. There was also a new chapter for carbon dioxide piping, extracting all of the previous carbon dioxide information into a stand-alone chapter. The definitions section was also revised with new entries. The 2012 edition was approved by ANSI on September 14, 2012, and designated as ASME B31.4-2012.

The 2016 edition of ASME B31.4 contained a revised scope and updates to the stress section in Chapter II. A new paragraph was added in Chapter III for material requirements in low-temperature applications. In addition, changes were included throughout to reference minimum wall thickness requirements as permitted by manufacturing specifications. The 2016 edition was approved by ANSI on February 22, 2016, and designated as ASME B31.4-2016.

The 2019 edition of ASME B31.4 contains a rework of Chapter IX to align with standardized numbering of other chapters. A new standard is referenced in Chapter II to improve the accuracy of calculations that use stress intensification and flexibility factors. Updates to the text and table in Chapter VI on allowable repairs were completed. The 2019 edition was approved by ANSI on July 18, 2019, and designated as ASME B31.4-2019.

ASME B31 COMMITTEE
Code for Pressure Piping

(The following is the roster of the Committee at the time of approval of this Code.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Code may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B31 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Code to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Code. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Code. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Code and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Code to which the proposed Case applies.

Interpretations. Upon request, the B31 Standards Committee will render an interpretation of any requirement of the Code. Interpretations can only be rendered in response to a written request sent to the Secretary of the B31 Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the B31 Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Code for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The B31 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B31 Standards Committee.

INTRODUCTION

The ASME B31 Code for Pressure Piping consists of a number of individually published Sections, each an American National Standard. Rules for each Section reflect the kinds of piping installations considered during its development, as follows:

B31.1 Power Piping: piping typically found in electric power-generating stations, industrial and institutional plants, geothermal heating systems, and central and district heating and cooling systems

B31.3 Process Piping: piping typically found in petroleum refineries; onshore and offshore petroleum and natural gas production facilities; chemical, pharmaceutical, textile, paper, ore processing, semiconductor, and cryogenic plants; food and beverage processing facilities; and related processing plants and terminals

B31.4 Pipeline Transportation Systems for Liquids and Slurries: piping transporting hazardous products that are predominately liquid between facilities, production and storage fields, plants, and terminals, and within terminals and pumping, regulating, and metering stations associated with liquid pipeline systems

B31.5 Refrigeration Piping and Heat Transfer Components: piping for refrigerants and secondary coolants

B31.8 Gas Transmission and Distribution Piping Systems: piping transporting products that are predominately gas between sources and terminals, including compressor, regulating, and metering stations, and gas gathering pipelines

B31.9 Building Services Piping: piping typically found in industrial, institutional, commercial, and public buildings, and in multi-unit residences, that does not require the range of sizes, pressures, and temperatures covered in B31.1

B31.12 Hydrogen Piping and Pipelines: piping in gaseous and liquid hydrogen service and pipelines in gaseous hydrogen service

This is Code Section B31.4, Pipeline Transportation Systems for Liquids and Slurries. Hereafter, in this Introduction and in the text of this Code Section B31.4, where the word "Code" is used without specific identification, it means this Code Section.

It is the user's responsibility to select the Code Section that most nearly applies to a proposed piping installation. Factors to be considered include limitations of the Code Section, jurisdictional requirements, and the applicability of other codes and standards. All applicable requirements of the selected Code Section shall be met. For some installations, more than one Code Section may apply to different parts of the installation. Certain piping within a facility may be subject to other national or industry codes and standards. The user is also responsible for imposing requirements supplementary to those of the Code if necessary to ensure safe piping for the proposed installation.

The Code specifies engineering requirements deemed necessary for safe design, construction, operation, and maintenance of pressure piping. While safety is the primary consideration, this factor alone will not necessarily govern the final specifications for any piping installation or operation. The Code is not a design handbook. Many decisions that must be made to produce a sound piping installation and to maintain system integrity during operation are not specified in detail within this Code. The Code does not serve as a substitute for sound engineering judgments by the operating company and the designer.

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 requirements and pressure–temperature ratings

(b) requirements for design of components and assemblies, including pipe supports

(c) requirements and data for evaluation and limitation of stresses, reactions, and movements associated with pressure, temperature changes, and other forces

(d) guidance and limitations on the selection and application of materials, components, and joining methods

(e) requirements for the fabrication, assembly, and erection of piping
(f) requirements for examination, inspection, and testing of piping
(g) procedures for operation and maintenance that are essential to public safety
(h) provisions for protecting pipelines from external corrosion and internal corrosion/erosion

It is intended that this edition of Code Section B31.4 not be retroactive. Unless agreement is specifically made between contracting parties to use another edition, or the regulatory body having jurisdiction imposes the use of another edition, the latest edition issued at least 6 months prior to the original contract date for the first phase of activity covering a piping system or systems shall be the governing document for all design, materials, fabrication, erection, examination, and testing for the piping until the completion of the work and initial operation.

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

Code users will note that paragraphs in the Code are not necessarily numbered consecutively. Such discontinuities result from following a common outline, insofar as practicable, for all Code Sections. In this way, corresponding material is correspondingly numbered in most Code Sections, thus facilitating reference by those who have occasion to use more than one Section.

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. New editions are published at intervals of 3 to 5 years.

When no Section of the ASME Code for Pressure Piping specifically covers a piping system, at his discretion the user may 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.

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 Correspondence With the B31 Committee 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 on the ASME Interpretations Database.

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 B31.4 web 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. However, the provisions of a Case 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, 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 and Section VIII, Division 1, Appendix B. (To develop usage and gain experience, unlisted materials may be used in accordance with para. 423.1.)

ASME B31.4-2019
SUMMARY OF CHANGES

Following approval by the ASME B31 Committee and ASME, and after public review, ASME B31.4-2019 was approved by the American National Standards Institute on July 18, 2019.

ASME B31.4-2019 includes the following changes identified by a margin note, **(19)**.

Page	*Location*	*Change*
xi	Correspondence With the B31 Committee	Added
2	400.1.1	(1) Subparagraph (b) added, and remaining subparagraphs redesignated
		(2) Subparagraphs (d) and (e) [formerly (c) and (d)] revised
13	402.1	Second paragraph revised
17	402.5.2	(1) Note designation deleted
		(2) Nomenclature revised
17	402.6.1	Definition of A revised
17	402.6.2	Definition of A and final paragraph revised
18	403.2.1	(1) Equation and nomenclature revised
		(2) Final paragraph deleted
23	403.9.1	Note added
24	404.1.2	Revised
25	404.2.3	Final paragraph revised
33	Figure 404.3.5-1	(1) Definition of L removed from figure and added to the nomenclature
		(2) Nomenclature revised
33	404.4.1	First paragraph revised
34	404.5.1	Final paragraph revised
36	404.11	First paragraph revised
38	425	Revised in its entirety
39	Table 423.1-1	Title revised
41	426.3	Revised
43	434.2.2	Revised
43	434.4	Revised
44	434.7.1	Subparagraph (a) revised
45	434.8.2	Subparagraph (a) revised
47	434.8.9	Subparagraph (a) revised
51	434.13.5	Subparagraph (b) revised
52	434.15.2	Subparagraph (f) added
53	434.18	Subparagraph (b)(1) revised
56	435.4.3	Revised
59	437.4.1	Subparagraph (a) revised

Page	*Location*	*Change*
59	437.4.3	Revised
59	437.6.4	Revised
62	451.6.1	Subparagraph (g) revised
65	451.6.2.6	First paragraph revised
66	451.6.2.9	First paragraph and subparas. (b) and (d) revised
68	451.9	Subparagraph (a) revised
69	Table 451.6.2.9-1	Entry in sixth row of fourth column revised
71	452.7	Subparagraph (d) revised
74	461.1.2	Subparagraphs (a) and (b) revised
75	461.1.7	Final sentence revised
77	462.1	Final sentence revised
77	462.2	Subparagraph (g)(1) revised
78	462.3	Subparagraphs (b)(1), (b)(2), (b)(3), (b)(5), (b)(6), and (b)(7) revised
78	463.1	Subparagraph (b) revised
80	466.1.1	Second and third paragraphs revised
81	467	Final sentence revised
82	A400	Subparagraph (d) revised
83	A401	Revised in its entirety
85	A402	Revised in its entirety
89	A403	Revised in its entirety
90	A404.4.3	(1) Redesignated from original A404.4.1 (2) Title revised
90	A404.8.3	Revised
90	A405	A405.1(a) and A405.2 revised
90	A406.3	Former A421 revised and redesignated as A406.3
91	A423.2	Final sentence revised
91	A434.2.2	Former A434.2 redesignated as A434.2.2
91	A434.8	Titles of A434.8.3, A434.8.5, A434.8.5(a), and A434.8.5(b) revised
92	A434.13.1	Revised
92	A434.25	(1) Former A434.14 redesignated as A434.25 (2) Cross-references updated
92	A436.5.1	(1) Subparagraphs (9), (11), (12), (13), and (15) redesignated as (19) through (23) (2) Subparagraph (23) [formerly (15)] revised
93	A451.3	Title revised
93	A451.5	Final sentence deleted
94	A451.6	Final paragraph added
94	A451.6.2	Revised in its entirety
94	A451.10	Title revised
95	A460	Subparagraph (c) revised
95	A461	(1) Titles of A461, A461.1.2, A461.1.3, and A461.1.5 revised (2) A461.1.1(c) redesignated as A461.1.1(a) (3) In A461.3, subparagraphs redesignated, and reference updated

Page	*Location*	*Change*
96	A463.2	Former A463.1 redesignated as A463.2
99	C400.2	Definition of *ductile iron* revised
100	C404.4.1	Revised
103	Mandatory Appendix I	Updated
107	Nonmandatory Appendix A	Information moved to Correspondence With the B31 Committee page
109	Index	Updated

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Chapter I
Scope and Definitions

400 GENERAL STATEMENTS

(a) This pipeline transportation systems Code is one of several sections of The American Society of Mechanical Engineers Code for Pressure Piping, ASME B31, and it is the responsibility of the user of this Code to select the applicable Section. This Section is published as a separate document for convenience. This Code is intended to apply to pipeline systems transporting liquids including, but not limited to, crude oil, condensate, liquid petroleum products, natural gasoline, natural gas liquids, liquefied petroleum gas, carbon dioxide (supercritical), liquid alcohol, liquid anhydrous ammonia, produced water, injection water, brine, biofuels, and slurries. Throughout this Code, these systems will be referred to as liquid pipeline systems.

(b) The requirements of this Code are adequate for safety under conditions normally encountered in the operation of liquid pipeline systems. Requirements for all abnormal or unusual conditions are not specifically provided for, nor are all details of engineering and construction prescribed. All work performed within the scope of this Code shall comply with the safety standards expressed or implied.

(c) The primary purpose of this Code is to establish requirements for safe design, construction, inspection, testing, operation, and maintenance of liquid pipeline systems for protection of the general public and operating company personnel, as well as for reasonable protection of the piping system against vandalism and accidental damage by others, and reasonable protection of the environment.

(d) This Code is concerned with employee safety to the extent that it is affected by basic design, quality of materials and workmanship, and requirements for construction, inspection, testing, operation, and maintenance of liquid pipeline systems. Existing industrial safety regulations pertaining to work areas, safe work practices, and safety devices are not intended to be supplanted by this Code.

(e) The designer is cautioned that the Code is not a design handbook. The Code does not do away with the need for the engineer or competent engineering judgment. The Code generally employs a simplified approach for many of its requirements.

(1) For design and construction, a designer may choose to use a more complete and rigorous analysis to develop design and construction requirements. When the designer decides to take this approach, the designer shall provide details and calculations demonstrating design, construction, examination, and testing are consistent with the criteria of this Code. These details shall be adequate for the operating company to verify the validity of the approach and shall be approved by the operating company. The details shall be documented in the engineering design.

(2) For operation and maintenance, the operating company may choose to use a more rigorous analysis to develop operation and maintenance requirements. When the operating company decides to take this approach, the operating company shall provide details and calculations demonstrating that such alternative practices are consistent with the objectives of this Code. The details shall be documented in the operating records and retained for the lifetime of the facility.

(f) This Code shall not be retroactive or construed as applying to piping systems installed before the date of issuance shown on the document title page insofar as design, materials, construction, assembly, inspection, and testing are concerned. It is intended, however, that the provisions of this Code shall be applicable within 6 months after date of issuance to the relocation, replacement, and uprating or otherwise changing of existing piping systems; and to the operation, maintenance, and corrosion control of new or existing piping systems. After Code revisions are approved by ASME and ANSI, they may be used by agreement between contracting parties beginning with the date of issuance. Revisions become mandatory or minimum requirements for new installations 6 months after date of issuance except for piping installations or components contracted for or under construction prior to the end of the 6-month period.

(g) The users of this Code are advised that in some areas legislation may establish governmental jurisdiction over the subject matter covered by this Code and are cautioned against making use of revisions that are less restrictive than former requirements without having assurance that they have been accepted by the proper authorities in the jurisdiction where the piping is to be installed. The Department of Transportation, United States of America, rules governing the transportation

by pipeline in interstate and foreign commerce of petroleum, petroleum products, and liquids such as anhydrous ammonia or carbon dioxide are prescribed under Part 195 — Transportation of Hazardous Liquids by Pipeline, Title 49 — Transportation, Code of Federal Regulations.

400.1 Scope

(19) **400.1.1** This Code prescribes requirements for the design, materials, construction, assembly, inspection, testing, operation, and maintenance of liquid pipeline systems between production fields or facilities, tank farms, above- or belowground storage facilities, natural gas processing plants, refineries, pump stations, ammonia plants, terminals (marine, rail, and truck), and other delivery and receiving points, as well as pipelines transporting liquids within pump stations, tank farms, and terminals associated with liquid pipeline systems (see Figures 400.1.1-1 and 400.1.1-2).

This Code also prescribes requirements for the design, materials, construction, assembly, inspection, testing, operation, and maintenance of piping transporting aqueous slurries of nonhazardous materials such as coal, mineral ores, concentrates, and other solid materials, between a slurry processing plant or terminal and a receiving plant or terminal (see Figure 400.1.1-3).

Piping consists of pipe, flanges, bolting, gaskets, valves, relief devices, fittings, and the pressure-containing parts of other piping components. It also includes hangers and supports, and other equipment items necessary to prevent overstressing the pressure-containing parts. It does not include support structures such as frames of buildings, stanchions, or foundations, or any equipment such as defined in para. 400.1.2(b).

Requirements for offshore pipelines are found in Chapter IX. Requirements for carbon dioxide pipelines are found in Chapter X. Requirements for slurry pipelines are found in Chapter XI.

Also included within the scope of this Code are

(a) primary and associated auxiliary liquid petroleum and liquid anhydrous ammonia piping at pipeline terminals (marine, rail, and truck), tank farms, pump stations, pressure-reducing stations, and metering stations, including scraper traps, strainers, and prover loops

(b) primary and auxiliary slurry piping at storage facilities, pipeline terminals, pump stations, choke stations, and pressure-reducing stations, including piping up to the first valve of attached auxiliary water lines

(c) storage and working tanks, including pipe-type storage fabricated from pipe and fittings, and piping interconnecting these facilities

(d) liquid petroleum, liquid anhydrous ammonia, and slurry piping located on property that has been designated for such piping within petroleum refinery, natural gasoline, gas processing, ammonia, bulk plants, and slurry transportation systems

(e) those aspects of operation and maintenance of liquid and slurry pipeline systems relating to the safety and protection of the general public, operating company personnel, environment, property, and the piping systems [see paras. 400(c) and 400(d)]

400.1.2 This Code was not developed to apply to

(a) building service piping, such as water, air, or steam

(b) pressure vessels, heat exchangers, pumps, meters, and other such equipment, including internal piping and connections for piping except as limited by para. 423.2.4(b)

(c) piping with a design temperature below −20°F (−30°C) or above 250°F (120°C) [for applications below −20°F (−30°C), see paras. 423.2.1(a) and 423.2.6]

(d) casing, tubing, or pipe used in oil wells and wellhead assemblies

400.2 Definitions

Some of the more common terms relating to piping are defined below. For welding terms used in this Code but not shown here, definitions in accordance with AWS A3.0 apply.

accidental loads: any unplanned load or combination of unplanned loads caused by human intervention or natural phenomena.

active corrosion: corrosion that is continuing or not arrested.

anomaly: an indication, detected by nondestructive examination (such as in-line inspection).

arc welding (AW)[1]*:* a group of welding processes that produces coalescence of workpieces by heating them with an arc. The processes are used with or without the application of pressure and with or without filler metal.

automatic welding[1]*:* welding with equipment that requires only occasional or no observation of the welding, and no manual adjustment of the equipment controls.

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

blunt imperfection: an imperfection characterized by smoothly contoured variations in wall thickness.[2]

breakaway coupling: a component installed in the pipeline to allow the pipeline to separate when a predetermined axial load is applied to the coupling.

buckle: a condition where the pipeline has undergone sufficient plastic deformation to cause permanent wrinkling in the pipe wall or excessive cross-sectional

[1] These welding terms agree with AWS A3.0.

[2] Sharp imperfections may be rendered blunt by grinding, but the absence of a sharp imperfection must be verified by visual and nondestructive examination.