ASME B31.9–2004
(Revision of ASME B31.9–1996)

Building Services Piping

ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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

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This edition was approved by the American National Standards Institute and designated ASME B31.9-2004 on August 16, 2004.

The next edition of this Code is scheduled for publication in 2008. There will be no addenda issued to ASME B31.9-2004.

ASME issues written replies to inquiries concerning interpretations of technical aspects of the Code. Interpretations are published on the ASME Web site under the Committee Pages at http://www.asme.org/codes/ as they are issued.

Periodically certain actions of the ASME B31 Committee will be published as Cases. While these Cases do not constitute formal revisions of the Code, they may be used in specifications, or otherwise, as representing considered opinions of the Committee. The Cases are not part of the Code and are published separately.

The American Society of Mechanical Engineers
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FOREWORD

The need for a national code for pressure piping became increasingly evident from 1915 to 1925. The American Standards Association initiated the B31 Project in March 1926 to meet that need. The American Society of Mechanical Engineers proposed the work and has served as sponsor since its inception.

The first edition was published in 1935 as the American Tentative Standard Code for Pressure Piping. To keep the Code abreast of developments in design, welding, and of new standards and specifications, as well as of developments in service conditions, new or supplementary editions were issued as follows:

B31.1-1942, American Standard Code for Pressure Piping
B31.1a-1944, Supplement 1
B31.1b-1947, Supplement 2
B31.1-1951, American Standard Code for Pressure Piping
B31.1a-1953, Supplement 1 to B31.1-1951
B31.1-1955, American Standard Code for Pressure Piping

In 1955, a decision was made to develop and publish separate Code Sections for various industries. The current Sections are:

B31.1, Power Piping
B31.3, Process Piping
B31.4, Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
B31.5, Refrigeration Piping
B31.8, Gas Transmission and Distribution Piping Systems
B31.9, Building Services Piping
B31.11, Slurry Transportation Piping Systems

In 1969, the American Standards Association, renamed the United States of America Standards Institute, became the American National Standards Institute (ANSI), and the B31 Sectional Committee became the B31 Standards Committee. In 1978, The American Society of Mechanical Engineers was granted accreditation by ANSI to organize the B31 Committee as the ASME Code for Pressure Piping, with Code Sections designated as ANSI/ASME B31.

Need for a separate Building Services Section of the Code for Pressure Piping was recognized for several years. This new Code Section, ASME B31.9 Building Services Piping, first issued in 1982, was developed to fill that need.

The Code has intentionally been written on a conservative basis in order to avoid the necessity for complex design, fabrication, and inspection criteria. For this reason, application of this Code is expected to be simple and straightforward.

Metric (SI) units have been added in parentheses after U.S. Customary units. This Code is based on U.S. Customary Units.

Following approval by the B31 Main Committee and the ASME Board on Pressure Technology Codes and Standards, and after public review, this Code Section was approved by the American National Standards Institute on August 16, 2004.

ASME CODE FOR PRESSURE PIPING, B31

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INTRODUCTION

The ASME B31 Code for Pressure Piping consists of a number of individually published Sections, each an American National Standard. Hereafter, in this Introduction and in the text of this Code Section B31.9, where the word *Code* is used without specific identification, it means this Code Section.

The Code sets forth engineering requirements deemed necessary for safe design and construction of pressure piping. While safety is the basic consideration, this factor alone will not necessarily govern the final specifications for any piping system. The designer is cautioned that the Code is not a design handbook; it does not do away with 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 assure 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

It is intended that this Edition of Code Section B31.9 and any subsequent addenda not be retroactive. Unless agreement is specifically made between contracting parties to use another issue, or the regulatory body having jurisdiction imposes the use of another issue, the latest edition and addenda 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 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 clauses 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 ASME procedures 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. Addenda may be issued periodically. New editions are published at intervals of 3 to 5 years.

It is the owner's responsibility to select the Code Section that most nearly applies to a proposed piping installation. Different Code Sections may apply to different parts of an installation. Factors to be considered by the owner 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, and the owner should impose additional requirements supplementing those of the Code in order to assure safe piping for the proposed installation.

Rules for each Code Section have been developed considering the need for application specific requirements for the pressure piping involved. Applications considered for each Code Section include:

(a) 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

(b) B31.3, Process Piping — piping typically found in petroleum refineries; chemical, textile, paper, semiconductor, and cryogenic plants; and related processing plants and terminals

(c) B31.4, Liquid Transportation Piping — piping for transporting predominantly liquid products between plants and terminals and within terminals, and for pumping, regulating, and metering stations

(d) B31.5, Refrigeration Piping — piping for refrigerants and secondary coolants

(e) B31.8, Gas Transportation and Distribution Piping — piping for transporting predominantly gas products between sources and terminals, including compressor, regulating, and metering stations; and gas gathering pipelines

(f) B31.9, Building Services Piping — piping for industrial, institutional, commercial, and public buildings, and multi-unit residences, which does not require the range of sizes, pressures, and temperatures covered in B31.1

(g) B31.11, Slurry Transportation Piping — piping for transporting aqueous slurries between plants and terminals, and within terminals and pumping and regulating stations.

Certain piping within a facility may be subject to other codes and standards, including but not limited to:

(a) ASME Boiler and Pressure Vessel Code, Section III — nuclear power piping

(b) ANSI Z223.1, National Fuel Gas Code — fuel gas piping from the point of delivery to the connections of each gas utilization device

(c) NFPA Fire Protection Standards — fire protection systems using water and other materials such as carbon dioxide, halon, foam, dry chemicals, and wet chemicals

(d) NFPA 99 Health Care Facilities — medical and laboratory gas systems

(e) NFPA 8503, Standard for Pulverized Fuel Systems. Building and Plumbing Codes.

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 Mandatory Appendix IV, 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 issued to the applicable Code Section.

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. Proposed Cases are published in *Mechanical Engineering* for public review. In addition, the Case will be published as part of a Case Supplement issued to the applicable Code Section.

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. (To develop usage and gain experience, unlisted materials may be used in accordance with para. 923.1.2.)

Requests for interpretation and suggestions for revision should be addressed to ASME, Secretary, B31 Committee, Three Park Avenue, New York, NY 10016.

ASME B31.9-2004
SUMMARY OF CHANGES

Following approval by the B31 Committee and ASME, and after public review, ASME B31.9-2004 was approved by the American National Standards Institute on August 16, 2004.

ASME B31.9-2004 includes editorial changes, revisions, and corrections identified by a margin note, **(04)**, placed next to the affected area.

Page	*Location*	*Change*
1	900.1.2(a)(1)	Revised
3, 5	900.2	Definitions for *chilled water, DN, employer, pipe, piping, piping components,* and *piping system* added
7, 8	900.3	h_g, r, W, W_e, W_f, and Z deleted
9	901.5(b)	Added
13	904.3	(1) Revised in its entirety (2) Figs. 904.3.3A and 904.3.3B and Table 904.3.3 deleted
	904.4.1	Last sentence of first para. revised
17, 18	919.4.1(a)(2)	Former Eq. (9) redesignated as Eq. (8) and revised
27	923.3.4	Added
28	926.4	PEX, PE-AL-PE, and PEX-AL-PEX added
29, 31, 32	Table 926.1	(1) AGA references deleted (2) ASTM F 876 through F 1335 added (3) ASTM F 2014 added
33	Table 926.2	ASTM F 2014 added
34	927.2.1	Revised in its entirety
	927.4.2(c)	Added
36, 37	Fig. 927.4.3B	Revised
	927.5	Revised in its entirety
	927.6	Revised in its entirety
39	930.2	Added
42	936.6.1	Subparagraphs (b) and (c) revised
43	936.6.6(a)	Revised
44	937.5.2	Second sentence revised

Page	*Location*	*Change*
46	Table I-1	Stress values for ASTM A 53 Class F revised
54, 55	Mandatory Appendix III	Last six ASTM references added

SPECIAL NOTE:

The Interpretations to ASME B31.9 are included in this edition as a separate section for the user's convenience.

Chapter I
Scope and Definitions

900 GENERAL

This Building Services Piping Code is a Section of The American Society of Mechanical Engineers Code for Pressure Piping, B31. This Section, herein called the Code, is published as a separate document for convenience.

Standards and specifications incorporated by reference in this Code are shown in Table 926.1, Mandatory Appendix I, and elsewhere. It is not considered practical to refer to a dated edition of each standard or specification where referenced. Instead, the dated edition references are included in Mandatory Appendix III.

The user is cautioned that the local building code must be observed and adhered to when its requirements are more stringent than those of this Code.

Components of piping systems shall conform to the specifications and standards listed in this Code. Piping elements neither specifically approved nor specifically prohibited by this Code may be used provided they are qualified for use as set forth in applicable chapters of this Code.

Engineering requirements of this Code, while considered necessary and adequate for safe design, generally employ a simplified approach. An engineer capable of applying a more rigorous analysis shall have the latitude to do so. He must be able to demonstrate the validity of his approach.

900.1 Scope

900.1.1 Coverage and Application. This Code Section has rules for the piping in industrial, institutional, commercial, and public buildings, and multi-unit residences, which does not require the range of sizes, pressures, and temperatures covered in B31.1. This Code prescribes requirements for the design, materials, fabrication, installation, inspection, examination, and testing of piping systems for building services. It includes piping systems in the building or within the property limits.

900.1.2 Services and Limits

(a) Services. This Code applies to the following building services, except as excluded in para. 900.1.3:

(04) *(1)* water and anti-freeze solutions for heating and cooling

(2) condensing water

(3) steam or other condensate

(4) other nontoxic liquids

(5) steam

(6) vacuum

(7) compressed air

(8) other nontoxic, nonflammable gases

(9) combustible liquids including fuel oil

(b) Boiler External Piping. The scope of this Code includes boiler external piping within the following limits:

(1) for steam boilers, 15 psig (103 kPa gage) max.

(2) for water heating units, 160 psig (1 103 kPa gage) max. and 250°F (121°C) max.

Boiler external piping above these pressure or temperature limits is within the scope of ASME B31.1. Boiler external piping is the piping connected to the boiler and extending to the points identified in Fig. 900.1.2B.

(c) Material and Size Limits. Piping systems of the following materials are within the scope of this Code, through the indicated maximum size (and wall thickness if noted):

(1) carbon steel: NPS 30 (DN 750) and 0.500 in. (12.7 mm) wall

(2) stainless steel: NPS 12 (DN 300) and 0.500 in. (12.7 mm) wall

(3) aluminum: NPS 12 (DN 300)

(4) brass and copper: NPS 12 (DN 300) and 12.125 in. (308 mm) O.D. for copper tubing

(5) thermoplastics: NPS 24 (DN 600)

(6) ductile iron: NPS 18 (DN 450)

(7) reinforced thermosetting resin: 24 in. (600 mm) nominal

Other materials may be used as noted in Chapter III.

(d) Pressure Limits. Piping systems with working pressures not in excess of the following limits are within the scope of this Code:

(1) steam and condensate: 150 psig (1 034 kPa g)

(2) liquids: 350 psig (2 413 kPa g)

(3) vacuum: 1 atm external pressure

(4) compressed air and gas: 150 psig (1 034 kPa g)

(e) Temperature Limits. Piping systems with working temperatures not in excess of the following limits are within the scope of this Code:

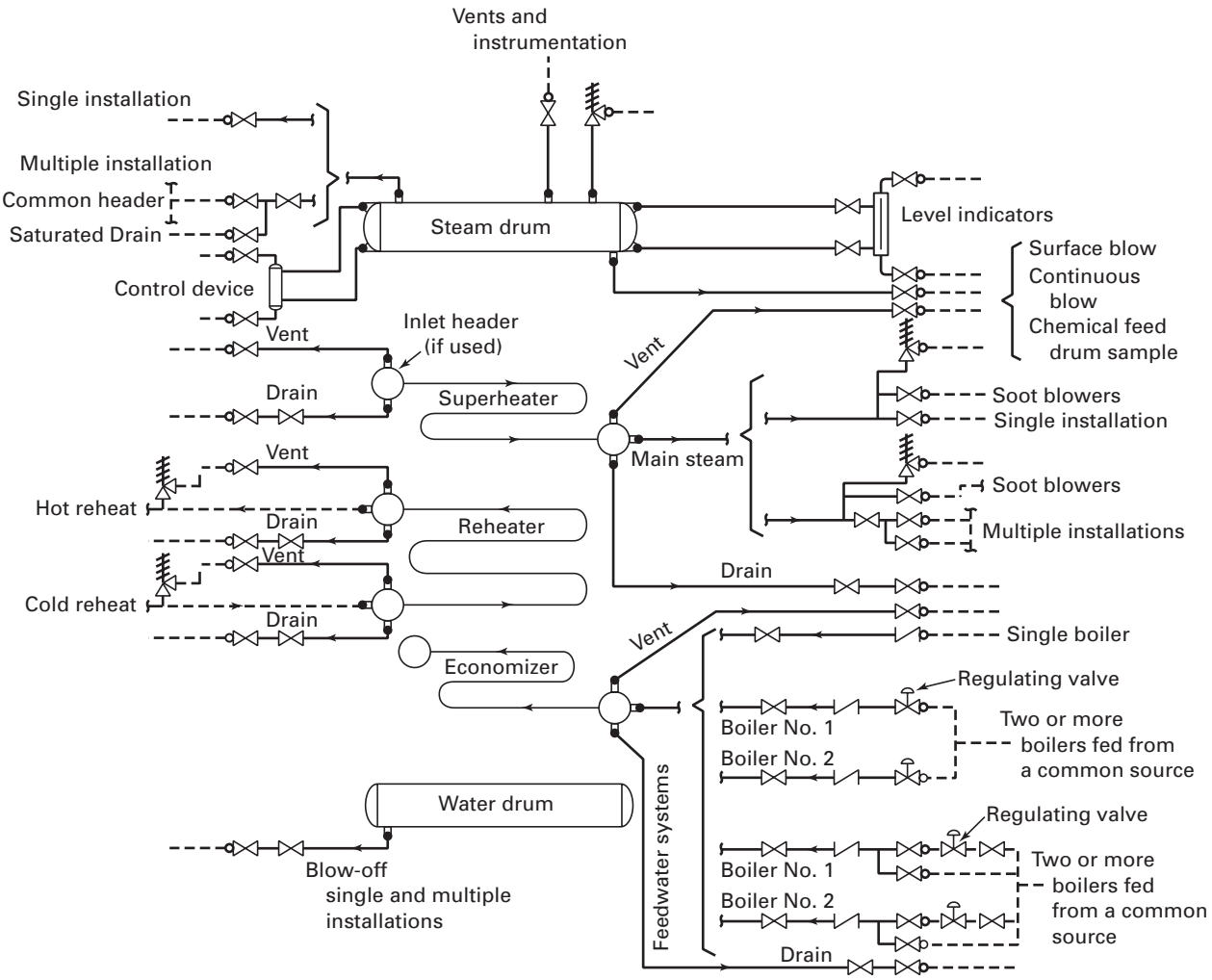
(1) steam and condensate: 366°F (186°C)

(2) other gases and vapors: 200°F (93°C)

(3) other nonflammable liquids: 250°F (121°C)

The minimum temperature for all services is 0°F (–18°C).

900.1.3 Exclusions. This Code does not apply to economizers, heaters, pumps, tanks, heat exchangers,



Administrative Jurisdiction and Technical Responsibility

——— Boiler Proper — The ASME Boiler and Pressure Vessel Code (ASME BPVC) has total administrative jurisdiction and technical responsibility. Refer to ASME BPVC Section I, Introduction, fourth paragraph.

●——— Boiler External Piping and Joint (BEP). See para. 900.1.2(b) for B31.9 Scope.

○- - - - - Nonboiler External Piping and Joint (NBEP).

Fig. 900.1.2B Code Jurisdictional Limits for Piping — Drum Type Boilers

and equipment covered by the ASME Boiler and Pressure Vessel (BPV) Code.

(04) 900.2 Definitions

adhesive bond: a union of materials by means of an adhesive.

anchor: a structural attachment device or mechanism that prevents the movement of pipe due to thermal expansion, expansion joint thrust, and other loads.

arc welding: a group of welding processes that produce coalescence of metals by heating them with an arc, with or without the use of filler metal.

assembly: the joining together of two or more piping components.

automatic welding: welding with equipment that performs the welding operation without constant observation and adjustment of controls by a welding operator. The equipment may or may not perform the loading and unloading of the work.

backing: material placed at the root of a weld joint to support molten weld metal.

backing ring: backing in the form of a ring.

ball or swivel joint: a joint that permits pipe motion by means of rotation.

base metal (material): the metal (material) to be welded, brazed, soldered, or cut.

boiler external piping (BEP): See para. 900.1.2(b).

branch connection: the attachment of the end of a branch pipe to the run of a main pipe, with or without the use of a fitting. Figure 927.4.6 shows typical branch connections which do not use fittings.

braze welding: a joining process that produces coalescence of metals by using a filler metal whose liquidus is above 800°F (427°C) and below the solidus of the base metals. Unlike brazing, the filler metal is *not* distributed in the joint by capillary attraction.

brazing: a joining process that produces coalescence of metals by heating to a suitable temperature and by using a filler metal whose liquidus is above 800°F (427°C) and below the solidus of the base metals. The filler metal is distributed by capillary attraction between closely fitted joint surfaces.

brine: a liquid used for the transmission of heat without change of state in cooling systems, which is nonflammable or has a flash point above 150°F (66°C) as determined by the method of ASTM D 93.

brittle failure: a pipe failure mode that exhibits no material deformation visible to the naked eye, i.e., stretching, elongation, or necking down, in the area of the break.

butt joint: a joint between two members aligned approximately in the same plane.

chilled water: water or an antifreeze solution used as a brine at a supply temperature below 60°F (16°C).

coalescence: the growing together or growth into one body of materials being welded, brazed, or soldered.

combustible liquid: a liquid having a flash point at or above 100°F (38°C).

consumable insert: backing in the form of filler metal which is melted into the root of the weld and fused with the base metals.

contractor: the entity responsible for fabrication and installation of piping and associated equipment.

crack: a fracture-type imperfection characterized by a sharp tip and high ratio of length and depth to opening displacement.

DN: metric designated pipe size. The number is the millimeter approximation of the inch pipe size using one inch equal to 25 mm. The pipe is still manufactured in inch sizes.

defect: an imperfection which by nature or accumulated effect renders a part of the piping unable to meet minimum applicable acceptance standards or specifications. A defect is cause for rejection.

deposited metal: filler metal that has been added during a welding operation.

design pressure: the pressure, equal to or greater than the highest working pressure, used to determine the minimum permissible wall thickness or component rating. See para. 901.2.

design temperature: the temperature equal to or higher than the highest working temperature, used in determining the required wall thickness or component rating. See para. 901.3.

design thickness: the sum of the minimum thicknesses required by the design conditions and corrosion, mechanical, and other allowances.

employer: the owner, manufacturer, fabricator, contractor, assembler, or installer responsible for the welding, brazing, and NDE performed by his organization, including procedure and performance qualifications.

engineer: the engineer as agent of the owner is the party responsible for design of piping systems to meet operating and safety standards.

engineering design: the detailed design for a piping installation, developed from the building systems requirements and conforming to Code requirements, including necessary drawings and specifications.

equipment connection: an integral part of equipment such as boilers, pressure vessels, heat exchangers, pumps, etc., designed for attachment of piping.

erection: the complete installation of a piping system, including field fabrication and assembly.