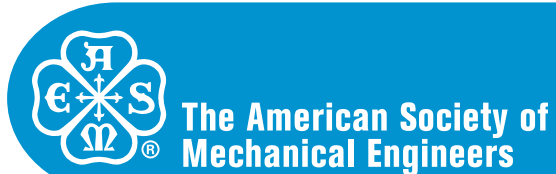


ASME B31.9-2017
(Revision of ASME B31.9-2014)

Building Services Piping

ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD



ASME B31.9-2017
(Revision of ASME B31.9-2014)

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AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

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CONTENTS

Foreword	vi
Committee Roster	vii
Introduction	ix
Summary of Changes	xi
Chapter I	
Scope and Definitions	1
900 General	1
Chapter II	
Design	9
PART 1	
Conditions and Criteria	9
901 Design Conditions	9
902 Design Criteria	9
PART 2	
Pressure Design of Piping Components	11
903 Criteria for Pressure Design of Piping Components	11
904 Pressure Design of Components	12
PART 3	
Selection and Limitation of Components	14
905 Pipe	14
906 Fittings, Bends, and Intersections	15
907 Valves	15
908 Flanges, Blanks, Gaskets, and Bolting	15
PART 4	
Selection and Limitation of Joints	15
910 Piping Joints	15
911 Welded Joints	15
912 Flanged Joints	16
913 Mechanical and Proprietary Joints	16
914 Threaded Joints	16
915 Flared, Flareless, and Compression Joints	16
916 Bell and Spigot Joints	16
917 Brazed and Soldered Joints	17
PART 5	
Expansion, Flexibility, and Support	17
919 Expansion and Flexibility	17
920 Loads on Pipe-Supporting Elements	20
921 Design of Pipe-Supporting Elements	21
PART 6	
Systems	25
922 Design Requirements Pertaining to Specific Piping Systems	25
Chapter III	
Materials	27
923 Materials — General Requirements	27
Chapter IV	
Component Requirements and Standard Practices	29
926 Dimensions and Ratings of Components	29
Chapter V	
Fabrication, Assembly, and Erection	36

927	Welded Fabrication of Metals	36
928	Brazing and Soldering of Metals	41
929	Bending	41
930	Forming	41
931	Heat Treatment	41
934	Fabrication of Nonmetals	42
935	Assembly	43
Chapter VI	Inspection, Examination, and Testing	45
936	Inspection and Examination	45
937	Leak Testing	46
 Mandatory Appendices		
I	Stress Tables	48
II	Allowable Pressures for Nonmetallic, Nonplastic Pressure Piping	56
III	Reference Standards	57
IV	Preparation of Technical Inquiries	61
 Nonmandatory Appendices		
A	Nonmandatory Quality System Program	62
B	Seismic Design and Retrofit of Piping Systems	63
 Figures		
900.1.2	Code Jurisdictional Limits for Piping — Drum-Type Boilers	3
904.2.2	Nomenclature for Miter Joints	13
921.1.3-1	Support Spans for Standard Wall Steel Pipe	22
921.1.3-2	Support Spans for Copper and Thermoplastic Pipe	23
927.4.3-1	Fillet Weld Size	37
927.4.3-2	Minimum Weld Size, Setback, and Depth of Insertion for Slip-On and Socket Weld Flanges	38
927.4.3-3	Minimum Welding Dimensions for Socket-Welding Components Other Than Flanges	38
927.4.5-1	Acceptable Welds for Flat Heads	39
927.4.5-2	Unacceptable Welds for Flat Heads	39
927.4.6-1	Typical Weld Branch Connections	40
927.4.6-2	Typical Weld Details	40
 Tables		
902.4.3	Joint Factors, <i>e</i>	11
904.2.1	Pipe Thickness for Bends	12
917.3	Rated Internal Working Pressures of Joints Made With Copper Water Tube and Solder Joint Fittings, psig	17
919.3.1	Moduli of Elasticity and Thermal Expansion Coefficients	18
921.2.2	Capacities of Threaded ASTM A36 Steel Rods	24
926.1	Component Standards and Specifications	30
926.2	Standard Practices	35
I-1	Allowable Stresses	49
I-2	Hydrostatic Design Stresses (HDS) and Recommended Temperature Limits for Thermoplastic Pipe	53

I-3	Design Stress Values for Contact Molded (Hand-Lay-Up) Pipe Made From Reinforced Thermosetting Resins	54
I-4	Hydrostatic Design Basis Stress for Machine-Made Thermosetting Resin Pipe	55
II-1	Allowable Pressures for Nonmetallic, Nonplastic Pressure Piping	56
B-3.2.1	Seismic Design Requirements, Applicable Sections	64
B-3.3.1	Maximum Span (ft) Between Lateral Seismic Restraints for Steel Pipe With a Yield Stress of 35 ksi, in Water Service at 70°F	66

FOREWORD

The need for a national code for pressure piping became increasingly evident from 1915 to 1925. The American Standards Association (ASA) initiated the B31 Project in March 1926 to meet that need. The American Society of Mechanical Engineers (ASME) 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 as follows:

B31.1	Power Piping
B31.3	Process Piping
B31.4	Pipeline Transportation Systems for Liquids and Slurries
B31.5	Refrigeration Piping and Heat Transfer Components
B31.8	Gas Transmission and Distribution Piping Systems
B31.9	Building Services Piping
B31.12	Hydrogen Piping and Pipelines

In 1969, ASA, renamed the United States of America Standards Institute (USASI), became the American National Standards Institute (ANSI), and the B31 Sectional Committee became the B31 Standards Committee. In 1978, ASME 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. The 2008 edition was approved by ANSI on April 1, 2008, and designated as ASME B31.9-2008.

The 2011 edition of B31.9 contained revisions to the definitions and materials section of the Standard. Additionally, the allowable stress values were updated to the 3.5 design margin.

The 2014 edition of B31.9 included revisions to materials and the standards for material specifications, and other errata found in the Code.

The 2017 edition of B31.9 includes the addition of allowable stresses for (austenitic) stainless steels to Table I-1 and revisions to references in Mandatory Appendix III.

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 ANSI on October 31, 2017.

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Code for Pressure Piping

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

(a) This Code Section includes

- (1) references to acceptable material specifications and component standards, including dimensional requirements and pressure-temperature ratings
- (2) requirements for design of components and assemblies, including pipe supports
- (3) requirements and data for evaluation and limitation of stresses, reactions, and movements associated with pressure, temperature changes, and other forces
- (4) guidance and limitations on the selection and application of materials, components, and joining methods
- (5) requirements for the fabrication, assembly, and erection of piping
- (6) requirements for examination, inspection, and testing of piping

It is intended that this Edition of Code [Section B31.9](#) 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 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. 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 ensure safe piping for the proposed installation.

(b) 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

- (1) *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

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

(3) *B31.4, Pipeline Transportation Systems for Liquids and Slurries* — piping for transporting predominantly liquid products between plants and terminals and within terminals, and for pumping, regulating, and metering stations

(4) *B31.5, Refrigeration Piping and Heat Transfer Components* — piping for refrigerants and secondary coolants

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

(6) *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

(7) *B31.12, Hydrogen Piping and Pipelines* — piping in gaseous and liquid hydrogen service, and pipelines in gaseous hydrogen service

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

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

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

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

(4) *NFPA 85, Boiler and Combustion Systems Hazards Code*

(5) *NFPA 99, Health Care Facilities* — medical and laboratory gas systems

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. The Case will be published as part of a Case Supplement issued to the applicable Code Section.

The ASME B31 Standards Committee took action to eliminate Code Case expiration dates effective September 21, 2007. This means that all Code Cases in effect as of this date will remain available for use until annulled by the ASME B31 Standards Committee.

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 the Secretary, ASME B31 Committee, Two Park Avenue, New York, NY 10016-5990.

ASME B31.9-2017

SUMMARY OF CHANGES

Following approval by the ASME B31 Committee and ASME, and after public review, ASME B31.9-2017 was approved by the American National Standards Institute on October 31, 2017.

ASME B31.9-2017 includes the following changes identified by a margin note, **(17)**.

<i>Page</i>	<i>Location</i>	<i>Change</i>
ix	Introduction	Second paragraph revised
1	900	Final paragraph revised
15	906.4	Added
30	Table 926.1	ASME PTC 19.3 TW, ASTM A992/A992M, and ASTM F2389 added
35	Table 926.2	ASTM F2389 deleted
45	936.6	Final sentence deleted
46	936.6.6	Revised in its entirety
49	Table I-1	(1) Second row under Carbon Steel Structurals added (2) Final six columns of Stainless Steel Seamless Pipe and Tube revised
57	Mandatory Appendix III	Revised in its entirety
65	B-3.3	Equation revised

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Chapter I

Scope and Definitions

(17) 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.

The Code generally specifies a simplified approach for many of its requirements. A designer may choose to use a more rigorous analysis to develop design and construction requirements. When the designer decides to take this approach, the designer shall provide to the owner details and calculations demonstrating that design, construction, examination, and testing are consistent with the criteria of this Code. These details shall be adequate for the owner to verify the validity and shall be approved by the owner. The details shall be documented in the engineering design.

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](#):

- (1) water and antifreeze 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 [Figure 900.1.2](#).

(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 48 (DN 1 200) and 0.50 in. (12.7 mm) wall
- (2) stainless steel: NPS 24 (DN 600) and 0.50 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 48 (DN 1 200)
- (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, and equipment covered by the ASME Boiler and Pressure Vessel (BPV) Code.

900.2 Terms and 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 927.4.6-1](#) shows typical branch connections that 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 D93.

brittle failure: a pipe failure mode that exhibits no material deformation visible to the naked eye, e.g., 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 that 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 1 in. equal to 25 mm. The pipe is still manufactured in inch sizes.

defect: an imperfection that 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.