ASME B31.3-2022

(Revision of ASME B31.3-2020)

Process Piping

ASME Code for Pressure Piping, B31

AN INTERNATIONAL PIPING CODE®

The American Society of
Mechanical Engineers

Errata
to
ASME B31.3-2022
Process Piping

Revisions to para. 328.5.2 were inadvertently omitted from ASME B31.3-2022, page 68. The paragraph should read as follows:

328.5.2 Fillet and Socket Welds

(a) Fillet and socket welds may vary from convex to concave. The size of these welds shall be determined as shown in Figure 328.5.2A.

(b) For any single continuous fillet weld greater than 5 mm ($^3/_{16}$ in.), the weld may be less than the specified fillet weld size by not more than 1.5 mm ($^1/_{16}$ in.), provided the total undersized portion of the weld does not exceed 10% of the total length of the weld or 50 mm (2 in.), whichever is less.

(c) Minimum attachment weld dimensions for double-welded slip-on flanges, socket welding flanges, and other socket welding components shall be as shown in Figures 328.5.2B and 328.5.2C.

(d) If slip-on flanges are single welded, the weld shall be at the hub, i.e., the X_{min} by X_{min} weld illustrated in Figure 328.5.2B.

(e) In making socket welded joints, a gap as shown in Figure 328.5.2B, illustration (c) and Figure 328.5.2C shall be provided prior to welding. After welding, a gap is not required to be present or verified.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Two Park Avenue, New York, NY 10016-5990

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Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: January 31, 2023

The next edition of this Code is scheduled for publication in 2024. 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/InterpsDatabase. 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 Page 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
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FOREWORD

Responding to evident need and at the request of The American Society of Mechanical Engineers (ASME), the American Standards Association initiated Project B31 in March 1926, with ASME as sole administrative sponsor. The breadth of the field involved required that membership of the Sectional Committee be drawn from some 40 engineering societies, industries, government bureaus, institutes, and trade associations.

Initial publication in 1935 was as the American Tentative Standard Code for Pressure Piping. Revisions from 1942 through 1955 were published as American Standard Code for Pressure Piping, ASA B31.1. It was then decided to publish as separate documents the various industry Sections, beginning with ASA B31.8-1955, Gas Transmission and Distribution Piping Systems. The first Petroleum Refinery Piping Code Section was designated ASA B31.3-1959. ASA B31.3 revisions were published in 1962 and 1966.

In 1967–1969, the American Standards Association became first the United States of America Standards Institute, then the American National Standards Institute (ANSI). The Sectional Committee became American National Standards Committee B31 and the Code was renamed the American National Standard Code for Pressure Piping. The next B31.3 revision was designated ANSI B31.3-1973. Addenda were published through 1975.

A draft Code Section for Chemical Plant Piping, prepared by Section Committee B31.6, was ready for approval in 1974. It was decided, rather than have two closely related Code Sections, to merge the Section Committees and develop a joint Code Section, titled Chemical Plant and Petroleum Refinery Piping. The first edition was published as ANSI B31.3-1976.

In this Code, responsibility for piping design was conceptually integrated with that for the overall processing facility, with safeguarding recognized as an effective safety measure. Three categories of Fluid Service were identified, with a separate Chapter for Category M Fluid Service. Coverage for nonmetallic piping was introduced. New concepts were better defined in five Addenda, the fourth of which added Appendix M, a graphic aid to selection of the proper Fluid Service category.

The Standards Committee was reorganized in 1978 as a Committee operating under ASME procedures with ANSI accreditation. It is now the ASME Code for Pressure Piping, B31 Committee. Section committee structure remains essentially unchanged.

The second edition of Chemical Plant and Petroleum Refinery Piping was compiled from the 1976 Edition and its five Addenda, with nonmetal requirements editorially relocated to a separate Chapter. Its new designation was ANSI/ASME B31.3-1980.

Section Committee B31.10 had a draft Code for Cryogenic Piping ready for approval in 1981. Again, it was decided to merge the two Section Committees and develop a more inclusive Code with the same title. The work of consolidation was partially completed in the ANSI/ASME B31.3-1984 Edition.

Significant changes were made in Addenda to the 1984 Edition: integration of cryogenic requirements was completed; a new stand-alone Chapter on high-pressure piping was added; and coverage of fabrication, inspection, testing, and allowable stresses was reorganized. The new Edition was designated as ASME/ANSI B31.3-1987 Edition.

Addenda to the subsequent five Editions, published at 3-year intervals, were primarily used to keep the Code up to date. New Appendices were added, however, on requirements for bellows expansion joints, estimating service life, submittal of Inquiries, aluminum flanges, and quality control in the 1990, 1993, 1999, and 2002 Editions, all designated as ASME B31.3.

In a program to clarify the application of all Sections of the Code for Pressure Piping, changes were made in the Introduction and Scope statements of the 1996 Edition, and its title was changed to Process Piping.

Under direction of ASME Codes and Standards management, SI (metric) units of measurement were emphasized. With certain exceptions, SI units were listed first in the 1996 Edition and were designated as the standard. Instructions for conversion were given where SI units data were not available. U.S. Customary units also were given. By agreement, either system may have been used.

Beginning with the 2004 Edition, the publication cycle of ASME B31.3 was changed to biennial. Other changes made in the 2004 Edition included the introduction of the weld joint strength reduction factor, W, and the additions of Appendix P, Alternative Rules for Evaluating Stress Range, and Appendix S, Piping System Stress Analysis Examples.

Changes that were made to the 2006 and 2008 Editions of ASME B31.3 included the requirement that valves have blowout-proof stems and the addition of a definition for elevated temperature fluid service, respectively. The most significant change that was made to the 2010 Edition of ASME B31.3 was the addition of Chapter X, High Purity

Piping. In the 2012 Edition, Tables A-1M and A-2M were added to Appendix A that give allowable design values in SI units, and Appendix N, Application of ASME B31.3 Internationally, was also added.

For the 2016 Edition, the allowable design values in SI units as shown in Tables A-1M and A-2M were changed from for information only to values that may be used to meet the requirements of the Code.

In this Edition, SI units are given first, with U.S. Customary units in parentheses. The values in Tables A-1, A-2, B-1, and K-1 are given in U.S. Customary units, and the SI values are given in Tables A-1M, A-2M, B-1M, and K-1M. Either the U.S. Customary units or the SI units for these values may be used. Values in SI units are to be regarded as the standard, unless otherwise agreed between the contracting parties.

Interpretations, Code Cases, and errata to the ASME B31.3 Code on Process Piping are published on the following ASME web page: http://go.asme.org/B31committee.

ASME B31.3-2022 was approved by ANSI on August 24, 2022.

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Code for Pressure Piping

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INTRODUCTION (22)

The ASME B31 Code for Pressure Piping consists of a number of individually published Sections, each an American National Standard, under the direction of ASME Committee B31, Code for Pressure Piping.

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, in 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 products that are predominately liquid between plants and terminals and within terminals, pumping, regulating, and metering stations

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; gas gathering pipelines

B31.9 Building Services Piping: piping typically found in industrial, institutional, commercial, and public buildings, and in multi-unit residences, which 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 the B31.3 Process Piping Code Section. Hereafter, in this Introduction and in the text of this Code Section B31.3, where the word *Code* is used without specific identification, it means this Code Section.

It is the owner's responsibility to select the Code Section that most nearly applies to a proposed piping 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. For some installations, more than one Code Section may apply to different parts of the installation. The owner is also responsible for imposing requirements supplementary to those of the Code if necessary to assure safe piping for the proposed installation.

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

— ANSI Z223.1 National Fuel Gas Code: piping for fuel gas from the point of delivery to the connection of each fuel utilization device

— NFPA Fire Protection Standards: fire protection systems using water, carbon dioxide, halon, foam, dry chemicals, and wet chemicals

— NFPA 99 Health Care Facilities: medical and laboratory gas systems

— building and plumbing codes, as applicable, for potable hot and cold water, and for sewer and drain systems

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 judgments by the owner 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 the following:

(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 piping 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

Either International System (SI, also known as metric) or U.S. Customary units may be used with this edition. Local customary units may also be used to demonstrate compliance with this Code. One system of units should be used consistently for requirements applying to a specific installation. The equations in this Code may be used with any consistent system of units. It is the responsibility of the organization performing calculations to ensure that a consistent system of units is used.

ASME Committee B31 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 2 years.

Code users will note that paragraphs in the Code are not necessarily numbered consecutively. Such discontinuities result from following a common outline, insofar as practical, 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.

This edition of Code Section B31.3 is not retroactive. Normally, agreement is made between contracting parties to use a specific edition, considering requirements of the authority having jurisdiction. When specified as the latest edition and when no edition is specified, the specific edition is the one issued at least 6 months prior to the original contract date for the first design activity.

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.

The B31 Committee has established an orderly procedure to consider requests for interpretation and revision of Code requirements. To receive consideration, such request must be in writing and must give full particulars in accordance with Appendix Z.

The approved reply to an inquiry will be sent directly to the inquirer. In addition, the question and reply will be published in the ASME Interpretation Database at http://go.asme.org/InterpsDatabase.

A Case is the prescribed form of reply 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 B31.3 web page at http://go.asme.org/B31committee.

Code Cases remain available for use until annulled by the ASME B31 Standards Committee.

A request for revision of the Code will be placed on the Committee's agenda. Further information or active participation on the part of the proponent may be requested during consideration of a proposed revision.

Materials ordinarily are listed in the stress tables only when sufficient usage in piping within the scope of the Code has been shown. 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. (To develop usage and gain experience, unlisted materials may be used in accordance with para. 323.1.2.)

ASME B31.3-2022
SUMMARY OF CHANGES

Following approval by the ASME B31 Committee and ASME, and after public review, ASME B31.3-2022 was approved by the American National Standards Institute on August 24, 2022.

ASME B31.3-2022 includes the following changes identified by a margin note, **(22)**.

Page	*Location*	*Change*
xxi	Introduction	Editorially revised
1	300	Subparagraphs (b)(1) and (c)(3) revised
3	300.2	(1) Definitions of *construction*, *designated lot*, *combination welded (COW) pipe*, *postweld hydrogen bakeout*, and *set pressure* added (2) Definitions of *examination, types of*; *heat treatment*; *pipe*; *submerged arc welding (SAW)*; and *severe cyclic conditions* revised
12	301.5.1	Revised
13	301.7	Revised
13	301.7.2	Revised
13	301.7.3	Revised
15	302.3.2	Subparagraphs (e)(1) and (e)(2) revised
16	302.3.5	Equations (1c) and (1d) and subpara. (f) revised
19	Figure 302.3.5	Image revised
19	302.3.6	(1) Subparagraphs (a)(1), (a)(1)(-a), and (a)(1)(-b) revised (2) Subparagraph (a)(3) added
20	Table 302.3.5	General Note (d) and Notes (1), (2), and (4) revised
25	304.3.3	Subparagraph (a) revised
26	Figure 304.3.3	General Note revised
28	Figure 304.3.4	Note at top of figure editorially redesignated as General Note and revised
33	305.2.1	Revised
33	305.2.3	Subparagraph (b) revised
35	307.2.3	Added
37	314.2.2	Revised
40	319.3.1	Subparagraph (a) revised
45	321.1	Second paragraph revised
47	322.6.3	Footnote 13 deleted and subsequent footnote redesignated
49	323.2.2	Subparagraph (f) corrected by errata
50	Table 323.2.2	(1) Note at top of table redesignated as General Note (2) Note (1) revised
52	Figure 323.2.2A	(1) Note at top of figure redesignated as General Note (2) Graphic and Note (3) revised
53	Figure 323.2.2B	Note at top of figure redesignated as General Note (a) and existing General Note redesignated as (b)

Page	*Location*	*Change*
54	Table 323.2.2A	Revised in its entirety
56	Table 323.2.2B	Note at top of table redesignated as General Note
58	Table 323.3.4	Celsius values revised
62	Table 326.1	Revised
68	328.5.2	Subparagraph (d) added
68	328.5.4	Subparagraph (a) revised
71	328.5.5	Revised
73	Figure 328.5.5	(1) Title and illustration (e) revised (2) Legend added (3) General Note deleted
73	328.7	(1) First and third paragraphs and subpara. (d) revised (2) Second paragraph added
75	331.1.2	Subparagraph (c) added
84	340.3	Revised
84	341.3.1	First paragraph revised
87	Table 341.3.2	"Imperfection" column and General Notes (a), (c), and (d) revised
88	Criterion Value Notes for Table 341.3.2	Revised
85	341.3.4	Revised in its entirety
85	341.4	Text added
85	341.4.1	Subparagraphs (a) and (b) revised in their entirety
91	341.4.4	Subparagraph (c) revised
91	341.5.3	First sentence revised
91	342.1	Revised
92	344	(1) Title revised (2) Paragraph 344.1.3 relocated to para. 300.2
93	344.6.1	Subparagraphs (c)(2) and (c)(3) editorially revised
94	345.2.2	Subparagraph (d) added
96	345.4.3	Footnote redesignated as 1
96	345.5.2	Revised
96	345.5.5	Revised
98	A301.3.2	Title revised
104	A319	(1) Title revised (2) Paragraph added
106	A321.5.1	Subparagraph (b) revised
106	A321.6	Added
110	Table A326.1	Revised
116	A335.8.2	Revised
117	A341.4.1	Subparagraph (b) revised
118	A344	Title revised
120	M307.2	Subparagraph (a) revised
121	M314.2.2	Revised
123	M341.4	Subparagraph (b) revised
124	M344	Title revised
126	MA344	Title revised

Page	*Location*	*Change*
127	K300	Subparagraph (e) revised
128	K301.3.2	Title revised
128	K302.2.2	Subparagraph (a) revised
128	K302.3.1	Subparagraphs (a) and (c) revised
130	K302.3.5	Subparagraphs (c) and (d) revised
130	K302.3.6	Subparagraph (a) revised
131	K304.1.2	(1) Equation (34b) corrected by errata (2) In nomenclature following eq. (35b), definition of *S* revised
132	K304.7.2	Subparagraph (b) revised
134	K307.2.3	Added
136	K314.3.1	Revised
136	K314.3.2	Subparagraph (b) revised
137	K323	Subparagraph (a) revised
138	K323.2.1	Revised
138	K323.2.2	Subparagraphs (b) and (c) revised
138	K323.3.1	Revised
139	Table K323.3.1	Revised
140	K323.3.3	Subparagraphs (b) and (c) revised
140	K323.3.4	Subparagraphs (a)(1) through (a)(3) revised
142	Table K326.1	Revised
143	K328.2.1	Subparagraph (g) deleted
144	K328.4.3	Subparagraph (b) revised
144	K328.5.4	Second paragraph revised
147	K335	Former paras. K335.1 and K335.2 revised and redesignated as K335
149	Table K341.3.2	Revised in its entirety
150	Criterion Value Notes for Table K341.3.2	Revised in its entirety
148	K344	Title revised
148	K344.1	Revised
151	K344.6.3	Subparagraph (b) revised
152	K345.4.2	Subparagraphs (b) and (c) revised
154	U301.3.2	Title revised
154	U306.6	Subparagraph (c) revised
158	U341.4.5	Revised in its entirety
159	U344	Title revised
167	Notes for Tables A-1 and A-1M	Revised in its entirety
170	Table A-1	Revised in its entirety
250	Table A-1M	Revised
360	Table A-1A	Revised
362	Table A-1B	Revised
366	Notes for Tables A-2 and A-2M	Added
368	Table A-2	Revised in its entirety
378	Table A-2M	Revised
395	Specification Index for Appendix B	ASTM F714 added

Page	*Location*	*Change*
396	Table B-1	Revised
398	Table B-1M	Revised
424	Appendix E	Revised
429	F301.4	Revised
429	F301.7.2	Added
431	F307	Subparagraph (c) added
431	F312.1	(1) Subparagraph (a)(1) revised (2) Subparagraph (a)(2) added and subsequent subparagraphs redesignated
431	F319	Added
434	F341	Added
447	Appendix J	Revised
463	Appendix K	Revised
465	Notes for Tables K-1 and K-1M	Revised in its entirety
466	Table K-1	Revised in its entirety
480	Table K-1M	Added
498	Appendix Q	Revised
502	Appendix S	(1) Titles of all figures and tables revised (2) Second paragraph of S303.1 revised
524	W305.3.1	Revised in its entirety
527	X302.2.2	Subparagraph (a) deleted and subsequent subparagraphs redesignated and revised
530	Index	Updated

Chapter I
Scope and Definitions

(22) 300 GENERAL STATEMENTS

(a) Identification This Process Piping Code is a Section of The American Society of Mechanical Engineers Code for Pressure Piping, ASME B31, an American National Standard. It is published as a separate document for convenience of Code users.

(b) Responsibilities

(1) Owner. The owner of a piping installation shall have overall responsibility for compliance with this Code, and for establishing the requirements for design and construction that will govern the entire fluid handling or process installation of which the piping is a part. The owner is also responsible for designating piping in Category D, Category M, High Pressure, and High Purity Fluid Services, and for determining if a specific Quality System is to be employed. [See (d)(4) through (d)(7) and Appendix Q.] Where applicable, the owner shall consider requirements imposed by the authority having jurisdiction regarding the piping installation. The owner may designate a representative to carry out selected responsibilities required by this Code, but the owner retains ultimate responsibility for the actions of the representative.

(2) Designer. The designer is responsible to the owner for assurance that the engineering design of piping complies with the requirements of this Code and with any additional requirements established by the owner.

(3) Manufacturer, Fabricator, and Erector. The manufacturer, fabricator, and erector of piping are responsible for providing materials, components, and workmanship in compliance with the requirements of this Code and of the engineering design.

(4) Owner's Inspector. The owner's Inspector (see para. 340) is responsible to the owner for ensuring that the requirements of this Code for inspection, examination, and testing are met. If a Quality System is specified by the owner to be employed, the owner's Inspector is responsible for verifying that it is implemented.

(c) Intent of the Code

(1) It is the intent of this Code to set forth engineering requirements deemed necessary for safe design and construction of piping installations.

(2) This Code is not intended to apply to the operation, examination, inspection, testing, maintenance, or repair of piping that has been placed in service. See para. F300.1 for examples of standards that may apply in these situations. The provisions of this Code may optionally be applied for those purposes, although other considerations may also be necessary.

(3) 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, materials, fabrication, assembly, erection, examination, and testing requirements. When the designer decides to take this approach, the designer shall provide to the owner details and calculations demonstrating that the proposed design, materials, fabrication, assembly, erection, examination, and testing requirements are consistent with the criteria of this Code, including the design criteria described in para. 302. These details shall be adequate for the owner to verify the validity of the approach. The approach may be implemented following approval by the owner. The details and calculations shall be documented in the engineering design.

(4) Piping elements shall conform to the specifications and standards listed in this Code or, if not prohibited by this Code, shall be qualified for use as set forth in applicable Chapters of this Code.

(5) The engineering design shall specify any unusual requirements for a particular service. Where service requirements necessitate measures beyond those required by this Code, such measures shall be specified by the engineering design. Where so specified, the Code requires that they be accomplished.

(6) Compatibility of materials with the service and hazards from instability of contained fluids are not within the scope of this Code. See para. F323.

(d) Determining Code Requirements

(1) Code requirements for design and construction include fluid service requirements, which affect selection and application of materials, components, and joints. Fluid service requirements include prohibitions, limitations, and conditions, such as temperature limits or a requirement for safeguarding (see Appendix G). Code requirements for a piping system are the most restrictive of those that apply to any of its elements.

(2) For metallic piping not designated by the owner as Category M, High Pressure, or High Purity Fluid Service (see para. 300.2 and Appendix M), Code requirements are found in Chapters I through VI (the base Code) and fluid service requirements are found in