ASME B31.3-2018

(Revision of ASME B31.3-2016)

Process Piping

ASME Code for Pressure Piping, B31

AN INTERNATIONAL PIPING CODE®

The American Society of Mechanical Engineers

ASME B31.3-2018
(Revision of ASME B31.3-2016)

Process Piping

ASME Code for Pressure Piping, B31

AN INTERNATIONAL PIPING CODE®

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

Date of Issuance: August 30, 2019

The next edition of this Code is scheduled for publication in 2020. 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 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
Two Park Avenue, New York, NY 10016-5990

CONTENTS

Figures

Tables

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 three-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. Table K-1 in Appendix K is an exception, containing only U.S. Customary units. The allowable design values in Tables A-1 and A-2 are given in U.S. Customary units, and the SI values are given in Tables A-1M and A-2M. Either the U.S. Customary units or the SI units for these allowable design values may be used. Except for Tables A-1, A-1M, A-2, A-2M, C-1, C-1M, C-6, C-6M, and K-1, values in SI units are to be regarded as the standard, unless otherwise agreed between the contracting parties. Instructions are given in Table K-1 for converting tabular data in U.S. Customary units to appropriate SI units.

Interpretations, Code Cases, and errata to the B31.3 Code on Process Piping are published on the following ASME web page: *https://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=N10020400.*

ASME B31.3-2018 was approved by the American National Standards Institute on August 8, 2018.

ASME B31 COMMITTEE
Code for Pressure Piping

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

STANDARDS COMMITTEE OFFICERS

J. E. Meyer, *Chair*
J. W. Frey, *Vice Chair*
A. Maslowski, *Secretary*

STANDARDS COMMITTEE PERSONNEL

R. J. T. Appleby, ExxonMobil Pipeline Co.
C. Becht IV, Becht Engineering Co.
K. C. Bodenhamer, TRC Pipeline Services
R. Bojarczuk, ExxonMobil Research and Engineering Co.
M. R. Braz, MRBraz & Associates, PLLC
J. S. Chin, TransCanada Pipeline U.S.
D. D. Christian, Victaulic
R. P. Deubler, Becht Engineering Co., Inc.
C. Eskridge, Jr., Worley ECR
D. J. Fetzner, BP Exploration Alaska, Inc.
P. D. Flenner, Flenner Engineering Services
J. W. Frey, Joe W. Frey Engineering Services, LLC
D. R. Frikken, Becht Engineering Co.
R. A. Grichuk, Fluor Enterprises, Inc.
R. W. Haupt, Pressure Piping Engineering Associates, Inc.
G. A. Jolly, Samshin Limited
K. Kaplan, Consultant
A. Maslowski, The American Society of Mechanical Engineers
W. J. Mauro, American Electric Power
J. E. Meyer, Louis Perry Group
T. Monday, Team Industries, Inc.
M. L. Nayyar, NICE
G. R. Petru, Acapella Engineering Services, LLC
D. W. Rahoi, CCM 2000
R. Reamey, Turner Industries Group, LLC
M. J. Rosenfeld, Kiefner/Applus — RTD
J. T. Schmitz, Southwest Gas Corp.
S. K. Sinha, Lucius Pitkin, Inc.
W. J. Sperko, Sperko Engineering Services, Inc.
J. P. Swezy, Jr., Boiler Code Tech, LLC
F. W. Tatar, FM Global
K. A. Vilminot, Commonwealth Associates, Inc.
G. Antaki, *Ex-Officio Member*, Becht Engineering Co., Inc.
L. E. Hayden, Jr., *Ex-Officio Member*
C. Kolovich, *Ex-Officio Member*
A. J. Livingston, *Ex-Officio Member*, Kinder Morgan
J. S. Willis, *Ex-Officio Member*, Page Southerland Page, Inc.

B31.3 PROCESS PIPING SECTION COMMITTEE

D. W. Diehl, *Chair*, Hexagon PPM
C. Eskridge, Jr., *Vice Chair*, Worley ECR
R. Mohamed, *Secretary*, The American Society of Mechanical Engineers
B. L. Agee, GE Energy
D. Arnett, Fluor
C. Becht IV, Becht Engineering Co.
R. M. Bojarczuk, ExxonMobil Research and Engineering Co.
B. T. Bounds, Bechtel Corp.
R. D. Campbell, Bechtel
D. D. Christian, Victaulic
S. S. Cimorelli, DuPont Advanced Printing
J. A. D'Avanzo, Fluoroseal Valves
C. E. Davila, Crane Energy
J. Davio, EllisDon Industrial
D. R. Edwards
J. P. Ellenberger
R. W. Engle, IHI E&C International Corp.
D. J. Fetzner, BP Exploration Alaska, Inc.
P. D. Flenner, Flenner Engineering Services
D. R. Fraser, NASA Ames Research Center
D. R. Frikken, Becht Engineering Co.
B. S. Gordon, Under Pressure Code Consulting and Training
O. R. Greulich, NASA Headquarters
R. A. Grichuk, Fluor Enterprises, Inc.
P. J. Guerrieri, Sr., Integrated Mechanical Services, Inc.
R. W. Haupt, Pressure Piping Engineering Associates, Inc.
B. K. Henon, Arc Machines, Inc., Retired
J. F. Hodgins, Car-Ber Testing Services
W. M. Huitt, W. M. Huitt Co.
D. L. Ianiro, Mainthia Technologies, Inc.
R. A. Leishear, Leishear Engineering, LLC
C. J. Melo, Technip FMC
J. E. Meyer, Louis Perry Group
V. B. Molina III, Air Products & Chemicals, Inc.
C. A. Moore, NOV Fiberglass Systems
A. D. Nalbandian, Thielsch Engineering, Inc.
M. Nguyen, S&B Engineers and Constructors, LTD
K. A. Nisly-Nagele, Archer Daniels Midland Co.
D. W. Rahoi, CCM 2000
R. K. Reamey, Turner Industries Group, LLC
G. C. Reinhardt II, Team Industries, Inc.
K. S. Shipley, The Equity Engineering Group, Inc.
C. Y. Shyu, Atkins
R. J. Silvia, Process Engineers & Constructors, Inc.
J. L. Smith, Technical Consultant

J. P. Swezy, Jr., Boiler Code Tech, LLC
F. W. Tatar, FM Global
S. J. Tonkins, BP Americas
S. Vail, Bechtel National, Inc.
B. K. Walker, Consolidated Nuclear Security, LLC
W. L. Weeks, Lummus Technology
T. D. Wills, Jr., Praxair, Inc.
G. E. Woods, GCS Consulting Services, Inc.
S. Biyuan, *Delegate*, PetroChina Pipeline Co.
F. Zhang, *Delegate*, SINOPEC Engineering, Inc.
D. L. Coym, *Contributing Member*, Intertek Moody
D. C. Glover, *Contributing Member*, KBR
R. A. McLeod, *Contributing Member*, General Electric Co.
Q. N. Truong, *Contributing Member*, Consulting Engineer

B31.3 INTERNATIONAL REVIEW GROUP

R. W. Engle, *Chair*, IHI E&C International Corp.
A. Bhattacharya, CB&I UK Ltd.
P. Burt, Fluor
A. Esmaeili, Origin Energy
G. Evans, BP Exploration
S. B. Feder, Apache Energy Limited
R. Gopalakrishnan, Samsung Saudi Arabia Co. Ltd.
P. Govindaraj, Dow Benelux B.V.
Z. Gu, Technip Norge AS
M. Guidara, Engineering Procurement & Project Management S.A.
J. M. Hamedi, Euromer Consultants
J. W. Horn, Sasol
H. W. Lange, Lisega AG
J. Langeland, My Piping AS
T. J. Naughton, Jacobs Engineering
A. Rokhsativand, Pars Oil & Gas Co.
W. Y. Sam, Shell Sarawak Berhad — Deepwater Engineering
R. Sils, Terra Nimbus Pty Ltd.
S. V. Merwe, Sasol
R. Verstegen, Dow Benelux B.V.

B31.3 SUBGROUP ON DESIGN

K. S. Shipley, *Chair*, The Equity Engineering Group, Inc.
T. C. Scrivner, *Vice Chair*, Engineering Services Canada, Imperial Oil
F. A. Abd Dzubir, PETRONAS
D. Arnett, Fluor
R. M. Bojarczuk, ExxonMobil Research & Engineering Co.
C. Chang, Bechtel National, Inc.
D. W. Diehl, Hexagon PPM
D. R. Edwards
R. W. Haupt, Pressure Piping Engineering Associates, Inc.
J. Haynes, WFI International, Inc.
D. L. Ianiro, Mainthia Technologies, Inc.
M. Jaouhari, Bechtel Corp.
J. M. Krance, Swagelok Co.
E. M. Kvarda, Swagelok
R. A. Leishear, Leishear Engineering, LLC
R. Maxwell, L-3 Combat Propulsion Systems
J. C. Mielcarek, SGT, Inc.
P. D. Moore, Burns & McDonnell
K. A. Nisly-Nagele, Archer Daniels Midland Co.
P. Parker, Monsanto Co.
S. Stelmar, Expansion Joint Manufacturers Association, Inc.
M. J. Stewart, AECOM
B. Swartz, Los Alamos National Laboratory
B. K. Walker, Consolidated Nuclear Security, LLC
G. E. Woods, GCS Consulting Services, Inc.
R. P. S. Bindra, *Contributing Member*, CB&I Lummus Private Ltd.
J. P. Ellenberger, *Contributing Member*
S. Krishnamurthy, *Contributing Member*, UOP LLC
S. LaForge, *Contributing Member*, Total France
H. W. Lange, *Contributing Member*, Lisega AG

B31.3 SUBGROUP ON EDIT

D. J. Fetzner, *Chair*, BP Exploration Alaska, Inc.
C. Becht IV, Becht Engineering Co.
R. W. Engle, IHI E&C International Corp.
D. R. Frikken, Becht Engineering Co.
J. E. Meyer, Louis Perry Group
R. J. Silvia, Process Engineers & Constructors, Inc.

B31.3 SUBGROUP ON FABRICATION, EXAMINATION, AND TESTING

R. D. Campbell, *Chair*, Bechtel
J. Davio, *Vice Chair*, EllisDon Industrial
C. Larsen, *Vice Chair*, Team Industrial Services
D. A. Bingham, Los Alamos National Labs
K. J. Chizen, NDE Level III
A. C. Collins, Keyline Enterprises LLC
M. G. Collins, ConocoPhillips
J. Cosentino, Shell Oil
T. Dang, Chevron Energy Technology Co.
M. DeLong, IHI E&C
C. Eskridge, Jr., Worley ECR
P. D. Flenner, Flenner Engineering Services
R. S. Gleave, PCL Industrial Management, Inc.
B. S. Gordon, Under Pressure Code Consulting and Training
P. T. Hayes, Advanced OEM Solutions
S. Hilliker, Steven Hilliker Consulting, LLC
J. F. Hodgins, Car-Ber Testing Services
J. R. Lindlof, Kiewit Engineering Group, Inc.
D. H. Markman, Summit Mechanical Services, LLC
V. B. Molina III, Air Products & Chemicals, Inc.
A. D. Nalbandian, Thielsch Engineering, Inc.
A. C. Ramirez, Bechtel
R. K. Reamey, Turner Industries Group, LLC
G. C. Reinhardt II, Team Industries, Inc.
L. G. Richardson, Crossbridge Compliance
W. J. Sperko, Sperko Engineering Services, Inc.
J. P. Swezy, Jr., Boiler Code Tech, LLC
R. Taylor, PBF Energy
S. W. Vail, Bechtel National, Inc.
D. A. Williams, Fixed Equipment Hess Corp.

R. A. McLeod, *Contributing Member*, General Electric Co.

A. Rokhsativand, *Contributing Member*, Pars Oil & Gas Co.

B31.3 SUBGROUP ON GENERAL REQUIREMENTS

C. J. Melo, *Chair*, Technip FMC
D. D. Christian, Victaulic
J. A. D'Avanzo, Fluoroseal Valves
C. E. Davila, Crane Energy
G. Evans, BP Exploration
K. Landreth, T. D. Williamson
C. Y. Shyu, Atkins
G. B. Trinker, Victaulic Co.
T. D. Wills, Jr., Praxair, Inc.
A. Ali, *Contributing Member*, Arabian Co. and Sasakura for Water & Power
S. S. Cimorelli, *Contributing Member*, DuPont Advanced Printing
D. L. Coym, *Contributing Member*, Intertek Moody
J. Langeland, *Contributing Member*, My Piping AS
P. S. Shriwal, *Contributing Member*, Shriwal Enterprises

B31.3 SUBGROUP ON HIGH PRESSURE PIPING

B. Bounds, *Chair*, Bechtel Corp.
D. R. Fraser, NASA Ames Research Center
O. R. Greulich, NASA Headquarters
M. H. Nguyen, S&B Engineers and Constructors, Ltd.
A. P. Rangus, Bechtel
F. W. Tatar, FM Global
H. Tiwari, Technip FMC
M. C. Warren, Xcel Energy
W. L. Weeks, Lummus Technology
A. Jettley, *Contributing Member*, Bechtel India Private Ltd.
Q. N. Truong, *Contributing Member*, Consulting Engineer

B31.3 SUBGROUP ON HIGH PURITY SYSTEMS

W. M. Huitt, *Chair*, W. M. Huitt Co.
W. F. Daprile, *Vice Chair*, Eli Lilly & Co.
R. Foster, Hose Master, LLC
B. K. Henon, Arc Machines, Inc., Retired
R. McGregor, Titan Research Group
N. T. Ulsvik, Aker Solutions
T. J. Naughton, *Contributing Member*, Jacobs Engineering

B31.3 SUBGROUP ON MATERIALS

B. L. Agee, *Chair*, GE Energy
S. J. Tonkins, *Vice Chair*, BP Americas
D. E. Brown, SSP
R. A. Grichuk, Fluor Enterprises, Inc.
L. Henderson, Jr., Chiyoda International Corp.
L. K. Hovey, Fluor Corp.
K. Pham, Fluor Enterprises, Inc.
D. W. Rahoi, CCM 2000
A. Raza, SFRL Consultants Ltd.
M. Sindelar, Lokring Technology
J. L. Smith, Technical Consultant
S. Tang, Swagelok Co.
D. K. Verma, Bechtel Oil, Gas and Chemicals
A. Yasemi, Cenovus Energy, Inc.
X. Chen, *Contributing Member*, SINOPEC Engineering, Inc.
R. Goel, *Contributing Member*, CB&I
R. Gopalakrishnan, *Contributing Member*, Samsung Saudi Arabia Co. Ltd.
M. Guidara, *Contributing Member*, Engineering Procurement & Project Management, S.A.
W. Y. Sam, *Contributing Member*, Shell Sarawak Berhad — Deepwater Engineering
J. Wang, *Contributing Member*, SINOPEC Shanghai Engineering Corp.

B31.3 SUBGROUP ON NON-METALLIC PIPING

J. M. Kalnins, *Chair*, Crane ResistoFlex
M. McDaniel, *Vice Chair*, The Dow Chemical Co.
C. A. Moore, *Vice Chair*, NOV Fiberglass Systems
J. R. Paschal, *Vice Chair*, Paschal Engineering & Forensic Consulting, Inc.
B. Allen, Crane ResistoFlex
J. Becker, ISCO Industries
M. A. Clark, Nibco, Inc.
A. M. Kyu, Bechtel
F. R. Volgstadt, Volgstadt & Associates, Inc.
D. Yanik, Crane ResistoFlex
C. Ziu, Nupi Americas, Inc.
R. Sils, *Contributing Member*, Terra Nimbus Pty Ltd.

B31.3 PROCESS PIPING, INDIA INTERNATIONAL WORKING GROUP

R. Goel, *Chair*, CB&I
A. Jettley, *Vice Chair*, Bechtel India Private Ltd.
R. Mohamed, *Secretary*, The American Society of Mechanical Engineers
R. P. S. Bindra, CB&I Lummus Private Ltd.
S. Biswas, Technip Noida
R. Jiwani, Intergraph Corp. India
N. Khera, CB&I India Private Ltd.

A. Kumar, Larsen & Toubro Ltd.
S. Kumar, CB&I India
A. Meghani, Petroleum & Natural Gas Regulatory Board
S. S. Palkar, CB&I India Private Ltd.
V. Pranjal, Fluor Daniel India Pvt Ltd.
R. S. Gururajan, Petrofac Engineering Services Private Ltd.
P. S. Shriwal, Shriwal Enterprises
R. Singh, CB&I
H. Toki, Bechtel India Private Ltd.
D. D. Christian, *Contributing Member*, Victaulic
M. Sharma, *Contributing Member*, ASME India Private Ltd.

B31 FABRICATION AND EXAMINATION COMMITTEE

J. P. Swezy, Jr., *Chair*, Boiler Code Tech, LLC
U. D'Urso, *Secretary*, The American Society of Mechanical Engineers
D. Bingham, Los Alamos National Labs
R. D. Campbell, Bechtel
R. D. Couch, Electric Power Research Institute
R. J. Ferguson, Metallurgist
P. D. Flenner, Flenner Engineering Services
J. Frey, Joe W. Frey Engineering Services, LLC
S. Gingrich, AECOM
J. Hainsworth, WR Metallurgical
T. Monday, Team Industries, Inc.
A. D. Nalbandian, Thielsch Engineering, Inc.
R. J. Silvia, Process Engineers & Constructors, Inc.
W. J. Sperko, Sperko Engineering Services, Inc.
K. P. Wu, Stellar Energy Systems

B31 MATERIALS TECHNICAL COMMITTEE

R. P. Deubler, *Chair,* Becht Engineering Co., Inc.
C. Eskridge, Jr., *Vice Chair*, Worley ECR
C. E. O'Brien, *Secretary*, The American Society of Mechanical Engineers
B. T. Bounds, Bechtel Corp.
W. P. Collins, WPC Sol, LLC
R. A. Grichuk, Fluor Enterprises, Inc.
J. Gundlach, Michigan Seamless Tube and Pipe
A. A. Hassan, Power Generation Engineering and Services Co.
L. Henderson, Jr., Chiyoda International Corp.
C. Henley, Kiewit Engineering Group, Inc.
G. A. Jolly, Samshin Limited
C. J. Melo, Technip FMC
M. L. Nayyar, NICE
D. W. Rahoi, CCM 2000
R. A. Schmidt, Canadoil
Z. Djilali, *Contributing Member*, Sonatrach
J. L. Smith, *Contributing Member*, Technical Consultant

B31 MECHANICAL DESIGN TECHNICAL COMMITTEE

J. E. Meyer, *Chair*, Louis Perry Group
U. D'Urso, *Secretary*, The American Society of Mechanical Engineers
J. Wu, *Secretary*, The American Society of Mechanical Engineers
G. A. Antaki, Becht Engineering Co., Inc.
D. Arnett, Fluor
C. Becht IV, Becht Engineering Co.
R. Bethea, Huntington Ingalls Industries — Newport News Shipbuilding
N. F. Consumo, Sr.
J. P. Ellenberger
M. Engelkemier, Cargill
D. J. Fetzner, BP Exploration Alaska, Inc.
D. Fraser, NASA Ames Research Center
J. A. Graziano, Consultant
J. D. Hart, SSD, Inc.
R. W. Haupt, Pressure Piping Engineering Associates, Inc.
B. P. Holbrook
R. A. Leishear, Leishear Engineering, LLC
G. D. Mayers, Alion Science & Technology
T. Q. McCawley, TQM Engineering PC
J. C. Minichiello, Bechtel National, Inc.
P. Moore, Burns & McDonnell
A. W. Paulin, Paulin Resource Group
R. A. Robleto, KBR
M. J. Rosenfeld, Kiefner/Applus — RTD
T. Sato, Japan Power Engineering and Inspection Corp.
M. Stewart, AECOM

(18)

INTRODUCTION

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

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 two 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 as part of an Interpretation supplement.

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 as part of a Case supplement.

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 B31.3-2018
SUMMARY OF CHANGES

Following approval by the ASME B31 Committee and ASME, and after public review, ASME B31.3-2018 was approved by the American National Standards Institute on August 8, 2018.

ASME B31.3-2018 includes the following changes identified by a margin note, **(18)**.

Page	*Location*	*Change*
xx	Introduction	Revised
1	300	Subparagraphs (b)(1) and (c)(4) revised
2	300.1	Revised
2	300.1.3	Footnote 2 revised
2	300.1.4	Revised
3	300.2	(1) Footnote 3 revised (2) *indication, linear; indication, rounded*; and *stress ratio* revised (3) *owner, readily accessible (for visual examination)*, and *representative* added
9	Table 300.4	Entry for W added
11	301.5	First paragraph deleted
11	301.5.1	Revised
11	301.5.4	Revised
12	302.2.3	Revised in its entirety
12	302.2.4	First paragraph and subpara. (c) revised
14	302.3.2	Revised in its entirety
15	302.3.5	Subparagraphs (c), (e), and (f) revised
18	302.3.6	Subparagraph (a) revised
20	Table 302.3.5	(1) Second column head revised (2) First row added (3) General Note (b) and Notes (2), (3), and (9) revised
29	304.5.1	Subparagraph (b) revised
32	306.3.2	Revised
32	306.3.3	Revised
33	306.4.4	Subparagraph (b) revised
33	306.5.2	Revised
33	Table 308.2.1	General Note revised
34	308.3	Revised
34	308.4	Revised
34	309.2.3	First paragraph revised
35	310	Revised
35	311.1	Revised
35	311.2	Paragraphs 311.2.1, 311.2.2, and 311.2.3 deleted, and subsequent paragraphs redesignated

35	312	First paragraph added
36	Table 314.2.1	Revised in its entirety
36	314.2.1	Subparagraphs (a) and (b) revised
36	315.2	Subparagraph (a) revised
36	315.3	Revised
37	318.2.3	Revised
39	319.3.6	Second paragraph revised
40	319.4.4	Subparagraph (c) revised
43	320.2	Second paragraph revised
45	321.3.2	(1) First paragraph revised
		(2) Last paragraph and footnote 10 added
47	323.2.2	Revised in its entirety
48	Table 323.2.2	(1) Last two column heads revised
		(2) Under Type of Material, third entry revised
		(3) Notes (1), (3), (4), (6), and (7) revised
50	Figure 323.2.2A	Previous Note (6) redesignated as (1) and revised; other Notes renumbered
51	Table 323.2.2A	In seventh group of rows, in fourth row, entries under Nominal Thickness revised
52	Figure 323.2.2B	(1) Fahrenheit values corrected by errata and moved to bottom of illustration
		(2) General Notes replaced by one General Note
54	323.3.5	Subparagraphs (b) and (c) revised
57	Table 323.3.5	In first column, last entry revised
60	Table 326.1	(1) ASME B18.31.2 added
		(2) Notes (4) and (5) revised
72	Table 330.1.1	For P-No. 5B, first two entries in third row revised
72	331.1.1	Subparagraph (a) revised
79	335.3.1	Revised
81	340.4	Subparagraph (b)(3) revised
82	341.4.1	Subparagraphs (a)(2) and (a)(3) revised
84	Table 341.3.2	(1) Under Weld Imperfection, fifth entry revised
		(2) For Criteria F and G, main entry under Measure revised
85	Criterion Value Notes for Table 341.3.2	Note (2) [formerly Note (10)] revised
89	344.2.1	Revised
89	344.2.2	Revised
89	344.5.1	Revised
90	344.6.2	Subparagraph (b) corrected by errata
91	345.2.1	Subparagraph (a) revised
91	345.2.5	Revised
93	345.8	(1) Paragraph 345.8.1 added
		(2) Existing text moved to new para. 345.8.2 and subpara. (a) revised
95	A302.2.3	Revised
96	A302.3.2	Footnote 1 revised

97	A302.3.4	Subparagraph (a) revised
101	A319.2.1	Revised in its entirety
102	A319.2.2	Subparagraph (a) revised
107	Table A326.1	(1) ASTM F1545 and AWWA C900 revised (2) Note (4) added
114	Table A341.3.2	Revised
119	M323.2	Revised
120	M335.1.1	First cross-reference corrected by errata to read 335.1
124	K300	Subparagraphs (a), (b)(1), and (e) revised
124	K300.1	Revised in its entirety
124	K300.4	Revised
124	K301	(1) First paragraph revised (2) Paragraph K301.1 deleted (3) Paragraph K301.2.1 revised (4) Paragraphs K301.4.2 and K301.7.3 added
125	K302.2.3	Revised in its entirety
125	K302.2.4	Revised
126	K302.3.3	First paragraph revised
127	K302.3.5	Subparagraph (c) revised
127	K302.3.6	Subparagraph (a) revised
128	K304.1.2	(1) Equations (34a), (34b), (34c), and (34d) revised (2) Footnote 3 deleted and subsequent footnotes renumbered
130	K304.7.4	Revised
131	K306.1.1	Revised
133	K314	Revised in its entirety
133	K315	Revised in its entirety
134	K318	Revised
134	K319	Revised
134	K320	Added
135	K323.2	Revised
135	K323.2.1	Revised
136	K323.2.4	Subparagraph (a) revised
139	K326.4	Revised in its entirety
144	Table K341.3.2	Under Type of Imperfection, fifth entry revised
145	Criterion Value Notes for Table K341.3.2	For Symbol C, Measure revised
146	K344.6.3	Subparagraph (b) revised
148	K346.2	Subparagraph (d) revised
151	U328.4	Revised
152	U341.3.2	Revised
157	Specification Index for Appendix A	Revised in its entirety
161	Notes for Tables A-1, A-1M, A-1A, A-1B, A-2, and A-2M	(1) General Note (a) and Notes (6), (30), and (65) revised (2) Note (79) added
165	Table A-1	(1) All Note (2) references deleted

(2) Under Carbon Steel — Forgings and Fittings, A694 F42, F46, F52, F56, F60, F65, and F70; A707 L1, L2, and L3; and A860 WPHY 42, WPHY 46, WPHY 52, WPHY 60, WPHY 65, and WPHY 70 added

(3) Under Low and Intermediate Alloy Steel — Pipes, for A671 CFB70 and CFE70, Type/Grade revised

(4) Under Low and Intermediate Alloy Steel — Plates, for A387 9, P-No. revised

(5) Under Stainless Steel — Pipes and Tubes, A312 TP321, A312 TP321H, A376 TP321, and A376 TP321H revised

(6) A270 TP304L and TP316L added

(7) A358 321 and A409 TP321 revised

(8) A358 321H added

(9) A270 TP316 added

(10) A270 TP304 added

(11) A789 and A790 S82441 added

(12) A789 and A790 S32003 revised

(13) For A928 S32003, Size revised

(14) A789 and A790 S32760 revised

(15) Under Stainless Steel — Plates and Sheets, A240 321 and 321H revised

(16) A240 S82441 added

(17) For A240 S32003, Size revised

(18) A240 S32760 revised

(19) Under Stainless Steel — Forgings and Fittings, A182 F321 and F321H revised

(20) A403 WP321 and WP321H revised

(21) Under Stainless Steel — Bar, for A479 304, 304H, 304L, 316, 316H, and 316L, Notes revised

(22) For A479 321 and 321H, stress value for 650°F and font for stress values revised

(23) A479 S82441 added

(24) Under Stainless Steel — Castings, for A351 CF8C, Notes and stress values revised

(25) Under Nickel and Nickel Alloy — Pipes and Tubes, N08825 B163, B474, and B704 added

(26) For N08825 B423 and B705, fonts for stress values corrected by errata

(27) N06690 B163 and B167 added

(28) N08120 B163, B407, B514, and B515 added

(29) Under Nickel and Nickel Alloy — Plates and Sheets, for N08825 B424, fonts for stress values corrected by errata

(30) N06690 B168 added

(31) N08120 B409 added

(32) Under Nickel and Nickel Alloy — Forgings and Fittings, for N02200 B366, stress value revised

(33) N02200 B564 deleted

		(34) For N08825 B366 and B564, fonts for stress values corrected by errata
		(35) N06690 B564 added
		(36) N08120 B366 and B564 added
		(37) Under Nickel and Nickel Alloy — Rod and Bar, for N08825 B425, fonts for stress values corrected by errata
		(38) N06690 B166 added
		(39) N08120 B408 added
		(40) For the titanium and titanium alloys, Product Form and Class/Condition/Temper entries added, and stress values revised
		(41) Under Titanium and Titanium Alloy — Pipes and Tubes, R50250, R50400, R50550, R52400, and R53400 B338 added
		(42) R53400 B861 and B862 added
		(43) Under Titanium and Titanium Alloy — Plates, Sheet, and Strips (formerly Plates and Sheets), for R50250 B265, Specified Min. Yield Strength revised
		(44) R52400 and R53400 B265 added
		(45) Under Titanium and Titanium Alloy — Forgings and Fittings (formerly Forgings), R50250, R50400, R50550, R52400, and R53400 B363 added
		(46) For R50250 B381, Type/Grade and Specified Min. Yield Strength revised
		(47) For R50400 and R50550 B381, Type/Grade revised
		(48) R52400 and R53400 B381 added
		(49) Under Titanium and Titanium Alloy — Bars, R50250, R50400, R50550, R52400, and R53400 B348 added
		(50) Under Titanium and Titanium Alloy — Castings, R52550 and R52700 B367 added
		(51) Under Aluminum Alloy — Seamless Pipes and Tubes, A83003, A91060, A93003, A95083, A95086, A96061, and A96063 B345 deleted
		(52) Under Aluminum Alloy — Castings, for A03560 B26, P-Nos. added
240	Table A-1M	(1) All Note (2) references deleted
		(2) A694 F42, F46, F52, F56, F60, F65, and F70; A707 L1, L2, and L3; and A860 WPHY 42, WPHY 46, WPHY 52, WPHY 60, WPHY 65, and WPHY 70 added
		(3) For A671 CFB70 and CFE70, Type/Grade revised
		(4) For A387 9, P-No. revised
		(5) A270 TP304L and TP316L added
		(6) A312 TP321, A312 TP321H, A358 321, A376 TP321, A376 TP321H, and A409 TP321 revised
		(7) A358 321H added
		(8) A270 TP304, TP304L, TP316, and TP316L added
		(9) A789 and A790 S82441 added
		(10) A789 and A790 S32003 revised
		(11) For A928 S32003, Size revised
		(12) A789 and A790 S32760 revised

(13) A358 S34565 revised

(14) A240 321 and 321H revised

(15) A240 S82441 added

(16) For A240 S32003, Size revised

(17) A240 S32760 revised

(18) A182 F321 and F321H revised

(19) A403 WP321 and WP321H revised

(20) A182 and A815 S32760 revised

(21) For A479 304, 304H, 304L, 316, 316H, and 316L, Notes revised

(22) A479 321 and 321H revised

(23) A479 S82441 added

(24) A351 CF8C revised

(25) N08825 B163 added

(26) For N08825 B423, Notes revised

(27) N08825 B474 and B704 added

(28) N08825 B705 revised

(29) N06690 B163 and B167 added

(30) N08120 B163, B407, B514, and B515 added

(31) For N06230 B619, B622, and B626, font for stress values revised

(32) N06690 B168 added

(33) N08120 B409 added

(34) For N06230 B435, font for stress values revised

(35) N06230 B435 added

(36) For N02200 B366, stress values revised

(37) N02200 B564 deleted

(38) N06690 B564 added

(39) N08120 B366 and B564 added

(40) For N06230 B366, font for stress values revised

(41) N06690 B166 added

(42) N08120 B408 added

(43) For N06230 B572, font for stress values revised

(44) For titanium and titanium alloy materials, Product Form and Class/Condition/Temper entries added; and Min. Tensile Strength, Min. Yield Strength, and stress values revised

(45) R50250, R50400, R50550, R52400, and R53400 B338 added

(46) R53400 B861 and B862 added

(47) R52400 and R53400 B265 added

(48) R50250, R50400, R50550, R52400, and R53400 B363 and B381 added

(49) R50250, R50400, R50550, R52400, and R53400 B348 added

(50) R52550 and R52700 B367 added

(51) A83003, A91060, A93003, A95083, A95086, A96061, and A96063 B345 deleted

(52) For A03560 B26, P-Nos. added

350	Table A-1A	B367 added
351	Table A-1B	(1) A105, A181, A350, A182, A487, B160, B164, B564, B247, and B345 deleted (2) A813, A814, B517, and B862 revised (3) A270, B163, B515, B704, and B338 added
356	Table A-2	(1) A325 deleted (2) F3125 A325 added (3) A354 BC and BD lines revised and new BC line added (4) For last B150 HR50, Size Range corrected by errata
366	Table A-2M	(1) For A307 B, Min. Yield Strength deleted by errata (2) A325 deleted (3) F3125 A325 added (4) A354 BC and BD lines revised and new BC line added (5) For last B150 HR50, Size Range corrected by errata
396	Table C-1M	Table C-2 redesignated as Table C-1M
403	Table C-6	Revised in its entirety
407	Table C-6M	Added
413	Table D300	General Note (b) added
417	Appendix E	Revised in its entirety
423	F300.1.4	Added
423	F301	(1) Paragraph F301.5.1 added (2) Paragraph F301.11 deleted
424	F308.4	Revised
425	F312.1	Subparagraph (b) revised
426	F323.2.2	Revised
426	F323.4	Subparagraphs (a) and (c)(4) revised
428	FK300	Added
439	Appendix J	(1) Entry for *X* deleted by errata (2) Appendix revised
455	Appendix K	ASTM A789, A790, and A815 added to Specification Index
457	Notes for Table K-1	(1) General Note (b) revised (2) Notes (9) and (10) deleted (3) Notes (19) and (20) added
458	Table K-1	(1) Under Carbon Steel — Pipes and Tubes, API 5L lines revised (2) Under Carbon Steel — Forgings and Fittings, for A694 F42 through F70, stress values for highest temperatures deleted (3) For Stainless Steel entries, UNS Nos. added (4) Under Stainless Steel — Pipes and Tubes, A789 and A790 S32750 added (5) Under Stainless Steel — Forgings and Fittings, A182 and A815 S32750 added (6) Titanium and Titanium Alloy entries revised, and entries in columns for 350°C, 450°F, and 550°F added
474	Figure M300	Cross-references in Col. 1 revised
476	Appendix Q	Footnote 1 revised
477	R300	Subparagraph (a) corrected by errata

480	Appendix S	Footnote 1 added
482	S301.6	First paragraph revised
492	V303.1.1	Subparagraph (b) revised
493	V303.1.3	Revised
495	Appendix W	Added
502	X302.2.1	In subparagraph (d), last cross-reference corrected by errata to read Table 331.1.1
502	X302.2.3	Subparagraph (a) revised
504	Appendix Z	Revised in its entirety

NOTES:
(1) The ASME B31.3 Interpretations Volume will no longer be published with the Code.
(2) The B31.3 Code Cases will no longer be published with the Code.

INTENTIONALLY LEFT BLANK

Chapter I
Scope and Definitions

(18) 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, construction, examination, inspection, and testing 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 paras. 300(d)(4) through (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 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 design 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.

(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

(-a) Chapter III for materials

(-b) Chapter II, Part 3, for components

(-c) Chapter II, Part 4, for joints