

**ASME B31.4-2022**  
(Revision of ASME B31.4-2019)

# **Pipeline Transportation Systems for Liquids and Slurries**

---

**ASME Code for Pressure Piping, B31**

**AN INTERNATIONAL PIPING CODE®**



**The American Society of  
Mechanical Engineers**

**ASME B31.4-2022**  
(Revision of ASME B31.4-2019)

# **Pipeline Transportation Systems for Liquids and Slurries**

---

**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: December 8, 2022

The next edition of this Code is scheduled for publication in 2025. 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 <https://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 <https://go.asme.org/B31committee>. The associated B31 Committee Pages for each code and standard can be accessed from this main page. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

ASME is the registered trademark of The American Society of Mechanical Engineers.

This international code or standard was developed under procedures accredited as meeting the criteria for American National Standards and it is an American National Standard. The Standards Committee that approved the code or standard was balanced to ensure that individuals from competent and concerned interests had an opportunity to participate. The proposed code or standard was made available for public review and comment, which provided an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity. ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable letters patent, nor does ASME assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representatives or persons affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations of this document issued in accordance with the established ASME procedures and policies, which precludes the issuance of interpretations by individuals.

No part of this document may be reproduced in any form,  
in an electronic retrieval system or otherwise,  
without the prior written permission of the publisher.

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

Copyright © 2022 by  
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS  
All rights reserved  
Printed in U.S.A.

# CONTENTS

Foreword .....		vi
Committee Roster .....		viii
Correspondence With the B31 Committee .....		x
Introduction .....		xii
Summary of Changes .....		xiv
<b>Chapter I</b>	<b>Scope and Definitions .....</b>	<b>1</b>
400	General Statements .....	1
<b>Chapter II</b>	<b>Design .....</b>	<b>11</b>
401	Loads .....	11
402	Calculation of Stresses .....	13
403	Criteria for Pipelines .....	15
404	Criteria for Fittings, Assemblies, and Other Components (Alternatively, Criteria for Components) .....	21
<b>Chapter III</b>	<b>Materials .....</b>	<b>34</b>
423	Materials — General Requirements .....	34
425	Materials Applied to Miscellaneous Parts .....	35
<b>Chapter IV</b>	<b>Dimensional Requirements .....</b>	<b>39</b>
426	Dimensional Requirements for Standard and Nonstandard Piping Components .....	39
<b>Chapter V</b>	<b>Construction, Welding, and Assembly .....</b>	<b>41</b>
434	Construction .....	41
435	Assembly of Piping Components .....	54
<b>Chapter VI</b>	<b>Inspection and Testing .....</b>	<b>55</b>
436	Inspection .....	55
437	Testing .....	56
<b>Chapter VII</b>	<b>Operation and Maintenance Procedures .....</b>	<b>59</b>
450	Operation and Maintenance Procedures Affecting the Safety of Liquid and Slurry Transportation Piping Systems .....	59
451	Pipeline Operation and Maintenance .....	60
452	Pump Station, Terminal, and Storage Facilities Operation and Maintenance .....	70
453	Corrosion Control .....	71
454	Emergency Plan .....	71
455	Records .....	72
456	Qualifying a Piping System for a Higher Operating Pressure .....	72
457	Abandoning a Piping System .....	73
<b>Chapter VIII</b>	<b>Corrosion Control .....</b>	<b>74</b>
460	General .....	74
461	External Corrosion Control for Buried or Submerged Pipelines .....	74
462	Internal Corrosion Control .....	77

463	External Corrosion Control for Pipelines Exposed to Atmosphere . . . . .	78
464	Pipelines in Arctic Environments . . . . .	79
465	Pipelines in High-Temperature Service . . . . .	79
466	External Corrosion Control for Thermally Insulated Pipelines . . . . .	80
467	Stress Corrosion and Other Phenomena . . . . .	81
468	Records . . . . .	81
<b>Chapter IX</b>	<b>Offshore Liquid Pipeline Systems . . . . .</b>	<b>82</b>
A400	General Statements . . . . .	82
A401	Loads . . . . .	83
A402	Calculation of Stresses . . . . .	85
A403	Criteria for Pipelines . . . . .	89
A404	Criteria for Fittings, Assemblies, and Other Components (Alternatively, Criteria for Components) . . . . .	89
A405	Pipe . . . . .	90
A406	Other Design Considerations . . . . .	90
A423	Materials — General Requirements . . . . .	91
A434	Construction . . . . .	91
A436	Inspection . . . . .	92
A437	Testing . . . . .	93
A450	Operation and Maintenance Procedures Affecting the Safety of Liquid and Slurry Transportation Piping Systems . . . . .	93
A451	Pipeline Operation and Maintenance . . . . .	93
A452	Pump Station, Terminal, and Storage Facilities Operation and Maintenance . . . . .	95
A454	Emergency Plan . . . . .	95
A460	General . . . . .	95
A461	External Corrosion Control for Buried or Submerged Pipelines . . . . .	95
A463	External Corrosion Control for Pipelines Exposed to Atmosphere . . . . .	96
<b>Chapter X</b>	<b>Carbon Dioxide Pipeline Systems . . . . .</b>	<b>97</b>
B400	General Statements . . . . .	97
B423	Materials — General Requirements . . . . .	97
B434	Construction . . . . .	97
B437	Testing . . . . .	97
B451	Pipeline Operation and Maintenance . . . . .	98
B454	Emergency Plan . . . . .	98
<b>Chapter XI</b>	<b>Slurry And Process Water Pipeline Systems . . . . .</b>	<b>99</b>
C400	General Statements . . . . .	99
C401	Loads . . . . .	99
C403	Criteria for Pipelines . . . . .	99
C404	Criteria for Fittings, Assemblies, and Other Components (Alternatively, Criteria for Components) . . . . .	100
C423	Materials — General Requirements . . . . .	100
C426	Dimensional Requirements for Standard and Nonstandard Piping Components . . . . .	100
C434	Construction . . . . .	100
C437	Testing . . . . .	102
C451	Pipeline Operation and Maintenance . . . . .	102
C454	Emergency Plan . . . . .	102

C457	Abandoning a Piping System . . . . .	102
C460	General . . . . .	102
C461	External Corrosion Control for Buried or Submerged Pipelines . . . . .	102
C468	Records . . . . .	102

**Mandatory Appendix**

I	Referenced Standards . . . . .	103
---	--------------------------------	-----

**Nonmandatory Appendices**

A	Submittal of Technical Inquiries to the B31 Pressure Piping Committee . . . . .	107
B	Publications That May Be of Informational Benefit . . . . .	108

**Figures**

400.1.1-1	Diagram Showing Scope of ASME B31.4 Excluding Carbon Dioxide Pipeline Systems (See Figure 400.1.1-2) . . . . .	3
400.1.1-2	Diagram Showing Scope of ASME B31.4 for Carbon Dioxide Pipeline Systems . . . . .	4
400.1.1-3	Diagram Showing Scope of ASME B31.4 for Slurry Pipeline Systems . . . . .	5
404.3.3.1-1	Reinforced Extruded Outlets . . . . .	24
404.3.4-1	Welding Details for Openings With Complete Encirclement Types of Reinforcement . . .	26
404.3.4-2	Welding Details for Openings With Localized-Type Reinforcement . . . . .	27
404.3.4-3	Welding Details for Openings Without Reinforcement Other Than That in Header and Branch Walls . . . . .	28
404.3.5-1	Reinforcement of Branch Connections . . . . .	30
434.8.6-1	Acceptable Butt Welded Joint Design for Equal Wall Thicknesses . . . . .	46
434.8.6-2	Acceptable Butt Welded Joint Design for Unequal Wall Thicknesses . . . . .	47
434.8.6-3	Recommended Attachment Details of Flanges . . . . .	48
451.6.2.2-1	Type I Interaction . . . . .	63
451.6.2.2-2	Type II Interaction . . . . .	63
451.6.2.9-1	Hot-Tap Fitting Sleeve or Pressure Containing (Type B) Sleeve End Fillet Weld Design .	69

**Tables**

403.2.1-1	Weld Joint Factors Applicable to Common Pipe Specifications . . . . .	16
403.3.1-1	Allowable Values for Pipeline System Stresses . . . . .	17
404.3.4-1	Design Criteria for Welded Branch Connections . . . . .	28
423.1-1	Material Standards and Specifications . . . . .	36
426.1-1	Dimensional Standards . . . . .	40
434.6-1	Minimum Cover for Buried Pipelines . . . . .	43
451.6.2.9-1	Acceptable Pipeline Repair Methods (Nonindented, Nonwrinkled, and Nonbuckled Pipe)	65
451.6.2.9-2	Acceptable Pipeline Repair Methods for Dents, Buckles, Ripples, Wrinkles, Leaking Couplings, and Defective Prior Repairs . . . . .	67
A402.3.2-1	Design Factors for Offshore Pipeline Systems . . . . .	87
C423.1-1	Material Standards . . . . .	101
C423.1-2	Material Standards Not Applicable for Slurry Piping Systems From Table 423.1-1 . . . . .	101
C426.1-2	Dimensional Standards Not Applicable for Slurry Piping Systems From Table 426.1-1 . .	101

# FOREWORD

The need for a national code for pressure piping became increasingly evident from 1915 to 1925. To meet this need, the American Engineering Standards Committee [later changed to the American Standards Association (ASA)] initiated Project B31 in March 1926 at the request of The American Society of Mechanical Engineers (ASME), and with that society as sole sponsor. After several years' work by Sectional Committee B31 and its subcommittees, a first edition was published in 1935 as an American Tentative Standard Code for Pressure Piping.

A revision of the original tentative standard was begun in 1937. Several more years' effort was given to securing uniformity between sections and to eliminating divergent requirements and discrepancies, as well as to keeping the code abreast of current developments in welding technique, stress computations, and references to new dimensional and material standards. During this period, a new section was added on refrigeration piping, prepared in cooperation with The American Society of Refrigeration Engineers (ASRE) and complementing the American Standard Code for Mechanical Refrigeration. This work culminated in the 1942 American Standard Code for Pressure Piping.

Supplements 1 and 2 of the 1942 code, which appeared in 1944 and 1947, respectively, introduced new dimensional and material standards, a new formula for pipe wall thickness, and more comprehensive requirements for instrument and control piping. Shortly after the 1942 code was issued, procedures were established for handling inquiries that require explanation or interpretation of code requirements, and for publishing such inquiries and answers in *Mechanical Engineering* for the information of all concerned.

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

- (a) a general revision and extension of requirements to agree with practices current at the time
- (b) revision of references to existing dimensional standards and material specifications, and the addition of new references
- (c) clarification of ambiguous or conflicting requirements

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ASME B31.4-2022 was approved by ANSI on September 6, 2022.

# 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

**C. H. Eskridge, Jr.**, *Chair*  
**K. A. Vilminot**, *Vice Chair*  
**J. Oh**, *Secretary*

### STANDARDS COMMITTEE PERSONNEL

<b>D. Anderson</b> , Retired	<b>G. A. Jolly</b> , Samshin, Ltd.
<b>R. J. T. Appleby</b> , Consultant	<b>K. Kaplan</b> , Consultant
<b>K. C. Bodenhamer</b> , TRC Pipeline Services	<b>W. J. Mauro</b> , Retired
<b>R. M. Bojarczuk</b> , Retired	<b>J. E. Meyer</b> , CDM Smith — Industrial Division
<b>M. R. Braz</b> , MRBraz and Associates, PLLC	<b>T. Monday</b> , Team Industries, Inc.
<b>M. Burkhart</b> , The Burkhart Group, Inc.	<b>J. Oh</b> , The American Society of Mechanical Engineers
<b>R. D. Campbell</b> , Bechtel Corp.	<b>W. Olson</b> , Gulf Interstate Engineering
<b>J. Caylor</b> , Caylor Engineering and Associates, PLLC	<b>D. W. Raho</b> , CCM 2000
<b>J. S. Chin</b> , TC Energy	<b>M. Rana</b> , Consultant
<b>D. D. Christian</b> , Victaulic Co.	<b>R. K. Reamey</b> , Turner Industries Group, LLC
<b>R. P. Deubler</b> , Becht Engineering Co., Inc.	<b>M. J. Rosenfeld</b> , RSI Pipeline Solutions, LLC
<b>D. W. Diehl</b> , Retired	<b>J. T. Schmitz</b> , Southwest Gas Corp.
<b>M. Engelkemier</b> , Cargill	<b>S. K. Sinha</b> , SOCOTEC Engineering, Inc.
<b>C. H. Eskridge, Jr.</b> , Becht Engineering Co., Inc.	<b>W. J. Sperko</b> , Sperko Engineering Services, Inc.
<b>D. J. Fetzner</b> , Retired	<b>F. W. Tatar</b> , Consultant
<b>D. R. Frikken</b> , Becht Engineering Co., Inc.	<b>K. A. Vilminot</b> , Commonwealth Associates, Inc.
<b>R. A. Grichuk</b> , S&B Engineers and Constructors, Ltd.	<b>P. D. Flenner</b> , <i>Contributing Member</i> , Flenner Engineering Services
<b>R. W. Haupt</b> , Pressure Piping Engineering Associates, Inc.	<b>M. L. Nayyar</b> , <i>Contributing Member</i> , NICE

### B31.4 LIQUID AND SLURRY PIPING TRANSPORTATION SYSTEMS SECTION COMMITTEE

<b>W. M. Olson</b> , <i>Chair</i> , Gulf Interstate Engineering	<b>B. Mittelstadt</b> , Dynamic Risk Assessments Systems, Inc.
<b>A. Baty</b> , <i>Vice Chair</i> , Paterson and Cooke USA, Ltd.	<b>D. Moore</b> , Trout Hydrodynamics, Inc..
<b>A. Maslowski</b> , <i>Secretary</i> , The American Society of Mechanical Engineers	<b>A. Morton</b> , T. D. Williamson, Inc.
<b>E. Alavi</b> , Energy Transfer	<b>B. Mumme</b> , Flint Hills Resources
<b>E. L. Baniak</b> , American Petroleum Institute	<b>G. Newman</b> , U.S. Department of Transportation
<b>J. Barrett</b> , TC Energy	<b>G. R. Petru</b> , Acapella Engineering Services, LLC
<b>K. C. Bodenhamer</b> , TRC Pipeline Services	<b>A. Post</b> , ClockSpring NRI
<b>W. M. Cauthen</b> , Tiger Energy Services, Inc.	<b>T. M. Shie</b> , Shell Pipeline Co., LP
<b>D. D. Christian</b> , Victaulic	<b>S. Singh</b> , Bechtel Oil, Gas, and Chemicals, Inc.
<b>R. Duran</b> , Chevron	<b>D. A. Soenjoto</b> , Integrity Tech Services
<b>S. P. Gade</b> , Gulf Interstate Engineering	<b>J. C. Spowart</b> , EnSiteUSA, Inc.
<b>K. M. Haley</b> , The Equity Engineering Group, Inc.	<b>A. Steiner</b> , RSI Pipeline Solutions
<b>E. M. Jorritsma</b> , Shell Projects and Engineering	<b>L. Sweeney</b> , Stantec Consulting Services, Inc.
<b>D. B. Kadakia</b> , Consultant	<b>S. Szemanek</b> , Marathon Petroleum Corp.
<b>P. W. Klein</b> , BHP	<b>W. L. Trimble</b> , Worley
<b>S. Koetting</b> , ExxonMobil Pipeline Co.	<b>Y. Yu</b> , Enbridge
<b>C. E. Kolovich</b> , Quest Integrity	<b>Z. Booth</b> , <i>Contributing Member</i> , DNV GL
<b>M. Leupp</b> , Marathon Pipe Line	<b>M. A. Boring</b> , <i>Contributing Member</i> , DNV GL
<b>Y. Li</b> , Enbridge Pipelines, Inc.	<b>A. Esmaeili</b> , <i>Contributing Member</i> , APA Group
<b>S. McKenna</b> , Burns and McDonnell	<b>D. Gilroy</b> , <i>Contributing Member</i> , Bechtel Oil, Gas, and Chemicals, Inc.
<b>T. P. McMahan</b> , DNV GL	<b>T. Guterrez</b> , <i>Contributing Member</i> , Burrow Global Services, LLC
	<b>B. Slater</b> , <i>Contributing Member</i> , BP Exploration Alaska

## B31 EXECUTIVE COMMITTEE

**K. A. Vilminot**, *Chair*, Commonwealth Associates, Inc.  
**C. H. Eskridge, Jr.**, *Vice Chair*, Becht Engineering Co., Inc.  
**D. Anderson**, Retired  
**M. R. Braz**, MRBraz and Associates, PLLC  
**M. Burkhart**, The Burkhart Group, Inc.  
**R. D. Campbell**, Bechtel Engineering Co., Inc.  
**J. Caylor**, Caylor Engineering and Associates, PLLC

**D. D. Christian**, Victaulic  
**P. Deubler**, Becht Engineering Co., Inc.  
**M. Engelkemier**, Cargill  
**D. R. Frikken**, Becht Engineering Co., Inc.  
**W. Olson**, Gulf Interstate Engineering  
**M. Rana**, Consultant  
**S. K. Sinha**, Lucius Pitkin, Inc.

## B31 FABRICATION AND EXAMINATION COMMITTEE

**R. D. Campbell**, *Chair*, Bechtel Corp.  
**S. Findlan**, *Vice Chair*, Stone and Webster, Inc.  
**U. D'Urso**, *Secretary*, The American Society of Mechanical Engineers  
**D. A. Bingham**, Los Alamos National Laboratory  
**B. Boseo**, Burns and McDonnell  
**P. M. Davis**, Wood Group USA, Inc.  
**M. DeLong**, IHI Energy Solutions Inc.  
**R. Duran**, Chevron  
**J. W. Frey**, Joe W. Frey Engineering Services, LLC

**D. R. Frikken**, Becht Engineering Co., Inc.  
**S. Gingrich**, AECOM  
**T. Monday**, Team Industries, Inc.  
**A. D. Nalbandian**, Thielsch Engineering, Inc.  
**R. K. Reamey**, Turner Industries Group, LLC  
**W. J. Sperko**, Sperko Engineering Services, Inc.  
**J. P. Swezy, Jr.**, Bureau Veritas Inspection and Insurance  
**K. P. Wu**, Stellar Energy Systems  
**P. D. Flenner**, *Contributing Member*, Flenner Engineering Services

## B31 MATERIALS TECHNICAL COMMITTEE

**R. P. Deubler**, *Chair*, Becht Engineering Co., Inc.  
**C. Henley**, *Vice Chair*, Kiewit Engineering Group, Inc.  
**C. Rodrigues**, *Secretary*, The American Society of Mechanical Engineers  
**B. T. Bounds**, Bechtel Energy, Inc.  
**W. P. Collins**, WPC Solutions, LLC  
**C. H. Eskridge, Jr.**, Consultant  
**A. Esmaili**, APA Group  
**R. A. Grichuk**, S&B Engineers and Constructors, Ltd.  
**J. Gundlach**, Michigan Seamless Tube and Pipe  
**A. A. Hassan**, PGESCO

**L. Henderson, Jr.**, Kiewit Engineering Group, Inc.  
**T. Hudson**, Black and Veatch  
**G. A. Jolly**, Samshin, Ltd.  
**C. J. Melo**, S&B Engineers and Constructors, Ltd.  
**K. Pham**, Fluor Enterprise  
**D. W. Raho**, CCM 2000  
**R. A. Schmidt**, Canadoil  
**S. Tonkins**, BP Americas  
**D. K. Verma**, Bechtel Energy, Inc.  
**Z. Djilali**, *Contributing Member*, Sonatrach  
**M. Nayyar**, *Contributing Member*, NICE

## B31 MECHANICAL DESIGN TECHNICAL COMMITTEE

**M. Engelkemier**, *Chair*, Cargill  
**D. Arnett**, *Vice Chair*, Exxonmobil Research and Engineering  
**R. Rahaman**, *Secretary*, The American Society of Mechanical Engineers  
**G. A. Antaki**, Becht Engineering Co., Inc.  
**R. Bethea**, HII — Newport News Shipbuilding  
**D. J. Fetzner**, Consultant  
**D. A. 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**, Consultant  
**R. A. Leishear**, Leishear Engineering, LLC  
**G. D. Mayers**, Serco, Inc.  
**T. Q. McCawley**, Consultant  
**J. E. Meyer**, CDM Smith — Industrial Division  
**P. Moore**, Burns and McDonnell  
**A. Paulin**, Paulin Research Group  
**M. J. Rosenfeld**, RSI Pipeline Solutions, LLC  
**H. Kosasayama**, *Contributing Member*, JGC Corp.

# CORRESPONDENCE WITH THE B31 COMMITTEE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# INTRODUCTION

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

- B31.1 Power Piping: piping typically found in electric power-generating stations, industrial and institutional plants, geothermal heating systems, and central and district heating and cooling systems
- B31.3 Process Piping: piping typically found in petroleum refineries; onshore and offshore petroleum and natural gas production facilities; chemical, pharmaceutical, textile, paper, ore processing, semiconductor, and cryogenic plants; food and beverage processing facilities; and related processing plants and terminals
- B31.4 Pipeline Transportation Systems for Liquids and Slurries: piping transporting hazardous products that are predominately liquid between facilities, production and storage fields, plants, and terminals, and within terminals and pumping, regulating, and metering stations associated with liquid pipeline systems
- B31.5 Refrigeration Piping and Heat Transfer Components: piping for refrigerants and secondary coolants
- B31.8 Gas Transmission and Distribution Piping Systems: piping transporting products that are predominately gas between sources and terminals, including compressor, regulating, and metering stations, and gas gathering pipelines
- B31.9 Building Services Piping: piping typically found in industrial, institutional, commercial, and public buildings, and in multi-unit residences, that does not require the range of sizes, pressures, and temperatures covered in B31.1
- B31.12 Hydrogen Piping and Pipelines: piping in gaseous and liquid hydrogen service and pipelines in gaseous hydrogen service

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

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

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

To the greatest possible extent, Code requirements for design are stated in terms of basic design principles and formulas. These are supplemented as necessary with specific requirements to ensure uniform application of principles and to guide selection and application of piping elements. The Code prohibits designs and practices known to be unsafe and contains warnings where caution, but not prohibition, is warranted.

This Code Section includes

- (a) references to acceptable material specifications and component standards, including dimensional requirements and pressure–temperature ratings
- (b) requirements for design of components and assemblies, including pipe supports
- (c) requirements and data for evaluation and limitation of stresses, reactions, and movements associated with pressure, temperature changes, and other forces
- (d) guidance and limitations on the selection and application of materials, components, and joining methods