

ASME B31.3-2006
(Revision of ASME B31.3-2004)

Process Piping

ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

ASME B31.3-2006
(Revision of ASME B31.3-2004)

Process Piping

ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD



**The American Society of
Mechanical Engineers**

Three Park Avenue • New York, NY 10016

Date of Issuance: May 31, 2007

The next edition of this Code is scheduled for publication in 2008. This Code will become effective 6 months after the Date of Issuance. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. The interpretations will be included with this edition.

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

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Standards Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment that provides 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 assumes 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 representative(s) or person(s) 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
Three Park Avenue, New York, NY 10016-5990

Copyright © 2007 by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
All rights reserved
Printed in U.S.A.

CONTENTS

| | |
|-------------------------------------------------------------------------|-----------|
| Foreword | xi |
| Committee Personnel | xiii |
| Introduction | xvi |
| Summary of Changes | xviii |
| Chapter I Scope and Definitions | 1 |
| 300 General Statements | 1 |
| Chapter II Design | 9 |
| Part 1 Conditions and Criteria | 9 |
| 301 Design Conditions | 9 |
| 302 Design Criteria | 11 |
| Part 2 Pressure Design of Piping Components | 17 |
| 303 General | 17 |
| 304 Pressure Design of Components | 18 |
| Part 3 Fluid Service Requirements for Piping Components | 27 |
| 305 Pipe | 27 |
| 306 Fittings, Bends, Miters, Laps, and Branch Connections | 28 |
| 307 Valves and Specialty Components | 29 |
| 308 Flanges, Blanks, Flange Facings, and Gaskets | 30 |
| 309 Bolting | 30 |
| Part 4 Fluid Service Requirements for Piping Joints | 31 |
| 310 General | 31 |
| 311 Welded Joints | 31 |
| 312 Flanged Joints | 32 |
| 313 Expanded Joints | 32 |
| 314 Threaded Joints | 32 |
| 315 Tubing Joints | 33 |
| 316 Caulked Joints | 33 |
| 317 Soldered and Brazed Joints | 33 |
| 318 Special Joints | 33 |
| Part 5 Flexibility and Support | 33 |
| 319 Piping Flexibility | 33 |
| 321 Piping Support | 39 |
| Part 6 Systems | 40 |
| 322 Specific Piping Systems | 40 |
| Chapter III Materials | 42 |
| 323 General Requirements | 42 |
| 325 Materials — Miscellaneous | 51 |
| Chapter IV Standards for Piping Components | 52 |
| 326 Dimensions and Ratings of Components | 52 |
| Chapter V Fabrication, Assembly, and Erection | 55 |
| 327 General | 55 |
| 328 Welding | 55 |
| 330 Preheating | 61 |
| 331 Heat Treatment | 62 |
| 332 Bending and Forming | 66 |
| 333 Brazing and Soldering | 67 |
| 335 Assembly and Erection | 67 |

| | | |
|--------------------|-----------------------------------------------------------------|----|
| Chapter VI | Inspection, Examination, and Testing | 69 |
| 340 | Inspection | 69 |
| 341 | Examination | 69 |
| 342 | Examination Personnel | 75 |
| 343 | Examination Procedures | 75 |
| 344 | Types of Examination | 75 |
| 345 | Testing | 76 |
| 346 | Records | 79 |
| Chapter VII | Nonmetallic Piping and Piping Lined With Nonmetals | 80 |
| A300 | General Statements | 80 |
| Part 1 | Conditions and Criteria | 80 |
| A301 | Design Conditions | 80 |
| A302 | Design Criteria | 80 |
| Part 2 | Pressure Design of Piping Components | 82 |
| A303 | General | 82 |
| A304 | Pressure Design of Piping Components | 82 |
| Part 3 | Fluid Service Requirements for Piping Components | 83 |
| A305 | Pipe | 83 |
| A306 | Fittings, Bends, Miters, Laps, and Branch Connections | 83 |
| A307 | Nonmetallic Valves and Specialty Components | 84 |
| A308 | Flanges, Blanks, Flange Facings, and Gaskets | 84 |
| A309 | Bolting | 84 |
| Part 4 | Fluid Service Requirements for Piping Joints | 84 |
| A310 | General | 84 |
| A311 | Bonded Joints in Plastics | 85 |
| A312 | Flanged Joints | 85 |
| A313 | Expanded Joints | 85 |
| A314 | Threaded Joints | 85 |
| A315 | Tubing Joints | 85 |
| A316 | Caulked Joints | 85 |
| A318 | Special Joints | 85 |
| Part 5 | Flexibility and Support | 86 |
| A319 | Flexibility of Nonmetallic Piping | 86 |
| A321 | Piping Support | 87 |
| Part 6 | Systems | 88 |
| A322 | Specific Piping Systems | 88 |
| Part 7 | Materials | 88 |
| A323 | General Requirements | 88 |
| A325 | Materials — Miscellaneous | 89 |
| Part 8 | Standards for Piping Components | 89 |
| A326 | Dimensions and Ratings of Components | 89 |
| Part 9 | Fabrication, Assembly, and Erection | 90 |
| A327 | General | 90 |
| A328 | Bonding of Plastics | 90 |
| A329 | Fabrication of Piping Lined With Nonmetals | 96 |
| A332 | Bending and Forming | 96 |
| A334 | Joining Nonplastic Piping | 96 |
| A335 | Assembly and Erection | 96 |
| Part 10 | Inspection, Examination, and Testing | 97 |
| A340 | Inspection | 97 |
| A341 | Examination | 97 |
| A342 | Examination Personnel | 98 |
| A343 | Examination Procedures | 98 |

| | | |
|---------------------|-------------------------------------------------------------------------------|------------|
| A344 | Types of Examination | 98 |
| A345 | Testing | 98 |
| A346 | Records | 99 |
| Chapter VIII | Piping for Category M Fluid Service | 100 |
| M300 | General Statements | 100 |
| Part 1 | Conditions and Criteria | 100 |
| M301 | Design Conditions | 100 |
| M302 | Design Criteria | 100 |
| Part 2 | Pressure Design of Metallic Piping Components | 101 |
| M303 | General | 101 |
| M304 | Pressure Design of Metallic Components | 101 |
| Part 3 | Fluid Service Requirements for Metallic Piping Components | 101 |
| M305 | Pipe | 101 |
| M306 | Metallic Fittings, Bends, Miters, Laps, and Branch Connections | 101 |
| M307 | Metallic Valves and Specialty Components | 101 |
| M308 | Flanges, Blanks, Flange Facings, and Gaskets | 102 |
| M309 | Bolting | 102 |
| Part 4 | Fluid Service Requirements for Metallic Piping Joints | 102 |
| M310 | Metallic Piping, General | 102 |
| M311 | Welded Joints in Metallic Piping | 102 |
| M312 | Flanged Joints in Metallic Piping | 102 |
| M313 | Expanded Joints in Metallic Piping | 102 |
| M314 | Threaded Joints in Metallic Piping | 102 |
| M315 | Tubing Joints in Metallic Piping | 102 |
| M316 | Caulked Joints | 102 |
| M317 | Soldered and Brazed Joints | 102 |
| M318 | Special Joints in Metallic Piping | 102 |
| Part 5 | Flexibility and Support of Metallic Piping | 103 |
| M319 | Flexibility of Metallic Piping | 103 |
| M321 | Piping Support | 103 |
| Part 6 | Systems | 103 |
| M322 | Specific Piping Systems | 103 |
| Part 7 | Metallic Materials | 103 |
| M323 | General Requirements | 103 |
| M325 | Material – Miscellaneous | 103 |
| Part 8 | Standards for Piping Components | 103 |
| M326 | Dimensions and Ratings of Components | 103 |
| Part 9 | Fabrication, Assembly, and Erection of Metallic Piping | 104 |
| M327 | General | 104 |
| M328 | Welding of Metals | 104 |
| M330 | Preheating of Metals | 104 |
| M331 | Heat Treatment of Metals | 104 |
| M332 | Bending and Forming of Metals | 104 |
| M335 | Assembly and Erection of Metallic Piping | 104 |
| Part 10 | Inspection, Examination, Testing, and Records of Metallic Piping | 104 |
| M340 | Inspection | 104 |
| M341 | Examination | 104 |
| M342 | Examination Personnel | 105 |
| M343 | Examination Procedures | 105 |
| M344 | Types of Examination | 105 |
| M345 | Testing | 105 |
| M346 | Records | 105 |

| | |
|---------------------------------------------------------------------------------------------------------------------|-----|
| Parts 11 Through 20, Corresponding to Chapter VII | 105 |
| MA300 General Statements | 105 |
| Part 11 Conditions and Criteria | 105 |
| MA301 Design Conditions | 105 |
| MA302 Design Criteria | 105 |
| Part 12 Pressure Design of Nonmetallic Piping Components | 105 |
| MA303 General | 105 |
| MA304 Pressure Design of Nonmetallic Components | 105 |
| Part 13 Fluid Service Requirements for Nonmetallic Piping Components | 105 |
| MA305 Pipe | 105 |
| MA306 Nonmetallic Fittings, Bends, Miters, Laps, and Branch Connections | 105 |
| MA307 Nonmetallic Valves and Specialty Components | 105 |
| MA308 Flanges, Blanks, Flange Facings, and Gaskets | 106 |
| MA309 Bolting | 106 |
| Part 14 Fluid Service Requirements for Nonmetallic Piping Joints | 106 |
| MA310 General | 106 |
| MA311 Bonded Joints | 106 |
| MA312 Flanged Joints | 106 |
| MA313 Expanded Joints | 106 |
| MA314 Threaded Joints | 106 |
| MA315 Tubing Joints in Nonmetallic Piping | 106 |
| MA316 Caulked Joints | 106 |
| MA318 Special Joints | 106 |
| Part 15 Flexibility and Support of Nonmetallic Piping | 106 |
| MA319 Piping Flexibility | 106 |
| MA321 Piping Support | 106 |
| Part 16 Nonmetallic and Nonmetallic Lined Systems | 106 |
| MA322 Specific Piping Systems | 106 |
| Part 17 Nonmetallic Materials | 106 |
| MA323 General Requirements | 106 |
| Part 18 Standards for Nonmetallic and Nonmetallic Lined Piping Components | 106 |
| MA326 Dimensions and Ratings of Components | 106 |
| Part 19 Fabrication, Assembly and Erection of Nonmetallic and Nonmetallic Lined Piping | 106 |
| MA327 General | 106 |
| MA328 Bonding of Plastics | 107 |
| MA329 Fabrication of Piping Lined With Nonmetals | 107 |
| MA332 Bending and Forming | 107 |
| MA334 Joining of Nonplastic Piping | 107 |
| MA335 Assembly and Erection | 107 |
| Part 20 Inspection, Examination, Testing, and Records of Nonmetallic and Nonmetallic Lined Piping | 107 |
| MA340 Inspection | 107 |
| MA341 Examination | 107 |
| MA342 Examination Personnel | 107 |
| MA343 Examination Procedures | 107 |
| MA344 Types of Examination | 107 |
| MA345 Testing | 107 |
| MA346 Records | 107 |
| Chapter IX High Pressure Piping | 108 |
| K300 General Statements | 108 |
| Part 1 Conditions and Criteria | 108 |
| K301 Design Conditions | 108 |
| K302 Design Criteria | 109 |

| | | |
|-------------------|---------------------------------------------------------------|-----|
| Part 2 | Pressure Design of Piping Components | 111 |
| K303 | General | 111 |
| K304 | Pressure Design of High Pressure Components | 111 |
| Part 3 | Fluid Service Requirements for Piping Components | 114 |
| K305 | Pipe | 114 |
| K306 | Fittings, Bends, and Branch Connections | 115 |
| K307 | Valves and Specialty Components | 115 |
| K308 | Flanges, Blanks, Flange Facings, and Gaskets | 115 |
| K309 | Bolting | 116 |
| Part 4 | Fluid Service Requirements for Piping Joints | 116 |
| K310 | General | 116 |
| K311 | Welded Joints | 116 |
| K312 | Flanged Joints | 116 |
| K313 | Expanded Joints | 116 |
| K314 | Threaded Joints | 116 |
| K315 | Tubing Joints | 116 |
| K316 | Caulked Joints | 116 |
| K317 | Soldered and Brazed Joints | 116 |
| K318 | Special Joints | 117 |
| Part 5 | Flexibility and Support | 117 |
| K319 | Flexibility | 117 |
| K321 | Piping Support | 117 |
| Part 6 | Systems | 117 |
| K322 | Specific Piping Systems | 117 |
| Part 7 | Materials | 118 |
| K323 | General Requirements | 118 |
| K325 | Miscellaneous Materials | 121 |
| Part 8 | Standards for Piping Components | 121 |
| K326 | Dimensions and Ratings of Components | 121 |
| Part 9 | Fabrication, Assembly, and Erection | 121 |
| K327 | General | 121 |
| K328 | Welding | 121 |
| K330 | Preheating | 124 |
| K331 | Heat Treatment | 125 |
| K332 | Bending and Forming | 126 |
| K333 | Brazing and Soldering | 126 |
| K335 | Assembly and Erection | 126 |
| Part 10 | Inspection, Examination, and Testing | 127 |
| K340 | Inspection | 127 |
| K341 | Examination | 127 |
| K342 | Examination Personnel | 127 |
| K343 | Examination Procedures | 127 |
| K344 | Types of Examination | 127 |
| K345 | Testing | 129 |
| K346 | Records | 129 |
| Appendices | | |
| 300.1.1 | Diagram Illustrating Application of B31.3 Piping at Equipment | 3 |
| 302.3.5 | Stress Range Factor, f | 16 |
| 304.2.1 | Nomenclature for Pipe Bends | 19 |
| 304.2.3 | Nomenclature for Miter Bends | 19 |
| 304.3.3 | Branch Connection Nomenclature | 21 |
| 304.3.4 | Extruded Outlet Header Nomenclature | 23 |
| 304.5.3 | Blanks | 27 |
| 319.4.4A | Moments in Bends | 37 |
| 319.4.4B | Moments in Branch Connections | 37 |

| | | |
|---------------|-------------------------------------------------------------------------------------------------|-----|
| 323.2.2A | Minimum Temperatures Without Impact Testing for Carbon Steel Materials | 45 |
| 323.2.2B | Reduction in Minimum Design Metal Temperature Without Impact Testing | 47 |
| 328.3.2 | Typical Backing Rings and Consumable Inserts | 57 |
| 328.4.2 | Typical Butt Weld End Preparation | 57 |
| 328.4.3 | Trimming and Permitted Misalignment | 57 |
| 328.4.4 | Preparation for Branch Connections | 58 |
| 328.5.2A | Fillet Weld Size | 59 |
| 328.5.2B | Typical Details for Double-Welded Slip-On and Socket Welding Flange Attachment Welds | 59 |
| 328.5.2C | Minimum Welding Dimensions for Socket Welding Components Other Than Flanges | 60 |
| 328.5.4A | Typical Welded Branch Connections | 60 |
| 328.5.4B | Typical Welded Branch Connections | 60 |
| 328.5.4C | Typical Welded Branch Connections | 60 |
| 328.5.4D | Acceptable Details for Branch Attachment Welds | 60 |
| 328.5.4E | Acceptable Details for Branch Attachment Suitable for 100% Radiography | 61 |
| 328.5.5 | Typical Fabricated Laps | 61 |
| 335.3.3 | Typical Threaded Joints Using Straight Threads | 68 |
| 341.3.2 | Typical Weld Imperfections | 73 |
| A328.5 | Typical Plastic Piping Joints | 95 |
| K323.3.3 | Example of an Acceptable Impact Test Specimen | 121 |
| K328.4.3 | Pipe Bored for Alignment: Trimming and Permitted Misalignment | 124 |
| K328.5.4 | Some Acceptable Welded Branch Connection Suitable for 100% Radiography | 125 |
| Tables | | |
| 300.4 | Status of Appendices in B31.3 | 8 |
| 302.3.3C | Increased Casting Quality Factors, E_c | 14 |
| 302.3.3D | Acceptance Levels for Castings | 14 |
| 302.3.4 | Longitudinal Weld Joint Quality Factor, E_j | 15 |
| 304.1.1 | Values of Coefficient Y for $2 < L/b < 6$ | 18 |
| 304.4.1 | BPV Code References for Closures | 25 |
| 308.2.1 | Permissible Sizes/Fatigue Classes for Slip-On Flanges Used as Lapped Flanges | 30 |
| 314.2.1 | Minimum Thickness of Male Threaded Components | 32 |
| 323.2.2 | Requirement for Low Temperature Toughness Tests for Metals | 43 |
| 323.2.2A | Tabular Values for Minimum Temperatures Without Impact Testing for Carbon Steel Materials | 46 |
| 323.3.1 | Impact Testing Requirements for Metals | 48 |
| 323.3.4 | Charpy Impact Test Temperature Reduction | 49 |
| 323.3.5 | Minimum Required Charpy V-Notch Impact Values | 50 |
| 326.1 | Component Standards | 53 |
| 330.1.1 | Preheat Temperatures | 63 |
| 331.1 | Requirements for Heat Treatment | 64 |
| 341.3.2 | Acceptance Criteria for Welds and Examination Methods for Evaluating Weld Imperfections | 70 |
| A323.2.2 | Requirements for Low Temperature Toughness Tests for Nonmetals | 89 |
| A323.4.2C | Recommended Temperature Limits for Reinforced Thermosetting Resin Pipe | 89 |
| A323.4.3 | Recommended Temperature Limits for Thermoplastics Used as Linings | 90 |
| A326.1 | Component Standards | 91 |
| A341.3.2 | Acceptance Criteria for Bonds | 98 |
| K302.3.3D | Acceptable Severity Levels for Steel Castings | 111 |

| | | |
|-------------------|---------------------------------------------------------------------------------------------------|-----|
| K305.1.2 | Required Ultrasonic or Eddy Current Examination of Pipe and Tubing for Longitudinal Defects | 115 |
| K323.3.1 | Impact Testing Requirements | 120 |
| K323.3.5 | Minimum Required Charpy V-Notch Impact Values | 122 |
| K326.1 | Component Standards | 123 |
| K341.3.2 | Acceptance Criteria for Welds | 128 |
| Appendices | | |
| Appendix A | Allowable Stresses and Quality Factors for Metallic Piping and Bolting | |
| | Materials | 131 |
| | Specification Index for Appendix A | 132 |
| | Notes for Appendix A Tables | 135 |
| | Table A-1 Basic Allowable Stresses in Tension for Metals | 135 |
| | Iron | |
| | Castings | 135 |
| | Carbon Steel | |
| | Pipes and Tubes | 140 |
| | Pipes (Structural Grade) | 144 |
| | Plates and Sheets | 144 |
| | Plates and Sheets (Structural) | 146 |
| | Forgings and Fittings | 146 |
| | Castings | 146 |
| | Low and Intermediate Alloy Steel | |
| | Pipes | 148 |
| | Plates | 150 |
| | Forgings and Fittings | 152 |
| | Castings | 154 |
| | Stainless Steel | |
| | Pipes and Tubes | 156 |
| | Plates and Sheets | 160 |
| | Forgings and Fittings | 162 |
| | Bar | 166 |
| | Castings | 166 |
| | Copper and Copper Alloy | |
| | Pipes and Tubes | 168 |
| | Plates and Sheets | 168 |
| | Forgings | 170 |
| | Castings | 170 |
| | Nickel and Nickel Alloy | |
| | Pipes and Tubes | 172 |
| | Plates and Sheets | 174 |
| | Forgings and Fittings | 176 |
| | Rod and Bar | 178 |
| | Castings | 178 |
| | Titanium and Titanium Alloy | |
| | Pipes and Tubes | 180 |
| | Plates and Sheets | 180 |
| | Forgings | 180 |
| | Zirconium and Zirconium Alloy | |
| | Pipes and Tubes | 180 |
| | Plates and Sheets | 180 |
| | Forgings and Bar | 180 |
| | Aluminum Alloy | |
| | Seamless Pipes and Tubes | 182 |
| | Welded Pipes and Tubes | 183 |
| | Structural Tubes | 183 |
| | Plates and Sheets | 184 |
| | Forgings and Fittings | 186 |
| | Castings | 187 |

| | |
|----------------------------------------------------------------------------------------------------------------------------|-----|
| Table A-1A Basic Casting Quality Factors, E_c | 188 |
| Table A-1B Basic Quality Factors for Longitudinal Weld Joints in Pipes, Tubes, and Fittings, E_j | 189 |
| Carbon Steel | 189 |
| Low and Intermediate Alloy Steel | 189 |
| Stainless Steel | 190 |
| Copper and Copper Alloy | 190 |
| Nickel and Nickel Alloy | 191 |
| Titanium and Titanium Alloy | 191 |
| Zirconium and Zirconium Alloy | 191 |
| Aluminum Alloy | 191 |
| Table A-2 Design Stress Values for Bolting Materials | 192 |
| Carbon Steel | 192 |
| Alloy Steel | 192 |
| Stainless Steel | 192 |
| Copper and Copper Alloy | 198 |
| Nickel and Nickel Alloy | 198 |
| Aluminum Alloy | 200 |
| Appendix B Stress Tables and Allowable Pressure Tables for Nonmetals | 202 |
| Appendix C Physical Properties of Piping Materials | 207 |
| Appendix D Flexibility and Stress Intensification Factors | 224 |
| Appendix E Reference Standards | 228 |
| Appendix F Precautionary Considerations | 234 |
| Appendix G Safeguarding | 238 |
| Appendix H Sample Calculations for Branch Reinforcement | 239 |
| Appendix J Nomenclature | 243 |
| Appendix K Allowable Stresses for High Pressure Piping | 254 |
| Appendix L Aluminum Alloy Pipe Flanges | 268 |
| Appendix M Guide to Classifying Fluid Services | 271 |
| Appendix P Alternative Rules for Evaluating Stress Range | 273 |
| Appendix Q Quality System Program | 275 |
| Appendix S Piping System Stress Analysis Examples | 276 |
| Appendix V Allowable Variations in Elevated Temperature Service | 289 |
| Appendix X Metallic Bellows Expansion Joints | 291 |
| Appendix Z Preparation of Technical Inquiries | 296 |
| Index | 297 |

FOREWORD

Responding to evident need and at the request of The American Society of Mechanical Engineers, 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. 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 last 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 redesignated as ASME/ANSI B31.3-1987 Edition.

Addenda to subsequent Editions, published at three-year intervals, have been primarily to keep the Code up-to-date. New Appendices have been 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 are being made in the Introduction and Scope statements of B31.3, and its title is changed to Process Piping.

Under direction of ASME Codes and Standards management, metric units of measurement are being emphasized. With certain exceptions, SI metric units were listed first in the 1996 Edition and were designated as the standard. Instructions for conversion are given where metric data

are not available. U.S. customary units also are given. By agreement, either system may be used.

In this Edition of the Code, SI metric units are given first, with U.S. customary units in parentheses. Appendices H and X, the tables in Appendices A and K, and Tables C-1, C-3, and C-6 in Appendix C are exceptions. Values in metric units are to be regarded as the standard, unless otherwise agreed between the contracting parties. Instructions are given, in those tables that have not been converted for converting tabular data in U.S. units to appropriate SI units.

Interpretations and Code Cases are published on the ASME website. Go to <http://cstools.asme.org>, click on Committee Central, click on Board on Pressure Technology Codes and Standards, click on B31 Code for Pressure Piping Standards Committee, and then click on B31.3 Process Piping Section Committee.

ASME CODE FOR PRESSURE PIPING, B31

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

OFFICERS

D. R. Frikken, *Chair*
K. C. Bodenhamer, *Vice Chair*
P. D. Stumpf, *Secretary*

COMMITTEE PERSONNEL

| | |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| H. A. Ainsworth , Consultant | E. Michalopoulos , Consultant |
| R. J. T. Appleby , ExxonMobil Upstream Research Co. | M. L. Nayyar , Bechtel Power Corp. |
| C. Becht IV , Becht Engineering Co. | T. J. O'Grady II , Veco Alaska |
| A. E. Beyer , Fluor Daniel | R. G. Payne , Alstom Power Inc. |
| K. C. Bodenhamer , Enterprise Products Co. | J. T. Powers , Parsons Energy & Chemicals |
| J. S. Chin , El Paso Corp. | E. H. Rinaca , Consultant |
| D. L. Coym , Worley Parsons | M. J. Rosenfeld , Kiefner & Associates Inc. |
| D. M. Fox , Atmos Energy | R. J. Silvia , Process Engineers and Constructors Inc. |
| J. W. Frey , Stress Engineering Services, Inc. | W. J. Sperko , Sperko Engineering Services Inc. |
| D. R. Frikken , Becht Engineering Co. | G. W. Spohn III , Coleman Spohn Corp. |
| R. A. Grichuk , Fluor Corp. | P. D. Stumpf , The American Society of Mechanical Engineers |
| L. E. Hayden, Jr. , Engineering Consultant | A. L. Watkins , The Perry Nuclear Power Plant |
| G. A. Jolly , Consultant | R. B. West , State of Iowa Division of Labor Services |
| W. J. Koves , UOP LLC | P. D. Flenner , <i>Ex-Officio Member</i> , Flenner Engineering Services |
| R. P. Merrill , Evapco Inc. | R. W. Haupt , <i>Ex-Officio Member</i> , Pressure Piping Engineering Associates Inc. |
| J. E. Meyer , Louis Perry & Associates, Inc. | |

B31.3 PROCESS PIPING SECTION COMMITTEE

| | |
|----------------------------------------------------------------------------------|-------------------------------------------------------------|
| C. Becht IV , <i>Chair</i> , Becht Engineering Co. | T. W. Johnson , ABB Lummus Global Inc. |
| J. E. Meyer , <i>Vice Chair</i> , Louis Perry & Associates, Inc. | D. B. Kadakia , TD Williamson, Inc. |
| N. Lobo , <i>Secretary</i> , The American Society of Mechanical Engineers | W. J. Koves , UOP LLC |
| B. L. Agee , GE Gas Turbines | J. C. Luf , Washington Group International |
| R. M. Bojarczuk , ExxonMobil Research & Engineering Co. | W. N. McLean , Newco Valves |
| D. D. Christian , Victaulic | R. A. McLeod , General Electric Gas Turbines |
| D. L. Coym , Worley Parsons | R. J. Medvick , Swagelok |
| J. A. D'Avanzo , DuPont Engineering | V. B. Molina III , Air Products & Chemicals, Inc. |
| D. W. Diehl , COADE Inc. | C. A. Moore , Smith Fibercast |
| D. R. Edwards , ConocoPhillips | J. R. Offutt , Chevron |
| J. P. Ellenberger , Consultant | J. M. Prawdzik , BP |
| R. W. Engle , The Dow Chemical Co. | D. W. Raho , CCM 2000 |
| W. H. Eskridge, Jr. , Aker Kvaerner E&C | A. P. Rangus , Bechtel |
| D. J. Fetzner , BP Exploration Alaska Inc. | G. C. Reinhardt II , Team Industries Inc. |
| D. R. Fraser , NASA Ames Research Center | K. S. Shipley , Consulting Engineer |
| D. R. Frikken , Becht Engineering Co. | R. J. Silvia , Process Engineers & Constructors Inc. |
| D. C. Glover , Halliburton Technical Services Co. | J. L. Smith , Jacobs Engineering Group |
| O. R. Greulich , NASA | F. W. Tatar , FM Global |
| R. A. Grichuk , Fluor Corp. | Q. N. Truong , Refinery Technology Inc. |
| B. S. Harris , Consultant | G. E. Woods , Technip USA |
| R. W. Haupt , Pressure Piping Engineering Associates Inc. | R. J. Young , Consultant |
| J. F. Hodgins , Car-Ber Testing Services | C. G. Ziu , Orion Fittings, Inc. |
| R. D. Hookway , Hookway Engineering | J. T. Wier , <i>Honorary Member</i> , Consultant |

B31.3 SUBGROUP ON ACTIVITIES

G. A. Babuder, Swagelok Co.
B. C. Bassett, Consultant
R. K. Broyles, Senior Flexonics Pathway
G. Burnett, IPEX Inc.
M. A. Clark, NIBCO Inc.
E. P. Coghlan, LSI Logic
A. D'Angelo, Fix N Tow
R. B. Davis, Ershigs Inc.
P. J. Guerrieri, Sr., Integrated Mechanical Services, Inc.
D. A. McGriff, ISCO Industries, LLC

T. R. McPherson, IPS Corp.
A. D. Nalbandian, Thielsch Engineering Inc.
C. Nath, DuPont Engineering
G. J. Peak, Spears Manufacturing Co.
E. V. Peterson, Boeing
C. D. Pham, SBM Offshore Inc.
R. A. Sierra, Fluor
X. Tang, Swagelok Co.
L. S. Varone, Shaw Stone & Webster
C. T. Widder, Jacobs NTEC

B31.3 INTERNATIONAL REVIEW NETWORK OF EXPERTS

D. Saile, Shell Global Solutions International
R. W. Temple, Engineering Consultant

F. Zezula, BP Exploration Co.

B31 FABRICATION AND EXAMINATION COMMITTEE

P. D. Flenner, *Chair*, Flenner Engineering Services
P. D. Stumpf, *Secretary*, The American Society of Mechanical Engineers
J. P. Ellenberger, Consultant
R. J. Ferguson, Xaloy Inc.
D. J. Fetzner, BP Exploration Alaska Inc.
W. W. Lewis, E. I. DuPont
S. P. Licud, Consultant

A. D. Nalbandian, Thielsch Engineering Inc.
A. P. Rangus, Bechtel
R. I. Seals, Consultant
R. J. Silvia, Process Engineers & Constructors Inc.
W. J. Sperko, Sperko Engineering Services Inc.
E. F. Summers, Jr., Babcock & Wilcox Construction Co.
P. L. Vaughan, Northern Plains Natural Gas Co. LLC

B31 MATERIALS TECHNICAL COMMITTEE

M. L. Nayyar, *Chair*, Bechtel Power Corp.
N. Lobo, *Secretary*, The American Society of Mechanical Engineers
M. H. Barnes, Sebesta Blomberg & Associates
J. A. Cox, Consultant
R. P. Deubler, BGA Engineering
P. J. Dobson, Cummings & Barnard Inc.
W. H. Eskridge, Jr., Aker Kvaerner E&C
R. A. Grichuk, Fluor Corp.

C. L. Henley, Black and Veatch
R. P. Merrill, Evapco Inc.
D. W. Rahoji, CCM 2000
R. A. Schmidt, Hackney Ladish Inc.
H. R. Simpson, PM&C Engineering
J. L. Smith, Jacobs Engineering Group
Z. Djilali, *Corresponding Member*, BEREP

B31 MECHANICAL DESIGN TECHNICAL COMMITTEE

R. W. Haupt, *Chair*, Pressure Piping Engineering Associates Inc.
T. Lazar, *Secretary*, The American Society of Mechanical Engineers
G. A. Antaki, Washington Group
C. Becht IV, Becht Engineering Co.
J. P. Breen, Alion Science and Technology
J. P. Ellenberger, Consultant
D. J. Fetzner, BP Exploration Alaska Inc.
J. A. Graziano, Tennessee Valley Authority
J. D. Hart, SSD, Inc.
B. P. Holbrook, Babcock Power Inc.
W. J. Koves, UOP LLC

G. D. Mayers, Anteon Corp.
T. Q. McCawley, TQM Engineering PC
J. C. Minichiello, Bechtel National Inc. — WTP
T. J. O'Grady II, Veco Alaska
A. W. Paulin, Paulin Resource Group
R. A. Robleto, Senior Technical Advisor
M. J. Rosenfeld, Kiefner & Associates Inc.
G. Stevick, Berkeley Engineering & Research Inc.
E. A. Wais, Wais and Associates Inc.
E. C. Rodabaugh, *Honorary Member*, Consultant

B31 CONFERENCE GROUP

- T. A. Bell**, Bonneville Power Administration
G. Bynog, The National Board of Boiler and Pressure Vessel Inspectors
R. A. Coomes, Commonwealth of Kentucky
D. H. Hanrath, Consultant
C. J. Harvey, Alabama Public Service Commission
D. T. Jagger, Ohio Department of Commerce
M. Kotb, Engineer
K. T. Lau, Alberta Boilers Safety Association
R. G. Marini, New Hampshire Public Utilities Commission
I. W. Mault, Manitoba Department of Labour and Immigration
A. W. Meiring, Fire and Building Boiler and Pressure Vessel Division — Indiana
- R. F. Mullaney**, Boiler and Pressure Vessel Safety Branch — Vancouver
P. Sher, State of Connecticut
M. E. Skarda, Department of Labor
D. A. Starr, Nebraska Department of Labor
D. J. Stursma, Iowa Utilities Board
R. P. Sullivan, The National Board of Boiler and Pressure Vessel Inspectors
J. E. Troppman, Division of Labor/State of Colorado
C. H. Walters, National Board of Boiler and Pressure Vessel Inspectors
W. A. M. West, Lighthouse Assistance Inc.
T. F. Wickham, Rhode Island Department of Labor

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, chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants, and related processing plants and terminals

B31.4 Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids: piping transporting products which are predominately liquid between plants and terminals and within terminals, pumping, regulating, and metering stations

B31.5 Refrigeration Piping: piping for refrigerants and secondary coolants

B31.8 Gas Transportation and Distribution Piping Systems: piping transporting products which 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

B31.11 Slurry Transportation Piping Systems: piping transporting aqueous slurries between plants and terminals and within terminals, pumping, and regulating stations

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 which 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 the following:

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

To the greatest possible extent, Code requirements for design are stated in terms of basic design principles and formulas. These are supplemented, as necessary, with specific requirements to assure uniform application of principles and to guide selection and application of piping elements.

The Code prohibits designs and practices known to be unsafe and contains warnings where caution, but not prohibition, is warranted.

This Code Section includes 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 clauses 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.

It is intended that this edition of Code Section B31.3 not be retroactive. Unless agreement is specifically made between contracting parties to use another issue, or the regulatory body having jurisdiction imposes the use of another issue, the latest edition issued at least 6 months prior to the original contract date for the first phase of activity covering a piping installation shall be the governing document for all design, materials, fabrication, erection, examination, and testing for the piping until the completion of the work and initial operation.

Users of this Code are cautioned against making use of 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.

A Case is normally issued for a limited period. If at the end of that period it has been incorporated in the Code, or if no further use of its provisions is anticipated, it will be allowed to expire. Otherwise, it will be renewed for a limited period.

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 and Section VIII, Division 1, Appendix B. (To develop usage and gain experience, unlisted materials may be used in accordance with para. 323.1.2.) Metric versions of Tables A-1 and A-2 are in the course of preparation. Please refer to the B31.3 Process Piping Web pages at <http://cstools.asme.org/csconnect/CommitteePages.cfm>.

SUMMARY OF CHANGES

Following approval by the B31 Committee and ASME, and after public review, ASME B31.3-2006 was approved by the American National Standards Institute on November 14, 2006.

Changes given below are identified on the pages by a margin note, **(06)**, placed next to the affected area.

| <i>Page</i> | <i>Location</i> | <i>Change</i> |
|-------------|-----------------|-------------------------------------------------------------------------------------------------------------|
| 14 | 302.3.5(c) | Second sentence corrected by errata |
| 16 | Fig. 302.3.5 | Title corrected by errata |
| 17 | 302.3.5(e) | Revised |
| 18 | 304.1.2(a) | In eq. (3a), <i>W</i> added by errata |
| 20, 22 | 304.3.3(a) | In nomenclature for <i>t</i> , two parentheses in penultimate sentence deleted by errata |
| 26, 27 | 304.5.1 | Revised in its entirety |
| | 304.5.2 | Nomenclature for S_f corrected by errata |
| | 304.5.3 | (1) Subparagraph (a) added and existing text designated as (b) (2) In eq. (15), <i>W</i> added by errata |
| | 304.7.2 | Title and first paragraph revised |
| 30 | 307.2 | Subparagraph 307.2.2 added and existing text designated as para. 307.2.1 |
| | Table 308.2.1 | Column for PN deleted |
| 31 | 309.2.1 | Revised |
| | 309.2.2 | Revised |
| 35, 36 | 319.3.6 | Revised |
| 52 | 326.1.2 | Revised |
| 54 | Table 326.1 | Under Miscellaneous, title of MSS SP-73 revised |
| 55 | 328.2.2(e) | Revised |
| 64 | Table 331.1.1 | In fourth column, first, second, third, fourth, third-to-last, and second-to-last entries revised |
| 70 | Table 341.3.2 | Under Examination Methods, Visual, sixth entry corrected by errata |
| 76 | 344.6.1 | Cross-references in first paragraph and subparagraph (a) revised |
| 78 | 345.4.2(c) | Revised |
| 81 | A302.3 | Title revised |
| | A302.3.2 | In footnote 1, titles of ASTM D 2321 and D 2837 revised |

| <i>Page</i> | <i>Location</i> | <i>Change</i> |
|-------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 82 | A304.1.2 | Title revised |
| 83 | A304.5 | Title revised |
| | A304.5.1 | Revised in its entirety |
| | A305 | Revised |
| | A306 | Title revised |
| 84 | A308.2.1 | Revised |
| | A309.3 | Revised |
| 88 | A323.2 | Title revised |
| 91, 92 | Table A326.1 | (1) Under Nonmetallic Fittings, titles revised for ASTM D 2467, D 3309, D 4024, and F 439 (2) Under Nonmetallic Fittings, ASTM F 423, F 491, F 492, F 546, F 599, and F 781 deleted (3) Under Nonmetallic Pipes and Tubes, titles revised for ASTM D 2672, D 3035, D 3309, F 441, and F 1673 (4) Under Nonmetallic Pipes and Tubes, ASTM F 423, F 491, F 492, F 546, F 599, and F 781 deleted (5) Under Miscellaneous, titles revised for ASTM D 2564 and D 2672 |
| 93 | A328.2.5(b) | Footnote 5 revised |
| 94 | A328.5.5 | Reference to footnote 5 added |
| 97 | A335.4.1 | Revised |
| 101 | M306.4.2(b) | Revised |
| 106 | MA323.4.2 | Revised |
| 108 | K300(a) | Revised |
| 111, 112 | K304.1.2 | Revised in its entirety |
| 118 | K323.1.1 | Revised in its entirety |
| 119 | K323.3.4(a) | Revised |
| 122 | K328.2.5 | Deleted |
| 123 | Table K326.1 | ASME B1.20.1 added |
| 124 | K328.4.3(a)(1) | In fourth line, measurement corrected by errata to read 1.5 mm |
| 127 | K341.4.1(b)(1) | Revised |
| 135, 137 | Notes for Appendix A Tables | In Note (75), metric tabular values added by errata |
| 144 | Table A-1 | Under Carbon Steel, Pipes and Tubes, for API 5L Grades X65, X70, and X80, Note (77) added by errata |

| <i>Page</i> | <i>Location</i> | <i>Change</i> |
|-------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 152, 153 | Table A-1 | Under Low and Intermediate Alloy Steel, Forgings and Fittings, for $1\frac{1}{4}\text{Cr}-\frac{1}{2}\text{Mo}$ A 234, Grade corrected by errata to read WP11 |
| 166 | Table A-1 | Under Stainless Steel, Castings, for A 351 Grade CD3M-W-Cu-N, S-No. corrected by errata to read S-10H |
| 176, 177 | Table A-1 | Under Nickel and Nickel Alloy, Plates and Sheets, third B 688 N08367 deleted by errata |
| 182 | Table A-1 | Under Aluminum Alloy, Seamless Pipes and Tubes, B 241 Grade 5652 deleted |
| 193 | Table A-2 | Under Carbon Steel, for A 194, Grade 2 transferred from first line to second line by errata |
| 203 | Specification Index for Appendix B | Titles revised for ASTM D 2672, D 3035, and D 3309 |
| 205 | Table B-1 | For PEEK material, maximum recommended Celsius temperature corrected by errata to read 230 |
| 228–233 | Appendix E | <ol style="list-style-type: none"> (1) First paragraph revised (2) ASTM A 508/A 508M, A 723/A 723M, B 338, B 363, D 1527, D 1600, D 1785 through D 2282, D 2321 through D 2467, D 2513 through D 2657, D 2672 through D 2855, D 3035 through D 3839, D 4024, E213, F 336, F 438, F 439, F 441/F 441M, F 493, and F 1055 through F 1673 updated (3) ASTM B 861, D 6041, F 714, and F 1970 added (4) ASTM F 423, F 491, F 492, F 546, F 599, and F 781 deleted (5) AISC M016 added (6) For ASME publications, years deleted (7) MSS SP-53 and SP-73 updated (8) PFI ES-7 updated (9) Addresses for AISC, CGA, PPI, and ANSI updated |
| 243–253 | Appendix J | <ol style="list-style-type: none"> (1) For c, D, E, I_i, P, S, S_A, S_E, S_{hr}, S_L, \bar{T}, t, $t_{m'}$ and Y, para. S300 added by errata (2) For E_{ar}, para. P319.4.4 added by errata (3) Entries for F_{ar}, f, and f_m corrected by errata (4) For second N_E and N_i entries, reference transferred into Paragraph column by errata |

| <i>Page</i> | <i>Location</i> | <i>Change</i> |
|-------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|
| | | (5) Entries for P_i , S_{cr} , and T_j corrected by errata (6) Definition for S_{om} corrected by errata (7) Revised |
| 254 | Appendix K | (1) ASTM B 337 deleted (2) ASTM B 861 added |
| 266, 267 | Table K-1 | Under Titanium and Titanium Alloy, all lines revised |
| 268 | L300 | Revised |
| 269 | Table L301.2M | Column heads revised |
| | L303.2.3 | Revised |
| | L303.3.2 | Revised |
| 272 | Fig. M300 | In Col. 3, fourth box, cross-reference corrected by errata to read para. 300(d)(4) |
| 273 | P302.3.5 | (1) First paragraph corrected by errata (2) Nomenclatures for eqs. (P1a) and (P1d) deleted by errata |
| 276 | S300.1 | Revised |
| 280–288 | S302 | Added |
| | S303 | Added |
| 292 | X302.1.2(c) | Corrected by errata |
| 293 | Fig. X302.1.3 | General Note (a) revised |
| 295 | X302.2.2(b) | In third line, measurement corrected by errata to read 2.4 mm |
| | X302.2.3 | Revised in its entirety |

NOTES:

- (1) The interpretations to ASME B31.3 issued between November 1, 2003 and October 31, 2005 follow the last page of this edition as a separate supplement, Interpretations Volume 20.
- (2) After the interpretations, a separate supplement containing Case 178 follows.

Page intentionally blank

Chapter I

Scope and Definitions

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 which 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 certain fluid services and for determining if a specific Quality System is to be employed. [See paras. 300(d)(4), (d)(5), (e), and Appendix Q.]

(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. The provisions of this Code may optionally be applied for those purposes, although other considerations may also be necessary.

(3) Engineering requirements of this Code, while considered necessary and adequate for safe design, generally employ a simplified approach to the subject. A designer capable of applying a more rigorous analysis

shall have the latitude to do so; however, the approach must be documented in the engineering design and its validity accepted by the owner. The approach used shall provide details of design, construction, examination, inspection, and testing for the design conditions of para. 301, with calculations consistent with the design criteria of this Code.

(4) Piping elements should, insofar as practicable, conform to the specifications and standards listed in this Code. Piping elements neither specifically approved nor specifically prohibited by this Code may be used provided they are qualified for use as set forth in applicable Chapters of this Code.

(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 para. 300.2 and Appendix G). Code requirements for a piping system are the most restrictive of those which apply to any of its elements.

(2) For metallic piping not in Category M or high pressure fluid service, 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

(3) For nonmetallic piping and piping lined with nonmetals, all requirements are found in Chapter VII. (Paragraph designations begin with "A.")

(4) For piping in a fluid service designated by the owner as Category M (see para. 300.2 and Appendix M), all requirements are found in Chapter VIII. (Paragraph designations begin with "M.")

(5) For piping in a fluid service designated by the owner as Category D (see para. 300.2 and Appendix M),

piping elements restricted to Category D Fluid Service in Chapters I through VII, as well as elements suitable for other fluid services, may be used.

(6) Metallic piping elements suitable for Normal Fluid Service in Chapters I through VI may also be used under severe cyclic conditions unless a specific requirement for severe cyclic conditions is stated.

(e) *High Pressure Piping.* Chapter IX provides alternative rules for design and construction of piping designated by the owner as being in High Pressure Fluid Service.

(1) These rules apply only when specified by the owner, and only as a whole, not in part.

(2) Chapter IX rules do not provide for Category M Fluid Service. See para. K300.1.4.

(3) Paragraph designations begin with "K."

(f) *Appendices.* Appendices of this Code contain Code requirements, supplementary guidance, or other information. See para. 300.4 for a description of the status of each Appendix.

300.1 Scope

Rules for the Process Piping Code Section B31.3¹ have been developed considering piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants; and related processing plants and terminals.

300.1.1 Content and Coverage

(a) This Code prescribes requirements for materials and components, design, fabrication, assembly, erection, examination, inspection, and testing of piping.

(b) This Code applies to piping for all fluids, including

- (1) raw, intermediate, and finished chemicals
- (2) petroleum products
- (3) gas, steam, air, and water
- (4) fluidized solids
- (5) refrigerants
- (6) cryogenic fluids

(c) See Fig. 300.1.1 for a diagram illustrating the application of B31.3 piping at equipment. The joint connecting piping to equipment is within the scope of B31.3.

300.1.2 Packaged Equipment Piping. Also included within the scope of this Code is piping which interconnects pieces or stages within a packaged equipment assembly.

300.1.3 Exclusions. This Code excludes the following:

(a) piping systems designed for internal gage pressures at or above zero but less than 105 kPa (15 psi), provided the fluid handled is nonflammable, nontoxic, and not damaging to human tissues as defined in 300.2,

¹B31 references here and elsewhere in this Code are to the ASME B31 Code for Pressure Piping and its various Sections, which are identified and briefly described in the Introduction.

and its design temperature is from -29°C (-20°F) through 186°C (366°F)

(b) power boilers in accordance with BPV Code² Section I and boiler external piping which is required to conform to B31.1

(c) tubes, tube headers, crossovers, and manifolds of fired heaters, which are internal to the heater enclosure

(d) pressure vessels, heat exchangers, pumps, compressors, and other fluid handling or processing equipment, including internal piping and connections for external piping

300.2 Definitions

Some of the terms relating to piping are defined below. For welding, brazing, and soldering terms not shown here, definitions in accordance with AWS Standard A3.0³ apply.

air-hardened steel: a steel that hardens during cooling in air from a temperature above its transformation range.

anneal heat treatment: see *heat treatment*.

arc cutting: a group of cutting processes wherein the severing or removing of metals is effected by melting with the heat of an arc between an electrode and the base metal. (Includes carbon-arc cutting, metal-arc cutting, gas metal-arc cutting, gas tungsten-arc cutting, plasma-arc cutting, and air carbon-arc cutting.) See also *oxygen-arc cutting*.

arc welding (AW): a group of welding processes which produces coalescence of metals by heating them with an arc or arcs, with or without the application of pressure and with or without the use of filler metal.

assembly: the joining together of two or more piping components by bolting, welding, bonding, screwing, brazing, soldering, cementing, or use of packing devices as specified by the engineering design.

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

backing filler metal: see *consumable insert*.

backing ring: material in the form of a ring used to support molten weld metal.

balanced piping system: see para. 319.2.2(a).

²BPV Code references here and elsewhere in this Code are to the ASME Boiler and Pressure Vessel Code and its various Sections as follows:

- Section I, Power Boilers
- Section II, Materials, Part D
- Section V, Nondestructive Examination
- Section VIII, Pressure Vessels, Divisions 1 and 2
- Section IX, Welding and Brazing Qualifications

³AWS A3.0, Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Coupling and Thermal Spraying