

ASME B31.3-2022
(Revision of ASME B31.3-2020)

Process Piping

ASME Code for Pressure Piping, B31

AN INTERNATIONAL PIPING CODE®



**The American Society of
Mechanical Engineers**

Errata
to
ASME B31.3-2022
Process Piping

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

328.5.2 Fillet and Socket Welds

- (a) Fillet and socket welds may vary from convex to concave. The size of these welds shall be determined as shown in Figure 328.5.2A.
- (b) For any single continuous fillet weld greater than 5 mm ($3/16$ in.), the weld may be less than the specified fillet weld size by not more than 1.5 mm ($1/16$ in.), provided the total undersize portion of the weld does not exceed 10% of the total length of the weld or 50 mm (2 in.), whichever is less.
- (c) Minimum attachment weld dimensions for double-welded slip-on flanges, socket welding flanges, and other socket welding components shall be as shown in Figures 328.5.2A and 328.5.2C.
- (d) If slip-on flanges are single welded, the weld shall be at the hump, i.e., the X_{\min} by X_{\min} weld illustrated in Figure 328.5.2B.
- (e) In making socket welded joints, a gap as shown in Figure 328.5.2B, illustration (c) and Figure 328.5.2C shall be provided prior to welding. After welding, a gap is not required to be present or verified.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
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CONTENTS

Foreword	xi
Committee Roster	vi
Introduction	xxi
Summary of Changes	xxiii
Chapter I	
Scope and Definitions	1
300 General Statements	1
Chapter II	
Design	11
Part 1	
Conditions and Criteria	11
301 Design Conditions	11
302 Design Criteria	13
Part 2	
Pressure Design of Piping Components	22
303 General	22
304 Pressure Design of Components	22
Part 3	
Fluid Service Requirements for Piping Components	33
305 Pipe	33
306 Fittings, Bends, Miters, Laps, and Branch Connections	33
307 Valves and Specialty Components	35
308 Flanges, Blanks, Flange Facings, and Gaskets	35
309 Bolting	36
Part 4	
Fluid Service Requirements for Piping Joints	36
310 General	36
311 Welded Joints	36
312 Flanged Joints	37
313 Expanded Joints	37
314 Threaded Joints	37
315 Tubing Joints	38
316 Caulked Joints	38
317 Soldered and Brazed Joints	38
318 Special Joints	38
Part 5	
Flexibility and Support	39
319 Piping Flexibility	39
320 Analysis of Sustained Loads	44
321 Piping Support	45
Part 6	
Systems	47
322 Specific Piping Systems	47
Chapter III	
Materials	49
323 General Requirements	49
325 Materials — Miscellaneous	60

Chapter IV	Standards for Piping Components	61
326	Dimensions and Ratings of Components	61
Chapter V	Fabrication, Assembly, and Erection	65
327	General	65
328	Welding and Brazing	65
330	Preheating	73
331	Heat Treatment	75
332	Bending and Forming	81
333	Brazing and Soldering	81
335	Assembly and Erection	82
Chapter VI	Inspection, Examination, and Testing	84
340	Inspection	84
341	Examination	84
342	Examination Personnel	91
343	Examination Procedures	91
344	Examination Methods	92
345	Testing	93
346	Records	97
Chapter VII	Nonmetallic Piping and Piping Lined With Nonmetals	98
A300	General Statements	98
Part 1	Conditions and Criteria	98
A301	Design Conditions	98
A302	Design Criteria	98
Part 2	Pressure Design of Piping Components	100
A303	General	100
A304	Pressure Design of Piping Components	100
Part 3	Fluid Service Requirements for Piping Components	102
A305	Pipe	102
A306	Fittings, Bends, Miters, Laps, and Branch Connections	102
A307	Valves and Specialty Components	102
A308	Flanges, Blanks, Flange Facings, and Gaskets	102
A309	Bolting	103
Part 4	Fluid Service Requirements for Piping Joints	103
A310	General	103
A311	Bonnet Joints in Plastics	103
A312	Flanged joints	103
A313	Expanded Joints	103
A314	Threaded Joints	103
A315	Tubing Joints	104
A316	Caulked Joints	104
A318	Special Joints	104
Part 5	Flexibility and Support	104
A319	Flexibility of Nonmetallic Piping and Piping Lined With Nonmetals	104
A321	Piping Support	106
Part 6	Systems	106

A322	Specific Piping Systems	106
Part 7	Materials	107
A323	General Requirements	107
A325	Materials — Miscellaneous	108
Part 8	Standards for Piping Components	108
A326	Dimensions and Ratings of Components	108
Part 9	Fabrication, Assembly, and Erection	109
A327	General	109
A328	Bonding of Plastics	110
A329	Fabrication of Piping Lined With Nonmetals	115
A332	Bending and Forming	115
A334	Joining Nonplastic Piping	115
A335	Assembly and Erection	116
Part 10	Inspection, Examination, and Testing	117
A340	Inspection	117
A341	Examination	117
A342	Examination Personnel	117
A343	Examination Procedures	118
A344	Examination Methods	118
A345	Testing	118
A346	Records	118
Chapter VIII	Piping for Category M Fluid Service	119
M300	General Statements	119
Part 1	Conditions and Criteria	119
M301	Design Conditions	119
M302	Design Criteria	119
Part 2	Pressure Design of Metallic Piping Components	119
M303	General	119
M304	Pressure Design of Metallic Components	119
Part 3	Fluid Service Requirements for Metallic Piping Components	119
M305	Pipe	119
M306	Metallic Fittings, Bends, Miters, Laps, and Branch Connections	120
M307	Metallic Valves and Specialty Components	120
M308	Flanges, Blanks, Flange Facings, and Gaskets	120
M309	Welding	121
Part 4	Fluid Service Requirements for Metallic Piping Joints	121
M310	Metallic Piping, General	121
M311	Welded Joints in Metallic Piping	121
M312	Flanged Joints in Metallic Piping	121
M313	Expanded Joints in Metallic Piping	121
M314	Threaded Joints in Metallic Piping	121
M315	Tubing Joints in Metallic Piping	121
M316	Caulked Joints	121
M317	Soldered and Brazed Joints	121
M318	Special Joints in Metallic Piping	121

Part 5	Flexibility and Support of Metallic Piping	121
M319	Flexibility of Metallic Piping	121
M320	Analysis of Sustained Loads	121
M321	Piping Support	121
Part 6	Systems	122
M322	Specific Piping Systems	122
Part 7	Metallic Materials	122
M323	General Requirements	122
M325	Materials — Miscellaneous	122
Part 8	Standards for Piping Components	122
M326	Dimensions and Ratings of Components	122
Part 9	Fabrication, Assembly, and Erection of Metallic Piping	123
M327	General	123
M328	Welding of Metals	123
M330	Preheating of Metals	123
M331	Heat Treatment of Metals	123
M332	Bending and Forming of Metals	123
M335	Assembly and Erection of Metallic Piping	123
Part 10	Inspection, Examination, Testing, and Records of Metallic Piping	123
M340	Inspection	123
M341	Examination	123
M342	Examination Personnel	124
M343	Examination Procedures	124
M344	Examination Methods	124
M345	Testing	124
M346	Records	124
Parts 11–20	Corresponding to Chapter VII	124
MA300	General Statements	124
Part 11	Conditions and Criteria	124
MA301	Design Conditions	124
MA302	Design Criteria	124
Part 12	Pressure Design of Nonmetallic Piping Components	124
MA303	General	124
MA304	Pressure Design of Nonmetallic Components	124
Part 13	Fluid Service Requirements for Nonmetallic Piping Components	124
MA305	Pipe	124
MA306	Nonmetallic Fittings, Bends, Miters, Laps, and Branch Connections	124
MA307	Valves and Specialty Components	125
MA308	Flanges, Blanks, Flange Facings, and Gaskets	125
MA309	Bolting	125
Part 14	Fluid Service Requirements for Nonmetallic Piping Joints	125
MA310	General	125
MA311	Bonded Joints	125
MA312	Flanged Joints	125
MA313	Expanded Joints	125

MA314	Threaded Joints	125
MA315	Tubing Joints in Nonmetallic Piping	125
MA316	Caulked Joints	125
MA318	Special Joints	125
Part 15	Flexibility and Support of Nonmetallic Piping	125
MA319	Piping Flexibility	125
MA321	Piping Support	125
Part 16	Nonmetallic and Nonmetallic-Lined Systems	125
MA322	Specific Piping Systems	125
Part 17	Nonmetallic Materials	125
MA323	General Requirements	125
Part 18	Standards for Nonmetallic and Nonmetallic-Lined Piping Components	126
MA326	Dimensions and Ratings of Components	126
Part 19	Fabrication, Assembly, and Erection of Nonmetallic and Nonmetallic-Lined Piping	126
MA327	General	126
MA328	Bonding of Plastics	126
MA329	Fabrication of Piping Lined With Nonmetals	126
MA332	Bending and Forming	126
MA334	Joining Nonplastic Piping	126
MA335	Assembly and Erection	126
Part 20	Inspection, Examination, Testing, and Records of nonmetallic and Nonmetallic-Lined Piping	126
MA340	Inspection	126
MA341	Examination	126
MA342	Examination Personnel	126
MA343	Examination Procedures	126
MA344	Examination Methods	126
MA345	Testing	126
MA346	Records	126
Chapter IX	High Pressure Piping	127
K300	General Statement	127
Part 1	Conditions and Criteria	127
K301	Design Conditions	127
K302	Design Criteria	128
Part 2	Pressure Design of Piping Components	130
K303	General	130
K304	Pressure Design of High Pressure Components	130
Part 3	Fluid Service Requirements for Piping Components	133
K305	Pipe	133
K306	Fittings, Bends, and Branch Connections	134
K307	Valves and Specialty Components	134
K308	Flanges, Blanks, Flange Facings, and Gaskets	135
K309	Bolting	135
Part 4	Fluid Service Requirements for Piping Joints	135
K310	General	135

K311	Welded Joints	135
K312	Flanged Joints	135
K313	Expanded Joints	135
K314	Threaded Pipe Joints	135
K315	Tubing Joints	136
K316	Caulked Joints	136
K317	Soldered and Brazed Joints	136
K318	Special Joints	136
Part 5	Flexibility and Support	136
K319	Flexibility	136
K320	Analysis of Sustained Loads	137
K321	Piping Support	137
Part 6	Systems	137
K322	Specific Piping Systems	137
Part 7	Materials	137
K323	General Requirements	137
K325	Miscellaneous Materials	141
Part 8	Standards for Piping Components	141
K326	Requirements for Components	141
Part 9	Fabrication, Assembly, and Erection	143
K327	General	143
K328	Welding	143
K330	Preheating	145
K331	Heat Treatment	145
K332	Bending and Forming	146
K333	Brazing and Soldering	146
K335	Assembly and Erection	147
Part 10	Inspection, Examination, and Testing	147
K340	Inspection	147
K341	Examination	147
K342	Examination Personnel	148
K343	Examination Procedures	148
K344	Examination Methods	148
K345	Leak Testing	151
K346	Records	153
Chapter X	High-Purity Piping	154
U300	General Statements	154
Part 1	Conditions and Criteria	154
U301	Design Conditions	154
Part 2	Pressure Design of Piping Components	154
Part 3	Fluid Service Requirements for Piping Components	154
U306	Fittings, Bends, Miters, Laps, and Branch Connections	154
U307	Valves and Specialty Components	154
U308	Flanges, Blanks, Flange Facings, and Gaskets	154
Part 4	Fluid Service Requirements for Piping Joints	155

U311	Welded Joints	155
U314	Threaded Joints	155
U315	Tubing Joints	155
Part 5	Flexibility and Support	155
U319	Piping Flexibility	155
Part 6	Systems	156
Part 7	Metallic Materials	156
Part 8	Standards for Piping Components	156
Part 9	Fabrication, Assembly, and Erection	156
U327	General	156
U328	Welding	156
U330	Preheating	156
U331	Heat Treatment	157
U332	Bending and Forming	157
U333	Brazing and Soldering	157
U335	Assembly and Erection	157
Part 10	Inspection, Examination, and Testing	157
U340	Inspection	157
U341	Examination	158
U342	Examination Personnel	158
U343	Examination Procedures	159
U344	Examination Methods	159
U345	Testing	160
U346	Records	160
Part 11	High Purity Piping in Category M Fluid Service	160
UM300	General Statements	160
UM307	Metallic Valves and Specialty Components	160
UM322	Specific Piping Systems	160
UM328	Welding of Materials	161
UM335	Assembly and Erection of Metallic Piping	161
UM341	Examination	161
UM345	Testing	161
 Appendices		
A	Allowable Stresses and Quality Factors for Metallic Piping and Bolting Materials	162
B	Stress Tables and Allowable Pressure Tables for Nonmetals	394
C	Physical Properties of Piping Materials	402
D	Flexibility and Stress Intensification Factors	423
E	Reference Standards	424
F	Guidance and Precautionary Considerations	429
G	Safeguarding	436
H	Sample Calculations for Branch Reinforcement	438
J	Nomenclature	447
K	Allowable Stresses for High Pressure Piping	463
L	Aluminum Alloy Pipe Flanges	492

M	Guide to Classifying Fluid Services	495
N	Application of ASME B31.3 Internationally	497
Q	Quality System Program	498
R	Use of Alternative Ultrasonic Acceptance Criteria	499
S	Piping System Stress Analysis Examples	502
V	Allowable Variations in Elevated Temperature Service	517
W	High-Cycle Fatigue Assessment of Piping Systems	520
X	Metallic Bellows Expansion Joints	525
Z	Preparation of Technical Inquiries	529

Figures

300.1.1	Diagram Illustrating Application of B31.3 Piping at Equipment	3
302.3.5	Stress Range Factor, f	19
304.2.1	Nomenclature for Pipe Bends	24
304.2.3	Nomenclature for Miter Bends	24
304.3.3	Branch Connection Nomenclature	26
304.3.4	Extruded Outlet Header Nomenclature	28
304.5.3	Blanks	32
319.4.4A	Moments in Bends	42
319.4.4B	Moments in Branch Connections	43
323.2.2A	Minimum Temperatures Without Impact Testing for Carbon Steel Materials	52
323.2.2B	Reduction in Lowest Exemption Temperature for Steels Without Impact Testing	53
328.3.2	Typical Backing Rings and Consumable Inserts	67
328.4.2	Typical Butt Weld End Preparation	67
328.4.3	Trimming and Permitted Misalignment	68
328.4.4	Preparation for Branch Connections	69
328.5.2A	Fillet and Socket Weld Sizes	69
328.5.2B	Minimum Attachment Weld Dimensions for Double-Welded Slip-On and Socket Welding Flanges	69
328.5.2C	Minimum Attachment Weld Dimensions for Socket Welding Components Other Than Flanges	70
328.5.4A, B, C	Typical Welded Branch Connections	70
328.5.4D	Acceptable Details for Branch Attachment Welds	71
328.5.4E	Acceptable Details for Branch Attachments Suitable for 100% Radiography	71
328.5.4F	Acceptable Details for Integrally Reinforced Branch Connections	72
328.5.5	Typical Details for Fabricated Laps	73
335.3.3	Typical Threaded Joints Using Straight Threads	83
341.3.2	Typical Weld Imperfections	86
A328.5.3	Thermoplastic Solvent Cemented Joint	113
A328.5.4	Thermoplastic Heat Fusion Joints	114
A328.5.5	Thermoplastic Electrofusion Joints	114
A328.5.6	Fully Tapered Thermosetting Adhesive Joint	114
A328.5.7	Thermosetting Wrapped Joints	115
K323.3.3	Example of an Acceptable Impact Test Specimen	140
K328.4.3	Pipe Bored for Alignment: Trimming and Permitted Misalignment	144
K328.5.4	Some Acceptable Welded Branch Connections Suitable for 100% Radiography	145

U304.5.3	Blanks	155
U328.4.2	Modified Pipe End Preparations	157
U335.7.1	Face Seal Joints	158
U335.8A	Hygienic Clamp Joint Assembly	158
U335.8B	Hygienic Clamp Types	159
U335.8C	Hygienic Ferrules	159
H301	Illustrations for SI Units Examples in Appendix H	439
H311	Illustrations for U.S. Customary Units Examples in Appendix H	443
M300	Guide to Classifying Fluid Services	496
R307	Surface and Subsurface Flaws	500
S301.1	Example 1: Simple Code-Compliant Model	502
S302.1	Example 2: Lift-Off Model	508
S303.1	Example 3: Moment Reversal Model	511
 Tables		
300.4	Status of Appendices in ASME B31.3	10
302.3.3C	Increased Casting Quality Factors, E_c	16
302.3.3D	Acceptance Levels for Castings	17
302.3.4	Longitudinal Weld Joint Quality Factor, E_j	18
302.3.5	Weld Joint Strength Reduction Factor, W	20
304.1.1	Values of Coefficient Y for $t < D/6$	23
304.4.1	ASME BPVC References for Closures	30
308.2.1	Permissible Sizes/Rating Classes for Slip-On Flanges Used as Lapped Flanges	35
314.2.1	Minimum Schedule of Components With External Threads	38
323.2.2	Requirements for Low Temperature Toughness Tests for Metals	50
323.2.2A	Tabular Values for Minimum Temperatures Without Impact Testing for Carbon Steel Materials	54
323.2.2B	Tabular Values for Reduction in Lowest Exemption Temperature for Steels Without Impact Testing	56
323.3.1	Impact Testing Requirements for Metals	57
323.3.4	Charpy Impact Test Temperature Reduction	58
323.3.5	Minimum Required Charpy V-Notch Impact Values	59
326.1	Component Standards	62
330.1.1	Preheat Temperatures	74
331.1.1	Postweld Heat Treatment	76
331.1.2	Alternate Postweld Heat Treatment Requirements for Carbon and Low Alloy Steels, P-Nos. 1 and 3	77
331.1.3	Exemptions to Mandatory Postweld Heat Treatment	78
341.3.2	Acceptance Criteria for Welds — Visual and Radiographic Examination	87
A323.2.2	Requirements for Low Temperature Toughness Tests for Nonmetals	108
A323.4.2C	Recommended Temperature Limits for Reinforced Thermosetting Resin Pipe	108
A323.4.3	Recommended Temperature Limits for Thermoplastics Used as Linings	108
A326.1	Component Standards	110
A341.3.2	Acceptance Criteria for Bonds	117
K302.3.3D	Acceptable Severity Levels for Steel Castings	130

K305.1.2	Required Ultrasonic or Eddy Current Examination of Pipe and Tubing for Longitudinal Defects	134
K323.3.1	Impact Testing Requirements	139
K323.3.5	Minimum Required Charpy V-Notch Impact Values	141
K326.1	Component Standards	142
K341.3.2	Acceptance Criteria for Welds	149
	Criterion Value Notes for Table K341.3.2	150
	Specification Index for Appendix A	163
A-1	Basic Allowable Stresses in Tension for Metals	170
A-1M	Basic Allowable Stresses in Tension for Metals (SI Units)	250
A-1A	Basic Casting Quality Factors, E_c	360
A-1B	Basic Quality Factors for Longitudinal Weld Joints in Pipes and Tubes, E_j	362
A-2	Design Stress Values for Bolting Materials	368
A-2M	Design Stress Values for Bolting Materials (SI Units)	378
	Specification Index for Appendix B	395
B-1	Hydrostatic Design Stresses (HDS) and Recommended Temperature Limits for Thermoplastic Pipe	396
B-1M	Hydrostatic Design Stresses (HDS) and Recommended Temperature Limits for Thermoplastic Pipe (SI Units)	398
B-2	Listed Specifications for Laminated Reinforced Thermosetting Resin Pipe	399
B-3	Listed Specifications for Filament Wound and Centrifugally Cast Reinforced Thermosetting Resin and Reinforced Plastic Mortar Pipe	399
B-4	Allowable Pressures and Recommended Temperature Limits for Concrete Pipe	400
B-5	Allowable Pressures and Recommended Temperature Limits for Borosilicate Glass Pipe	400
B-6	Allowable Pressures and Recommended Temperature Limits for PEX-AL-PEX and PE-AL-PE Pipe	401
C-1	Thermal Expansion Data	403
C-1M	Thermal Expansion Data (SI Units)	406
C-5	Thermal Expansion Coefficients, Nonmetals	411
C-6	Moduli of Elasticity for Metals	413
C-6M	Moduli of Elasticity for Metals (SI Units)	417
C-8	Modulus of Elasticity for Nonmetals	421
	Specification Index for Appendix K	464
K-1	Allowable Stresses in Tension for Metals for Chapter IX	466
K-1M	Allowable Stresses in Tension for Metals for Chapter IX (SI Units)	480
L301.2M	Pressure–Temperature Ratings (SI Units)	493
L301.2U	Pressure–Temperature Ratings (U.S. Customary Units)	493
L303.2	Aluminum Bolting Materials	494
R308.1	Acceptance Criteria for Surface Flaws	501
R308.2	Acceptance Criteria for Subsurface Flaws	501
S301.1	Example 1: Pressure–Temperature Combinations	503
S301.3.1	Example 1: Generic Pipe Stress Model Input	503
S301.3.2	Example 1: Element Connectivity, Type, and Lengths	504
S301.5.1	Example 1: Operating Load Case Results: Internal Loads and Deflections	505
S301.5.2	Example 1: Operating Load Case Results: Reactions on Supports and Anchors	505

S301.6	Example 1: Sustained Forces, Moments, and Stresses [Allowable $S_h = 130.8$ MPa (19.0 ksi)]	506
S301.7	Example 1: Displacement Stress Range [Allowable, Eq. (1a), $S_A = 205.2$ MPa (29.75 ksi)]	507
S302.2	Example 2: Pressure–Temperature Combinations	508
S302.3	Example 2: Generic Pipe Stress Model Input: Component Connectivity, Type, and Lengths	509
S302.5	Example 2: Results for Operating Case: Reactions on Support and Anchors	509
S302.6.2	Example 2: Sustained Load Condition Listing	510
S302.6.3	Example 2: Sustained Forces, Moments, and Stresses for Sustained Condition 3 With Node 50's Y+ Support Inactive [Allowable $S_h = 127$ MPa (18.4 ksi): Fails]	511
S303.1	Example 3: Pressure–Temperature Combinations	512
S303.3	Example 3: Generic Pipe Stress Model Input: Component Connectivity, Type, and Lengths	513
S303.7.1	Example 3: Operating Case 1: Displacement Stress Range [Eq. (1b) Allowable $S_A = 364$ MPa (52.7 ksi): Passes]	514
S303.7.2	Example 3: Operating Case 2: Displacement Stress Range [Eq. (1b) Allowable $S_A = 364$ MPa (52.7 ksi): Passes]	515
S303.7.3	Example 3: Moment Reversal Load Combination Considering Operating Cases 1 and 2, Total Strain Based: Displacement Stress Range [Eq. (1b) Allowable $S_A = 364$ MPa (52.7 ksi): Fails]	516
W301-1	Gamma Function Evaluation	521
W302.1-1	Fatigue Material Coefficients (-3σ)	522
W302.1-2	Fatigue Material Coefficients (-2σ)	522
W302.1-3	Optional Fatigue Material Coefficients When $N_{ti} > 10^7$	523
W302.1-4	Environmental Fatigue Factors for Carbon Steel Piping, $T \leq 93^\circ\text{C}$ (200°F)	523
Index	530
Notes for Index	546

FOREWORD

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Code for Pressure Piping

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INTRODUCTION

(22)

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

Rules for each Section reflect the kinds of piping installations considered during its development, as follows:

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

This is the B31.3 Process Piping Code Section. Hereafter, in this Introduction and in the text of this Code Section B31.3, where the word *Code* is used without specific identification, it means this Code Section.

It is the owner's responsibility to select the Code Section that most nearly applies to a proposed piping installation. Factors to be considered by the owner include limitations of the Code Section; jurisdictional requirements; and the applicability of other codes and standards. All applicable requirements of the selected Code Section shall be met. For some installations, more than one Code Section may apply to different parts of the installation. The owner is also responsible for imposing requirements supplementary to those of the Code if necessary to assure safe piping for the proposed installation.

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

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

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

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

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

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

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

This Code Section includes the following:

(a) references to acceptable material specifications and component standards, including dimensional requirements and pressure–temperature ratings

(b) requirements for design of components and assemblies, including piping supports

(c) requirements and data for evaluation and limitation of stresses, reactions, and movements associated with pressure, temperature changes, and other forces

(d) guidance and limitations on the selection and application of materials, components, and joining methods

(e) requirements for the fabrication, assembly, and erection of piping

(f) requirements for examination, inspection, and testing of piping

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

ASME Committee B31 is organized and operates under procedures of The American Society of Mechanical Engineers that have been accredited by the American National Standards Institute. The Committee is a continuing one, and keeps all Code Sections current with new developments in materials, construction, and industrial practice. New editions are published at intervals of 2 years.

Code users will note that paragraphs in the Code are not necessarily numbered consecutively. Such discontinuities result from following a common outline, insofar as practical, for all Code Sections. In this way, corresponding material is correspondingly numbered in most Code Sections, thus facilitating reference by those who have occasion to use more than one Section.

This edition of Code Section B31.3 is not retroactive. Normally, agreement is made between contracting parties to use a specific edition, considering requirements

of the authority having jurisdiction. When specified as the latest edition and when no edition is specified, the specific edition is the one issued at least 6 months prior to the original contract date for the first design activity.

Users of this Code are cautioned against making use of Code revisions without assurance that they are acceptable to the proper authorities in the jurisdiction where the piping is to be installed.

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

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

A Case is the prescribed form of reply when study indicates that the Code wording needs clarification, or when the reply modifies existing requirements of the Code or grants permission to use new materials or alternative constructions. The Case will be published on the B31.3 web page at <http://go.asme.org/B31committee>.

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

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

Materials ordinarily are listed in the stress tables only when sufficient usage in piping within the scope of the Code has been shown. Requests for listing shall include evidence of satisfactory usage and specific data to permit establishment of allowable stresses, maximum and minimum temperature limits, and other restrictions. Additional criteria can be found in the guidelines for addition of new materials in the ASME Boiler and Pressure Vessel Code, Section II. (To develop usage and gain experience, unlisted materials may be used in accordance with [para. 323.1.2.](#))

ASME B31.3-2022

SUMMARY OF CHANGES

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

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

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

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

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

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

Chapter I

Scope and Definitions

(22) 300 GENERAL STATEMENTS

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

(b) *Responsibilities*

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

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

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

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

(c) *Intent of the Code*

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

(2) This Code is not intended to apply to the operation, examination, inspection, testing, maintenance, or repair of piping that has been placed in service. See para. F300.1 for examples of standards that may apply

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

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

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

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

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

(d) *Determining Code Requirements*

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

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