

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, Mitters, 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	38
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	Nonmetallic 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	85
A310	General	85
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	90
Part 8	Standards for Piping Components	90
A326	Dimensions and Ratings of Components	90
Part 9	Fabrication, Assembly, and Erection	90
A327	General	90
A328	Bonding of Plastics	93
A329	Fabrication of Piping Lined With Nonmetals	96
A332	Bending and Forming	96
A334	Joining Nonplastic Piping	97
A335	Assembly and Erection	97
Part 10	Inspection, Examination, and Testing	98
A340	Inspection	98
A341	Examination	98
A342	Examination Personnel	98
A343	Examination Procedures	98

A344	Types of Examination	98
A345	Testing	99
A346	Records	100
Chapter VIII	Piping for Category M Fluid Service	101
M300	General Statements	101
Part 1	Conditions and Criteria	101
M301	Design Conditions	101
M302	Design Criteria	101
Part 2	Pressure Design of Metallic Piping Components	102
M303	General	102
M304	Pressure Design of Metallic Components	102
Part 3	Fluid Service Requirements for Metallic Piping Components	102
M305	Pipe	102
M306	Metallic Fittings, Bends, Miters, Laps, and Branch Connections	102
M307	Metallic Valves and Specialty Components	102
M308	Flanges, Blanks, Flange Facings, and Gaskets	103
M309	Bolting	103
Part 4	Fluid Service Requirements for Metallic Piping Joints	103
M310	Metallic Piping, General	103
M311	Welded Joints in Metallic Piping	103
M312	Flanged Joints in Metallic Piping	103
M313	Expanded Joints in Metallic Piping	103
M314	Threaded Joints in Metallic Piping	103
M315	Tubing Joints in Metallic Piping	103
M316	Caulked Joints	104
M317	Soldered and Brazed Joints	104
M318	Special Joints in Metallic Piping	104
Part 5	Flexibility and Support of Metallic Piping	104
M319	Flexibility of Metallic Piping	104
M321	Piping Support	104
Part 6	Systems	104
M322	Specific Piping Systems	104
Part 7	Metallic Materials	104
M323	General Requirements	104
M325	Materials — Miscellaneous	104
Part 8	Standards for Piping Components	105
M326	Dimensions and Ratings of Components	105
Part 9	Fabrication, Assembly, and Erection of Metallic Piping	105
M327	General	105
M328	Welding of Metals	105
M330	Preheating of Metals	105
M331	Heat Treatment of Metals	105
M332	Bending and Forming of Metals	105
M335	Assembly and Erection of Metallic Piping	105
Part 10	Inspection, Examination, Testing, and Records of Metallic Piping	106
M340	Inspection	106
M341	Examination	106
M342	Examination Personnel	106
M343	Examination Procedures	106
M344	Types of Examination	106
M345	Testing	106
M346	Records	106
Parts 11 Through 20, Corresponding to Chapter VII	106
MA300	General Statements	106

Part 11	Conditions and Criteria	106
MA301	Design Conditions	106
MA302	Design Criteria	106
Part 12	Pressure Design of Nonmetallic Piping Components	106
MA303	General	106
MA304	Pressure Design of Nonmetallic Components	107
Part 13	Fluid Service Requirements for Nonmetallic Piping Components	107
MA305	Pipe	107
MA306	Nonmetallic Fittings, Bends, Miters, Laps, and Branch Connections	107
MA307	Nonmetallic Valves and Specialty Components	107
MA308	Flanges, Blanks, Flange Facings, and Gaskets	107
MA309	Bolting	107
Part 14	Fluid Service Requirements for Nonmetallic Piping Joints	107
MA310	General	107
MA311	Bonded Joints	107
MA312	Flanged Joints	107
MA313	Expanded Joints	107
MA314	Threaded Joints	107
MA315	Tubing Joints in Nonmetallic Piping	107
MA316	Caulked Joints	107
MA318	Special Joints	107
Part 15	Flexibility and Support of Nonmetallic Piping	107
MA319	Piping Flexibility	107
MA321	Piping Support	107
Part 16	Nonmetallic and Nonmetallic Lined Systems	107
MA322	Specific Piping Systems	107
Part 17	Nonmetallic Materials	108
MA323	General Requirements	108
Part 18	Standards for Nonmetallic and Nonmetallic Lined Piping Components	108
MA326	Dimensions and Ratings of Components	108
Part 19	Fabrication, Assembly, and Erection of Nonmetallic and Nonmetallic Lined Piping	108
MA327	General	108
MA328	Bonding of Plastics	108
MA329	Fabrication of Piping Lined With Nonmetals	108
MA332	Bending and Forming	108
MA334	Joining Nonplastic Piping	108
MA335	Assembly and Erection	108
Part 20	Inspection, Examination, Testing, and Records of Nonmetallic and Nonmetallic Lined Piping	108
MA340	Inspection	108
MA341	Examination	108
MA342	Examination Personnel	108
MA343	Examination Procedures	108
MA344	Types of Examination	108
MA345	Testing	108
MA346	Records	108
Chapter IX	High Pressure Piping	109
K300	General Statements	109
Part 1	Conditions and Criteria	109
K301	Design Conditions	109
K302	Design Criteria	110
Part 2	Pressure Design of Piping Components	112
K303	General	112

K304	Pressure Design of High Pressure Components	112
Part 3	Fluid Service Requirements for Piping Components	115
K305	Pipe	115
K306	Fittings, Bends, and Branch Connections	115
K307	Valves and Specialty Components	116
K308	Flanges, Blanks, Flange Facings, and Gaskets	116
K309	Bolting	116
Part 4	Fluid Service Requirements for Piping Joints	117
K310	General	117
K311	Welded Joints	117
K312	Flanged Joints	117
K313	Expanded Joints	117
K314	Threaded Joints	117
K315	Tubing Joints	117
K316	Caulked Joints	117
K317	Soldered and Brazed Joints	117
K318	Special Joints	118
Part 5	Flexibility and Support	118
K319	Flexibility	118
K321	Piping Support	118
Part 6	Systems	118
K322	Specific Piping Systems	118
Part 7	Materials	119
K323	General Requirements	119
K325	Miscellaneous Materials	122
Part 8	Standards for Piping Components	122
K326	Dimensions and Ratings of Components	122
Part 9	Fabrication, Assembly, and Erection	122
K327	General	122
K328	Welding	122
K330	Preheating	125
K331	Heat Treatment	125
K332	Bending and Forming	126
K333	Brazing and Soldering	127
K335	Assembly and Erection	127
Part 10	Inspection, Examination, and Testing	127
K340	Inspection	127
K341	Examination	127
K342	Examination Personnel	128
K343	Examination Procedures	128
K344	Types of Examination	128
K345	Testing	130
K346	Records	131
Figures		
300.1.1	Diagram Illustrating Application of B31.3 Piping at Equipment	3
302.3.5	Stress Range Reduction 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	36
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	58
328.4.3	Trimming and Permitted Misalignment	58
328.4.4	Preparation for Branch Connections	59
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, B, C	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	74
A328.5	Typical Plastic Piping Joints	95
K323.3.3	Example of an Acceptable Impact Test Specimen	122
K328.4.3	Pipe Bored for Alignment: Trimming and Permitted Misalignment	125
K328.5.4	Some Acceptable Welded Branch Connections Suitable for 100% Radiography	126
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 $t < D/6$	18
304.4.1	BPV Code References for Closures	25
308.2.1	Permissible Sizes/Rating Classes for Slip-On Flanges Used as Lapped Flanges	30
314.2.1	Minimum Thickness of Male Threaded Components	32
323.2.2	Requirements 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
331.1.1	Requirements for Heat Treatment	64
341.3.2	Acceptance Criteria for Welds and Examination Methods for Evaluating Weld Imperfections	71
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	99
K302.3.3D	Acceptable Severity Levels for Steel Castings	112
K305.1.2	Required Ultrasonic or Eddy Current Examination of Pipe and Tubing for Longitudinal Defects	116
K323.3.1	Impact Testing Requirements	121
K323.3.5	Minimum Required Charpy V-Notch Impact Values	123

K326.1	Component Standards	124
K341.3.2	Acceptance Criteria for Welds	129
Appendices		
Appendix A	Allowable Stresses and Quality Factors for Metallic Piping and Bolting	
	Materials	133
	Specification Index for Appendix A	134
	Notes for Appendix A Tables	137
	Table A-1 Basic Allowable Stresses in Tension for Metals	141
	Iron	
	Castings	141
	Carbon Steel	
	Pipes and Tubes	142
	Pipes (Structural Grade)	146
	Plates and Sheets	146
	Plates and Sheets (Structural)	148
	Forgings and Fittings	148
	Castings	148
	Low and Intermediate Alloy Steel	
	Pipes	150
	Plates	152
	Forgings and Fittings	154
	Castings	156
	Stainless Steel	
	Pipes and Tubes	158
	Plates and Sheets	162
	Forgings and Fittings	164
	Bar	168
	Castings	168
	Copper and Copper Alloy	
	Pipes and Tubes	170
	Plates and Sheets	170
	Forgings	172
	Castings	172
	Nickel and Nickel Alloy	
	Pipes and Tubes	174
	Plates and Sheets	176
	Forgings and Fittings	178
	Rod and Bar	180
	Castings	180
	Titanium and Titanium Alloy	
	Pipes and Tubes	182
	Plates and Sheets	182
	Forgings	182
	Zirconium and Zirconium Alloy	
	Pipes and Tubes	182
	Plates and Sheets	182
	Forgings and Bar	182
	Aluminum Alloy	
	Seamless Pipes and Tubes	184
	Welded Pipes and Tubes	185
	Structural Tubes	185
	Plates and Sheets	186
	Forgings and Fittings	188
	Castings	189
	Table A-1A Basic Casting Quality Factors E_c	190

Table A-1B Basic Quality Factors for Longitudinal Weld Joints in Pipes, Tubes, and Fittings E_j	191
Carbon Steel	191
Low and Intermediate Alloy Steel	191
Stainless Steel	192
Copper and Copper Alloy	192
Nickel and Nickel Alloy	193
Titanium and Titanium Alloy	193
Zirconium and Zirconium Alloy	193
Aluminum Alloy	193
Table A-2 Design Stress Values for Bolting Materials	194
Carbon Steel	194
Alloy Steel	194
Stainless Steel	194
Copper and Copper Alloy	200
Nickel and Nickel Alloy	200
Aluminum Alloy	202
Appendix B Stress Tables and Allowable Pressure Tables for Nonmetals	204
Appendix C Physical Properties of Piping Materials	209
Appendix D Flexibility and Stress Intensification Factors	226
Appendix E Reference Standards	230
Appendix F Precautionary Considerations	236
Appendix G Safeguarding	241
Appendix H Sample Calculations for Branch Reinforcement	243
Appendix J Nomenclature	247
Appendix K Allowable Stresses for High Pressure Piping	257
Appendix L Aluminum Alloy Pipe Flanges	272
Appendix M Guide to Classifying Fluid Services	275
Appendix P Alternative Rules for Evaluating Stress Range	277
Appendix Q Quality System Program	279
Appendix S Piping System Stress Analysis Examples	280
Appendix V Allowable Variations in Elevated Temperature Service	285
Appendix X Metallic Bellows Expansion Joints	288
Appendix Z Preparation of Technical Inquiries	293
Index	294