

CONTENTS

Foreword		ix
Personnel		xi
Introduction		xiv
Summary of Changes		xvi
Chapter I	Scope and Definitions	
400	General Statements	1
400.1	Scope	1
400.2	Definitions	4
Figures		
400.1.1	Diagram Showing Scope of ASME B31.4 Excluding Carbon Dioxide Pipeline Systems (See Fig. 400.1.2)	2
400.1.2	Diagram Showing Scope of ASME B31.4 for Carbon Dioxide Pipeline Systems	3
Chapter II	Design	
Part 1	Conditions and Criteria	7
401	Design Conditions	7
401.1	General	7
401.2	Pressure	7
401.3	Temperature	7
401.4	Ambient Influences	7
401.5	Dynamic Effects	7
401.6	Weight Effects	7
401.7	Thermal Expansion and Contraction Loads	7
401.8	Relative Movement of Connected Components	8
402	Design Criteria	8
402.1	General	8
402.2	Pressure–Temperature Ratings for Piping Components	8
402.3	Allowable Stresses and Other Stress Limits	8
402.4	Allowances	11
402.5	Fracture Propagation in Carbon Dioxide Pipelines	11
402.6	Use of High D/t Ratio	11
Part 2	Pressure Design of Piping Components	12
403	Criteria for Pressure Design of Piping Components	12
404	Pressure Design of Components	13
404.1	Straight Pipe	13
404.2	Curved Segments of Pipe	13
404.3	Intersections	13
404.5	Pressure Design of Flanges	21
404.6	Reducers	21
404.7	Pressure Design of Other Pressure Containing Components	21
Part 3	Design Applications of Piping Components Selection and Limitations	21
405	Pipe	21
405.2	Metallic Pipe	21
406	Fittings, Elbows, Bends, and Intersections	22
406.1	Fittings	22

406.2	Bends, Miters, and Elbows	22
406.3	Couplings	22
406.4	Reductions	22
406.5	Intersections	22
406.6	Closures	23
407	Valves	23
407.1	General	23
407.8	Special Valves	23
408	Flanges, Facings, Gaskets, and Bolting	23
408.1	Flanges	23
408.3	Flange Facings	24
408.4	Gaskets	24
408.5	Bolting	24
409	Used Piping Components and Equipment	24
Part 4	Selection and Limitation of Piping Joints	24
411	Welded Joints	24
411.2	Butt Welds	24
412	Flanged Joints	25
412.1	General	25
414	Threaded Joints	25
414.1	General	25
418	Sleeve, Coupled, and Other Patented Joints	25
418.1	General	25
Part 5	Expansion, Flexibility, Structural Attachments, Supports, and Restraints	25
419	Expansion and Flexibility	25
419.1	General	25
419.5	Flexibility	25
419.6	Properties	25
419.7	Analysis	26
420	Loads on Pipe Supporting Elements	26
420.1	General	26
421	Design of Pipe Supporting Elements	26
421.1	Supports, Braces, and Anchors	26
Part 6	Auxiliary and Other Specific Piping	30
422	Design Requirements	30
422.2	Directionally Drilled Crossings	30
422.3	Instrument and Other Auxiliary Liquid Petroleum or Liquid Anhydrous Ammonia Piping	30
422.6	Pressure Disposal Piping	30
422.7	Other Piping	30
Figures		
404.3.1(b)(3)	Reinforced Extruded Outlets	15
404.3.1(c)(1)	Welding Details for Openings With Complete Encirclement Types of Reinforcement	16
404.3.1(c)(2)	Welding Details for Openings With Localized Type Reinforcement	17
404.3.1(c)(3)	Welding Details for Openings Without Reinforcement Other Than That in Header and Branch Walls	18
404.3.1(d)(2)	Reinforcement of Branch Connections	20
419.6.4(c)	Flexibility Factor k and Stress Intensification Factor i	27
Tables		
402.3.1(a)	Tabulation of Examples of Allowable Stresses for Reference Use in Piping Systems Within the Scope of This Code	9
402.4.3	Weld Joint Factor E	12

404.3.1(c)	Design Criteria for Welded Branch Connections	18
Chapter III	Materials	
423	Materials — General Requirements	31
423.1	Acceptable Materials and Specifications	31
423.2	Limitations on Materials	31
425	Materials Applied to Miscellaneous Parts	34
425.3	Gaskets	34
425.4	Bolting	34
Table		
423.1	Material Standards	32
Chapter IV	Dimensional Requirements	
426	Dimensional Requirements for Standard and Nonstandard Piping Components	35
426.1	Standard Piping Components	35
426.2	Nonstandard Piping Components	35
426.3	Threads	35
Table		
426.1	Dimensional Standards	36
Chapter V	Construction, Welding, and Assembly	
434	Construction	37
434.1	General	37
434.2	Qualifications	37
434.3	Right-of-Way	37
434.4	Handling, Hauling, Stringing, and Storing	37
434.5	Damage to Fabricated Items and Pipe	37
434.6	Ditching	38
434.7	Bends, Miters, and Elbows	38
434.8	Welding	39
434.9	Tie-In	46
434.10	Installation of Pipe in the Ditch	46
434.11	Backfilling	46
434.12	Restoration of Right-of-Way and Cleanup	46
434.13	Special Crossings	46
434.14	Inland Coastal Water Construction	47
434.15	Block and Isolating Valves	47
434.16	Connections to Main Lines	48
434.17	Scraper Traps	48
434.18	Line Markers	48
434.19	Corrosion Control	49
434.20	Pump Station, Tank Farm, and Terminal Construction	49
434.21	Storage and Working Tankage	49
434.22	Electrical Installations	50
434.23	Liquid Metering	50
434.24	Liquid Strainers and Filters	50
435	Assembly of Piping Components	51
435.1	General	51
435.2	Bolting Procedure	51
435.3	Pumping Unit Piping	51
435.4	Manifolds	51
435.5	Auxiliary Liquid Petroleum, Carbon Dioxide, Liquid Anhydrous Ammonia, or Liquid Alcohol Piping	51
Figures		
434.8.6(a)-(1)	Acceptable Butt Welded Joint Design for Equal Wall Thicknesses	42

434.8.6(a)-(2)	Acceptable Butt Welded Joint Design for Unequal Wall Thicknesses	43
434.8.6(b)	Recommended Attachment Details of Flanges	45
Table		
434.6(a)	Minimum Cover for Buried Pipelines	39
Chapter VI		
Inspection and Testing		
436	Inspection	52
436.1	General	52
436.2	Qualification of Inspectors	52
436.5	Type and Extent of Examination Required	52
436.6	Repair of Defects	53
437	Testing	53
437.1	General	53
437.4	Test Pressure	53
437.6	Qualification Tests	54
437.7	Records	55
Chapter VII		
Operation and Maintenance Procedures		
450	Operation and Maintenance Procedures Affecting the Safety of Liquid Transportation Piping Systems	56
450.1	General	56
450.2	Operation and Maintenance Plans and Procedures	56
451	Pipeline Operation and Maintenance	57
451.1	Operating Pressure	57
451.2	Communications	57
451.3	Line Markers and Signs	57
451.4	Right-of-Way Maintenance	57
451.5	Patrolling	57
451.6	Pipeline Integrity Assessments and Repairs	57
451.8	Valve Maintenance	65
451.9	Railroads and Highways Crossing Existing Pipelines	65
451.10	Inland Waters Platform Risers	66
451.11	Leak Detection	66
452	Pump Station, Terminal, and Tank Farm Operation and Maintenance	66
452.1	General	66
452.2	Controls and Protective Equipment	67
452.3	Storage Vessels	67
452.4	Storage of Combustible Materials	67
452.5	Fencing	67
452.6	Signs	67
452.7	Prevention of Accidental Ignition	67
453	Corrosion Control	67
454	Emergency Plan	67
455	Records	68
456	Qualifying a Piping System for a Higher Operating Pressure	68
457	Abandoning a Piping System	69
Figures		
451.6.2(a)(2)(d)(1)	Type I Interaction	60
451.6.2(a)(2)(d)(2)	Type II Interaction	60
Tables		
451.6.2(b)-1	Acceptable Pipeline Repair Methods (Nonindented, Nonwrinkled, and Nonbuckled Pipe)	62
451.6.2(b)-2	Acceptable Pipeline Repair Methods for Dents, Buckles, Ripples, Wrinkles, Leaking Couplings, and Defective Prior Repairs	64

Chapter VIII	Corrosion Control	
460	General	70
461	External Corrosion Control for Buried or Submerged Pipelines	70
461.1	New Installations	70
461.2	Existing Piping Systems	72
461.3	Monitoring	72
462	Internal Corrosion Control	73
462.1	New Installations	73
462.2	Existing Piping Systems	73
462.3	Monitoring	73
463	External Corrosion Control for Piping Exposed to Atmosphere	73
463.1	New Installations	73
463.2	Existing Piping Systems	73
463.3	Monitoring	73
464	Corrective Measures	73
465	Records	74
Chapter IX	Offshore Liquid Pipeline Systems	
A400	General Statements	75
A400.1	Scope	75
A400.2	Definitions	75
A401	Design Conditions	76
A401.1	General	76
A401.9	Installation Design Considerations	76
A401.10	Operational Design Considerations	77
A401.11	Hydrostatic Test Design Considerations	77
A401.12	Route Selection Considerations	78
A402	Design Criteria	78
A402.3	Allowable Stresses and Other Stress Limits	78
A402.4	Allowances	82
A404	Pressure Design of Components	82
A404.1	Straight Pipe	82
A404.3	Intersections	82
A405	Pipe	82
A405.2	Metallic Pipe	82
A405.3	Flexible Pipe	83
A406	Fittings, Elbows, Bends, and Intersections	83
A406.2	Bends, Miters, and Elbows	83
A406.4	Reductions	83
A406.6	Closures	83
A407	Valves	83
A407.1	General	83
A408	Flanges, Facings, Gaskets, and Bolting	83
A408.1	Flanges	83
A408.3	Flange Facings	83
A409	Used Piping Components and Equipment	83
A410	Other Design Considerations	83
A410.1	Pigs and Internal Inspection Tools	83
A410.2	Special Components	83
A414	Threaded Joints	83
A414.1	General	83
A419	Expansion and Flexibility	83
A421	Design of Pipe-Supporting Elements	83
A423	Materials — General Requirements	84
A423.1	Acceptable Materials and Specifications	84
A423.2	Limitations on Materials	84
A434	Construction	84

A434.2	Inspection	84
A434.3	Right-of-Way	84
A434.6	Ditching	84
A434.7	Bends, Miters, and Elbows	84
A434.8	Welding	84
A434.11	Backfilling	85
A434.13	Special Crossings	85
A434.14	Offshore Pipeline Construction	85
A434.15	Block and Isolating Valves	85
A434.18	Line Markers	85
A436	Inspection	85
A436.2	Qualification of Inspectors	85
A436.5	Type and Extent of Examination Required	85
A437	Testing	85
A437.1	General	85
A437.4	Test Pressure	86
A437.6	Qualification Tests	86
A437.7	Records	86
A450	Operation and Maintenance Procedures Affecting the Safety of Liquid Transportation Piping Systems	86
A450.2	Operation and Maintenance Plans and Procedures	86
A451	Pipeline Operation and Maintenance	86
A451.3	Markers	86
A451.4	Right-of-Way Maintenance	86
A451.5	Patrolling	86
A451.6	Pipeline Repairs	86
A451.7	Derating a Pipeline to a Lower Operating Pressure	87
A451.8	Valve Maintenance	87
A451.9	Railroads and Highways Crossing Existing Pipelines	87
A451.10	Offshore Pipeline Risers	87
A451.11	Inspection	87
A452	Offshore Platform, Pump Station, Terminal, and Tank Farm Operation and Maintenance	87
A452.5	Fencing	87
A452.7	Prevention of Accidental Ignition	87
A454	Emergency Plan	87
A460	General	88
A461	External Corrosion Control for Offshore Submerged Pipelines	88
A461.1	New Installations	88
A461.3	Monitoring	89
A463	External Corrosion Control for Offshore Piping Systems Exposed to Atmospheric Conditions	89
A463.1	New Installations	89
Table		
A402.3.5(a)	Design Factors for Offshore Pipeline Systems	80
Nonmandatory Appendices		
A	Referenced Standards	91
B	Submission of Technical Inquiries to the B31 Pressure Piping Committee	94
C	Publications That Do Not Appear in the Code or Nonmandatory Appendix A But May Be Of Informational Benefit	96
Index		97