

2013

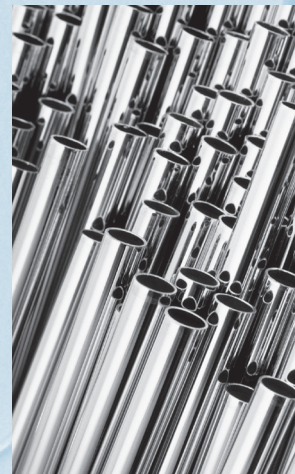
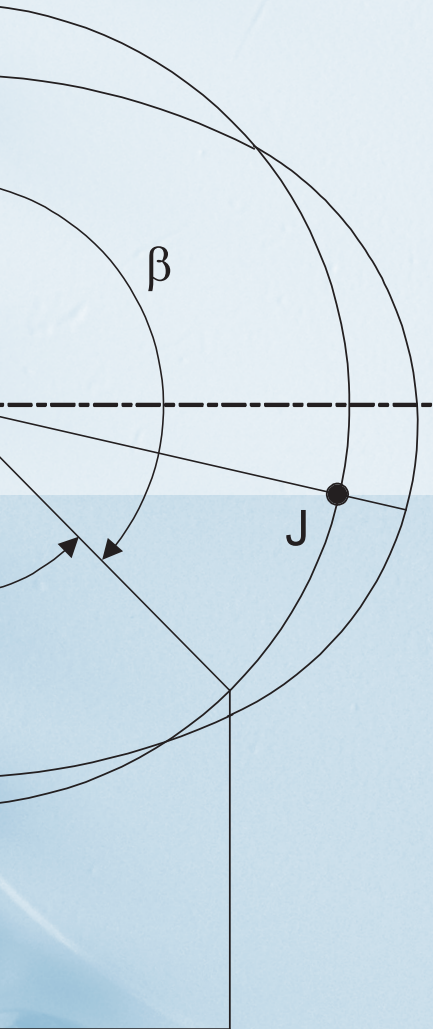
ASME Boiler and
Pressure Vessel Code
AN INTERNATIONAL CODE

III

Rules for Construction of Nuclear Facility Components

Division 3

Containments for Transportation
and Storage of Spent Nuclear Fuel
and High Level Radioactive Material
and Waste



INTENTIONALLY LEFT BLANK

AN INTERNATIONAL CODE

2013 ASME Boiler & Pressure Vessel Code

2013 Edition

July 1, 2013



RULES FOR CONSTRUCTION OF NUCLEAR FACILITY COMPONENTS

Division 3

Containments for Transportation and Storage of Spent Nuclear Fuel and High Level Radioactive Material and Waste

ASME Boiler and Pressure Vessel Committee
on Nuclear Power



The American Society of
Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: July 1, 2013

This international code or standard was developed under procedures accredited as meeting the criteria for American National Standards and it is an American National Standard. The Standards Committee that approved the code or standard was balanced to 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 assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency 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.

The endnotes in this document (if any) are part of this American National Standard.



ASME collective membership mark



Certification Mark

The above ASME symbol is registered in the U.S. Patent Office.

“ASME” is the trademark of The American Society of Mechanical Engineers.

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.

Library of Congress Catalog Card Number: 56-3934
Printed in the United States of America

Adopted by the Council of The American Society of Mechanical Engineers, 1914; latest edition 2013.

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

Copyright © 2013 by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
All rights reserved

TABLE OF CONTENTS

List of Sections	xii
Foreword	xiv
Statement of Policy on the Use of the Certification Mark and Code Authorization in Advertising	xvi
Statement of Policy on the Use of ASME Marking to Identify Manufactured Items	xvi
Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees	xvii
Personnel	xix
Organization of Section III	xxxiv
Summary of Changes	xxxvii
List of Changes in Record Order Number	xxxix
Cross-Referencing and Stylistic Changes in the Boiler and Pressure Vessel Code	xl
Subsection WA	
General Requirements	1
Article WA-1000	
Scope of Division 3	1
WA-1100	1
WA-1110	1
WA-1120	1
WA-1130	1
WA-1140	1
WA-1150	1
WA-1200	2
WA-1210	2
WA-1220	2
WA-1230	2
Article WA-2000	
Design Basis for Containments	3
WA-2100	3
WA-2110	3
WA-2120	3
WA-2130	4
Article WA-3000	
Responsibilities and Duties	5
WA-3100	5
WA-3110	5
WA-3120	5
WA-3130	6
WA-3300	6
WA-3320	6
WA-3330	7
WA-3340	7
WA-3350	7
WA-3360	8
WA-3370	8
WA-3380	9
WA-3390	9
WA-3400	9
WA-3420	9
WA-3430	9
WA-3440	9
WA-3450	9
WA-3460	9

WA-3470	Data Report	10
WA-3800	Metallic Material	10
WA-3810	Scope and Applicability	10
WA-3820	Material Organizations	10
Article WA-4000	Quality Assurance	11
WA-4100	Requirements	11
WA-4110	Scope and Applicability	11
WA-4120	Definitions	11
WA-4130	Establishment and Implementation	11
Article WA-5000	Authorized Inspection	13
WA-5100	Introduction	13
WA-5110	Applicability	13
WA-5120	Performance of Inspection	13
WA-5130	Access for Inspection Agency Personnel	13
WA-5200	Duties of Inspector	13
WA-5210	General Inspection Duties	13
WA-5220	Categories of Inspector's Duties	14
WA-5230	Scope of Work, Design Specifications, Design Reports, and Fabrication Specifications	14
WA-5240	Quality Assurance Programs	14
WA-5250	Qualification Records	14
WA-5260	Materials, Parts, and Heat Treatment	15
WA-5270	Examinations and Tests	15
WA-5280	Final Tests	15
WA-5290	Data Reports	15
WA-5300	Responsibilities of the Authorized Inspection Agency	15
Article WA-7000	Reference Standards	16
WA-7100	General Requirements	16
Article WA-8000	Certificates of Authorization, Nameplates, Certification Mark, and Data Reports	18
WA-8100	Authorization to Perform Code Activities	18
WA-8110	General	18
WA-8120	Scope of Authorization	18
WA-8130	Inspection Agreement Required	18
WA-8140	Quality Assurance Program Requirements	19
WA-8150	Application for Authorization	19
WA-8160	Evaluation for Authorization	19
WA-8170	Issuance of Authorization	19
WA-8180	Renewal of Authorization	19
WA-8200	Nameplates and Stamping with Certification Mark	19
WA-8210	General Requirements	19
WA-8220	Nameplates	20
WA-8230	Nameplates for Certification Mark with NPT Designator Items	20
WA-8300	Certification Mark	20
WA-8310	General Requirements	20
WA-8330	Removable Items	21
WA-8400	Data Reports	21
WA-8410	General Requirements	21
Article WA-9000	Glossary	27
WA-9100	Introduction	27
WA-9200	Definitions	27
Subsection WB	Class TC Transportation Containments	29
Article WB-1000	Introduction	29
WB-1100	Scope	29
WB-1120	Rules for Class TC Transportation Containments	29

WB-1130	Boundaries of Jurisdiction	29
Article WB-2000	Material	31
WB-2100	General Requirements for Material	31
WB-2110	Scope of Principal Terms Employed	31
WB-2120	Containment Material	31
WB-2130	Certification of Material	32
WB-2140	Welding Material	32
WB-2150	Material Identification	32
WB-2160	Deterioration of Material in Service	33
WB-2170	Heat Treatment to Enhance Impact Properties	33
WB-2180	Procedures for Heat Treatment of Material	33
WB-2190	Material Not Performing a Containment Function	33
WB-2200	Material Test Coupons and Specimens for Ferritic Steel Material and Ductile Cast Iron	33
WB-2210	Heat Treatment Requirements	33
WB-2220	Procedure for Obtaining Test Coupons and Specimens for Quenched and Tempered Material and for Ductile Cast Iron	34
WB-2300	Fracture Toughness Requirements for Material	35
WB-2310	Material to Be Toughness Tested	35
WB-2320	Impact Test Procedures	35
WB-2330	Test Requirements and Acceptance Standards	36
WB-2340	Number of Toughness Tests Required	38
WB-2350	Retests	38
WB-2360	Calibration of Instruments and Equipment	39
WB-2400	Welding Material	39
WB-2410	General Requirements	39
WB-2420	Required Tests	39
WB-2430	Weld Metal Tests	40
WB-2440	Storage and Handling of Welding Material	42
WB-2500	Examination and Repair of Containment Material	42
WB-2510	Examination of Containment Material	42
WB-2520	Examination After Quenching and Tempering	43
WB-2530	Examination and Repair of Plate	43
WB-2540	Examination and Repair of Forgings and Bars	45
WB-2550	Examination and Repair of Seamless and Welded Tubular Products and Fittings	47
WB-2570	Examination and Repair of Cast Products	49
WB-2580	Examination of Bolts, Studs, and Nuts	51
WB-2600	Material Organization's Quality System Programs	53
WB-2610	Documentation and Maintenance of Quality System Programs	53
WB-2700	Dimensional Standards	53
Article WB-3000	Design	54
WB-3100	General Design	54
WB-3110	Loading Criteria	54
WB-3120	Special Considerations	55
WB-3130	General Design Rules	55
WB-3200	Design of Containments	59
WB-3210	Design Criteria	59
WB-3220	Stress Limits for Other Than Bolts	62
WB-3230	Stress Limits for Bolts	71
WB-3240	Nozzles or Openings	73
WB-3250	Design of Welded Construction	73
WB-3260	Special Containment Requirements	76
WB-3700	Strain-Based Acceptance Criteria	76
Article WB-4000	Fabrication	78
WB-4100	General Requirements	78
WB-4110	Introduction	78

WB-4120	Certification of Materials and Fabrication by Certificate Holder	78
WB-4130	Repair of Material	79
WB-4200	Forming, Fitting, and Aligning	79
WB-4210	Cutting, Forming, and Bending	79
WB-4220	Forming Tolerances	80
WB-4230	Fitting and Aligning	83
WB-4240	Requirements for Weld Joints in Containments	83
WB-4300	Welding Qualifications	86
WB-4310	General Requirements	86
WB-4320	Welding Qualifications, Records, and Identifying Stamps	90
WB-4330	General Requirements for Welding Procedure Qualification Tests	91
WB-4400	Rules Governing Making, Examining, and Repairing Welds	94
WB-4410	Precautions to Be Taken Before Welding	94
WB-4420	Rules for Making Welded Joints	94
WB-4430	Welding of Attachments	95
WB-4450	Repair of Weld Metal Defects	96
WB-4600	Heat Treatment	98
WB-4610	Welding Preheat Requirements	98
WB-4620	Postweld Heat Treatment	98
WB-4630	Heat Treatment of Welds Other Than the Final Postweld Heat Treatment	107
WB-4700	Mechanical Joints	108
WB-4710	Bolting and Threading	108
WB-4720	Bolting Flanged Joints	108
Article WB-5000	Examination	109
WB-5100	General Requirements for Examination	109
WB-5110	Procedures, Qualifications, and Evaluation	109
WB-5120	Time of Examination of Welds and Weld Metal Cladding	109
WB-5130	Examination of Weld Edge Preparation Surfaces	111
WB-5140	Examination of Adjacent Base Material	111
WB-5200	Required Examination of Welds	111
WB-5210	Category A Welded Joints	111
WB-5220	Category B Welded Joints	111
WB-5230	Category C Welded Joints	111
WB-5240	Category D Welded Joints	111
WB-5260	Fillet, Partial Penetration, Socket, and Attachment Welded Joints	112
WB-5270	Special Welded Joints	112
WB-5300	Acceptance Standards	112
WB-5320	Radiographic Acceptance Standards	112
WB-5330	Ultrasonic Acceptance Standards	113
WB-5340	Magnetic Particle Acceptance Standards	113
WB-5350	Liquid Penetrant Acceptance Standards	113
WB-5400	Final Examination of Containments	113
WB-5410	Examination After Hydrostatic Test	113
WB-5500	Qualifications and Certification of Nondestructive Examination Personnel	114
WB-5510	General Requirements	114
WB-5520	Personnel Qualification, Certification, and Verification	114
WB-5530	Records	115
Article WB-6000	Testing	116
WB-6100	General Requirements	116
WB-6110	Scope	116
WB-6120	Testing of Containments	116
WB-6130	Preparation for Testing	116
WB-6200	Hydrostatic Tests	117
WB-6210	Hydrostatic Test Procedure	117
WB-6220	Hydrostatic Test Pressure Requirements	117

WB-6300	Pneumatic Tests	117
WB-6310	Pneumatic Testing Procedures	117
WB-6320	Pneumatic Test Pressure Requirements	117
WB-6400	Test Gages	118
WB-6410	.....	118
WB-6600	Special Test Pressure Situations	118
WB-6610	Containments Designed for External Pressure	118
WB-6620	Testing of Combination Units	118
WB-6700	Leak Testing	118
WB-6710	Helium Leak Testing	118
Article WB-8000	Nameplates, Stamping with Certification Mark, and Reports	119
WB-8100	General Requirements	119
Subsection WC	Class SC Storage Containments	120
Article WC-1000	Introduction	120
WC-1100	Scope	120
WC-1120	Rules for Class SC Containments	120
WC-1130	Boundaries of Jurisdiction	120
Article WC-2000	Material	122
WC-2100	General Requirements for Material	122
WC-2110	Scope of Principal Terms Employed	122
WC-2120	Containment Material	122
WC-2130	Certification of Material	123
WC-2140	Welding Materials	123
WC-2150	Material Identification	124
WC-2160	Deterioration of Material in Service	124
WC-2170	Heat Treatment to Enhance Impact Properties	124
WC-2180	Procedures for Heat Treatment of Material	124
WC-2190	Attachment Material	124
WC-2200	Material Test Coupons and Specimens for Ferritic Steel Material and Ductile Cast Iron	124
WC-2210	Heat Treatment Requirements	124
WC-2220	Procedure for Obtaining Test Coupons and Specimens for Quenched and Tempered Material and for Ductile Cast Iron	125
WC-2300	Fracture Toughness Requirements for Material	126
WC-2310	Material to Be Impact Tested	126
WC-2320	Impact Test Procedures	127
WC-2330	Test Requirements and Acceptance Standards	128
WC-2340	Number of Impact Tests Required	129
WC-2350	Retests	130
WC-2360	Calibration of Instruments and Equipment	130
WC-2400	Welding Material	130
WC-2410	General Requirements	130
WC-2420	Required Tests	131
WC-2430	Weld Metal Tests	132
WC-2440	Storage and Handling of Welding Material	134
WC-2500	Examination and Repair of Containment Material	134
WC-2510	Containment Material	134
WC-2530	Examination and Repair of Plate	134
WC-2540	Examination and Repair of Forgings and Bars	136
WC-2550	Examination and Repair of Seamless and Welded (Without Filler Metal) Tubular Products and Fittings	137
WC-2560	Examination and Repair of Tubular Products and Fittings Welded With Filler Metal .	139
WC-2570	Examination and Repair of Cast Products	139
WC-2580	Examination of Bolts, Studs, and Nuts	141
WC-2600	Material Organizations' Quality System Programs	141

WC-2610	Documentation and Maintenance of Quality System Programs	141
WC-2700	Dimensional Standards	141
Article WC-3000	Design	142
WC-3100	General Design	142
WC-3110	Loading Criteria	142
WC-3120	Special Considerations	142
WC-3130	General Design Rules	143
WC-3200	Design Rules for Containments	146
WC-3210	General Requirements	146
WC-3220	Design Consideration	150
WC-3230	Openings and Reinforcement	154
WC-3250	Design of Welded Construction	157
WC-3260	Special Containment Requirements	161
WC-3700	Strain-Based Acceptance Criteria	162
Article WC-4000	Fabrication	163
WC-4100	General Requirements	163
WC-4110	Introduction	163
WC-4120	Certification of Materials and Fabrication by Certificate Holder	163
WC-4130	Repair of Material	164
WC-4200	Forming, Cutting, and Aligning	164
WC-4210	Cutting, Forming, and Bending	164
WC-4220	Forming Tolerances	165
WC-4230	Fitting and Aligning	168
WC-4260	Requirements for Weld Joints in Containments	168
WC-4300	Welding Qualifications	171
WC-4310	General Requirements	171
WC-4320	Welding Qualifications, Records, and Identifying Stamps	176
WC-4330	General Requirements for Welding Procedure Qualification Tests	177
WC-4400	Rules Governing Making, Examining, and Repairing Welds	179
WC-4410	Precautions to Be Taken Before Welding	179
WC-4420	Rules for Making Welded Joints	179
WC-4430	Welding of Attachments	180
WC-4450	Repair of Weld Metal Defects	183
WC-4500	Brazing	184
WC-4510	Rules for Brazing	184
WC-4520	Brazing Qualification Requirements	184
WC-4530	Fitting and Aligning of Parts to Be Brazed	184
WC-4540	Examination of Brazed Joints	184
WC-4600	Heat Treatment	185
WC-4610	Welding Preheat Requirements	185
WC-4620	Postweld Heat Treatment	185
WC-4630	Heat Treatment of Welds Other Than the Final Postweld Heat Treatment	195
WC-4700	Mechanical Joints	195
WC-4710	Bolting and Threading	195
WC-4720	Bolting Flanged Joints	195
Article WC-5000	Examination	196
WC-5100	General Requirements for Examination	196
WC-5110	Procedures, Qualifications, and Evaluation	196
WC-5120	Time of Examination of Welds and Weld Metal Cladding	196
WC-5130	Examination of Weld Edge Preparation Surfaces	198
WC-5140	Examination of Adjacent Base Material	198
WC-5200	Required Examination of Welds	198
WC-5210	Category A Longitudinal Welded Joints	198
WC-5220	Category B Circumferential Welded Joints	198
WC-5230	Category C Welded Joints	198

WC-5240	Category D Welded Joints	198
WC-5250	Examination of Containment Closure Welds	199
WC-5260	Fillet, Partial Penetration, Socket, and Attachment Welded Joints	199
WC-5270	Special Welds and Brazed Joints	199
WC-5300	Acceptance Standards	199
WC-5320	Radiographic Acceptance Standards	199
WC-5330	Ultrasonic Acceptance Standards	200
WC-5340	Magnetic Particle Acceptance Standards	200
WC-5350	Liquid Penetrant Acceptance Standards	200
WC-5360	Visual Acceptance Standards for Brazed Joints	201
WC-5400	Final Examination of Containments	201
WC-5410	Examination After Pressure Test	201
WC-5500	Qualifications and Certification of Nondestructive Examination Personnel	201
WC-5510	General Requirements	201
WC-5520	Personnel Qualification, Certification, and Verification	201
WC-5530	Records	202
Article WC-6000	Testing	203
WC-6100	General Requirements	203
WC-6110	Scope	203
WC-6120	Testing of Containments	203
WC-6130	Preparation for Testing	203
WC-6200	Hydrostatic Tests	204
WC-6210	Hydrostatic Test Procedure	204
WC-6220	Hydrostatic Test Pressure Requirements	204
WC-6300	Pneumatic Tests	204
WC-6310	Pneumatic Testing Procedures	204
WC-6320	Pneumatic Test Pressure Requirements	204
WC-6400	Test Gages	205
WC-6410	.....	205
WC-6600	Special Test Pressure Situations	205
WC-6610	Containments Designed for External Pressure	205
WC-6620	Pressure Testing of Combination Units	205
WC-6700	Leak Testing	205
WC-6710	Helium Leak Testing	205
WC-6720	Containment Closures	205
Article WC-8000	Nameplates, Stamping with Certification Mark, and Reports	207
WC-8100	General Requirements	207
FIGURES		
WA-8212-1	Form of Stamping	20
WB-2433.1-1	Weld Metal Delta Ferrite Content	43
WB-2552.1-1	Axial Propagation of Sound in Tube Wall	48
WB-3221-1	Stress Categories and Limits of Stress Intensity for Design Loadings	64
WB-3222-1	Stress Categories and Limits of Stress Intensity for Normal Loadings	65
WB-3224.1-1	Stress Categories and Limits of Stress Intensity for Accident Loadings for Elastic Analysis	70
WB-3251-1	Welded Joint Locations Typical of Categories A, B, C, and D	74
WB-3252-1	Typical Butt Joints	75
WB-3261-1	Categories A and B Joints Between Sections of Unequal Thickness	77
WB-4221.1-1	Maximum Difference in Cross-Sectional Diameters	80
WB-4221.2(a)-1	Maximum Permissible Deviation e From a True Circular Form	81
WB-4221.2(a)-2	Maximum ARC Length for Determining Plus or Minus Deviation	82
WB-4233(a)-1	Butt Weld Alignment and Mismatch Tolerances for Unequal I.D. and O.D. When Items Are Welded From One Side and Fairing Is Not Performed	84
WB-4243-1	Acceptable Full Penetration Weld Details for Category C Joints	85

WB-4243-2	Typical Flat Heads With Hubs	86
WB-4244(a)-1	Nozzles Attached by Full Penetration Butt Welds	87
WB-4244(b)-1	Nozzles Attached by Full Penetration Corner Welds	88
WB-4244(c)-1	Deposited Weld Metal Used As Reinforcement of Openings for Nozzles	89
WB-4244(d)-1	Nozzles Attached by Partial Penetration Welds	90
WB-4427-1	Fillet Weld Details	95
WB-4433-1	Types of Attachment Welds	97
WB-4622.9(c)(8)-1	Temper Bead Weld Repair and Weld Temper Bead Reinforcement	102
WB-4622.9(c)(8)-2	Temper Bead Reinforcement	103
WB-4622.9(f)-1	Qualification Test Plate	104
WB-4622.11(c)(6)-1	Temper Bead Weld Repair and Weld Temper Bead Reinforcement of Dissimilar Metal Welds or Buttering	106
WC-2433.1-1	Weld Metal Delta Ferrite Content	135
WC-3224.6-1	Design Curves for Torispherical Heads and 2:1 Ellipsoidal Heads for Use With WC-3224.8 and WC-3224.6	152
WC-3225-1	Typical Flat Heads	153
WC-3225-2	Some Acceptable Types of Unstayed Flat Heads and Covers	154
WC-3225-3	Attachment of Flat Heads to Containment Shell	155
WC-3232.2-1	Chart for Determining the Value of F	156
WC-3251-1	Welded Joint Locations Typical of Categories A, B, C, and D	158
WC-3251-2	Typical Butt Joints	159
WC-3261-1	Categories A and B Joints Between Sections of Unequal Thickness	161
WC-4221.1-1	Maximum Difference in Cross-Sectional Diameters	165
WC-4221.2(a)-1	Maximum Permissible Deviation e From a True Circular Form	166
WC-4221.2(a)-2	Maximum ARC Length for Determining Plus or Minus Deviation	167
WC-4233-1	Butt Weld Alignment and Mismatch Tolerances for Unequal I.D. and O.D. When Items Are Welded From One Side and Fairing Is Not Performed	169
WC-4265-1	Acceptable Full Penetration Weld Details for Category C Joints	170
WC-4265-2	Typical Partial Penetration Weld Detail for Category C Flat Head Closure Joints	171
WC-4265-3	Typical Flat Heads	172
WC-4266(a)-1	Nozzles Attached by Full Penetration Butt Welds	173
WC-4266(b)-1	Full Penetration Corner Welded Attachments	174
WC-4266(c)-1	Deposited Weld Metal Used As Reinforcement of Openings for Nozzles	175
WC-4266(d)-1	Fittings With Internal Threads	175
WC-4266(e)-1	Partial Penetration Weld Connections	176
WC-4427-1	Fillet and Socket Weld Details and Dimensions	181
WC-4433-1	Typical Types of Attachment Welds	182
WC-4433-2	Typical Attachments	183
WC-4622.10(c)(7)-1	Temper Bead Weld Repair and Weld Temper Bead Reinforcement	190
WC-4622.10(c)(7)-2	Temper Bead Reinforcement	191
WC-4622.10(f)-1	Qualification Test Plate	192
WC-4622.12(c)(6)-1	Temper Bead Weld Repair and Weld Temper Bead Reinforcement of Dissimilar Metal Welds or Buttering	194

TABLES

WA-4134.17-1	Lifetime Quality Assurance Records	12
WA-4134.17-2	Nonpermanent Quality Assurance Records	12
WA-7100-1	Dimensional Standards	16
WA-7100-2	Standards and Specifications Referenced in Text	17
WA-8100-1	Authorizations and Certification Mark Issued by the Society for the Construction of Transportation and Storage Containments and Parts	18
WB-2331.2-1	Required LST- RT_{NDT} Values for Ferritic Steel Material for Containment Material	37
WB-2331.2-2	Required Fracture Toughness Values for Ferritic Steel Material for Containments Having a Specified Yield Strength of 50 ksi (350 000 kPa) or Less at 100°F (38°C)	37
WB-2332(a)-1	Required C_v Values for Piping	37
WB-2333-1	Required C_v Values for Bolting Material	38

WB-2432.1-1	Sampling of Welding Materials for Chemical Analysis	41
WB-2432.2-1	Chemical Analysis for Welding Material	42
WB-3133.4-1	Values of Spherical Radius Factor, K_1	57
WB-3217-1	Classification of Stress Intensity in Containments for Some Typical Cases	63
WB-4232-1	Maximum Allowable Offset in Final Welded Joints	83
WB-4622.1-1	Mandatory Requirements for Postweld Heat Treatment of Welds	99
WB-4622.4(c)-1	Alternative Holding Temperatures and Times	99
WB-4622.7(b)-1	Exemptions to Mandatory PWHT	100
WB-5111-1	Thickness, IQI Designations, Essential Holes, and Wire Diameters	110
WC-2311(a)-1	Exemptions From Impact Testing Under WC-2311(a)(7)	127
WC-2332.1-1	Required C_v Lateral Expansion Values for Containment Material Other Than Bolting ...	128
WC-2332.1-2	Required C_v Energy Values for Containment Material Other Than Bolting	129
WC-2332.3-1	Required C_v Values for Bolting Material Tested in Accordance With WC-2332.3	129
WC-2432.1-1	Sampling of Welding Materials for Chemical Analysis	133
WC-2432.2-1	Welding Material Chemical Analysis	134
WC-3133.4-1	Values of Spherical Radius Factor K_1	145
WC-3217-1	Stress Intensity k Factors for Design and Operating Load Combinations	148
WC-3262-1	Stress Reduction Factors and Examinations for Closure Welds	162
WC-4232(a)-1	Maximum Allowable Offset in Final Welded Joints	168
WC-4524-1	Maximum Design Temperatures for Brazing Filler Metal, °F (°C)	185
WC-4622.1-1	Mandatory Requirements for Postweld Heat Treatment of Welds	186
WC-4622.4(c)-1	Alternative Holding Temperatures and Times	186
WC-4622.7(b)-1	Exemptions to Mandatory PWHT	187
WC-5111-1	Thickness, IQI Designations, Essential Holes, and Wire Diameters	197

FORMS

N-7	.....	22
N-8	.....	24
N-9	.....	25

ENDNOTES	209
-----------------	-------	-----

(13)

LIST OF SECTIONS

SECTIONS

- I Rules for Construction of Power Boilers

- II Materials
 - Part A — Ferrous Material Specifications
 - Part B — Nonferrous Material Specifications
 - Part C — Specifications for Welding Rods, Electrodes, and Filler Metals
 - Part D — Properties (Customary)
 - Part D — Properties (Metric)

- III Rules for Construction of Nuclear Facility Components
 - Subsection NCA — General Requirements for Division 1 and Division 2
 - Appendices
 - Division 1
 - Subsection NB — Class 1 Components
 - Subsection NC — Class 2 Components
 - Subsection ND — Class 3 Components
 - Subsection NE — Class MC Components
 - Subsection NF — Supports
 - Subsection NG — Core Support Structures
 - Subsection NH — Class 1 Components in Elevated Temperature Service
 - Division 2 — Code for Concrete Containments
 - Division 3 — Containments for Transportation and Storage of Spent Nuclear Fuel and High Level Radioactive Material and Waste
 - Division 5 — High Temperature Reactors

- IV Rules for Construction of Heating Boilers

- V Nondestructive Examination

- VI Recommended Rules for the Care and Operation of Heating Boilers

- VII Recommended Guidelines for the Care of Power Boilers

- VIII Rules for Construction of Pressure Vessels
 - Division 1
 - Division 2 — Alternative Rules
 - Division 3 — Alternative Rules for Construction of High Pressure Vessels

- IX Welding, Brazing, and Fusing Qualifications

- X Fiber-Reinforced Plastic Pressure Vessels

- XI Rules for Inservice Inspection of Nuclear Power Plant Components

- XII Rules for Construction and Continued Service of Transport Tanks

INTERPRETATIONS

ASME issues written replies to inquiries concerning interpretation of technical aspects of the Code.

Interpretations of the Code are posted in January and July at <http://cstools.asme.org/interpretations.cfm>. Any Interpretations issued during the previous two calendar years are included with the publication of the applicable Section of the Code. Interpretations of Section III, Divisions 1 and 2 and Section III Appendices are included with Subsection NCA.

CODE CASES

The Boiler and Pressure Vessel Code committees meet regularly to consider proposed additions and revisions to the Code and to formulate Cases to clarify the intent of existing requirements or provide, when the need is urgent, rules for materials or constructions not covered by existing Code rules. Those Cases that have been adopted will appear in the appropriate 2013 Code Cases book: "Boilers and Pressure Vessels" or "Nuclear Components." Supplements will be sent automatically to the purchasers of the Code Cases books up to the publication of the 2015 Code.

FOREWORD

(This Foreword is provided as an aid to the user and is not part of the rules of this Code.)

In 1911, The American Society of Mechanical Engineers established the Boiler and Pressure Vessel Committee to formulate standard rules for the construction of steam boilers and other pressure vessels. In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees:

- (a) Committee on Power Boilers (I)
- (b) Committee on Materials (II)
- (c) Committee on Construction of Nuclear Facility Components (III)
- (d) Committee on Heating Boilers (IV)
- (e) Committee on Nondestructive Examination (V)
- (f) Committee on Pressure Vessels (VIII)
- (g) Committee on Welding and Brazing (IX)
- (h) Committee on Fiber-Reinforced Plastic Pressure Vessels (X)
- (i) Committee on Nuclear Inservice Inspection (XI)
- (j) Committee on Transport Tanks (XII)

Where reference is made to “the Committee” in this Foreword, each of these committees is included individually and collectively.

The Committee's function is to establish rules of safety relating only to pressure integrity, which govern the construction* of boilers, pressure vessels, transport tanks, and nuclear components, and the inservice inspection of nuclear components and transport tanks. The Committee also interprets these rules when questions arise regarding their intent. This Code does not address other safety issues relating to the construction of boilers, pressure vessels, transport tanks, or nuclear components, or the inservice inspection of nuclear components or transport tanks. Users of the Code should refer to the pertinent codes, standards, laws, regulations, or other relevant documents for safety issues other than those relating to pressure integrity. Except for Sections XI and XII, and with a few other exceptions, the rules do not, of practical necessity, reflect the likelihood and consequences of deterioration in service related to specific service fluids or external operating environments. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property, and to provide a margin for deterioration in service to give a reasonably long, safe period of usefulness. Advancements in design and materials and evidence of experience have been recognized.

This Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities and inservice inspection and testing activities. The Code does not address all aspects of these activities and those aspects that are not specifically addressed should not be considered prohibited. The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment. The phrase *engineering judgement* refers to technical judgments made by knowledgeable engineers experienced in the application of the Code. Engineering judgments must be consistent with Code philosophy, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of the Code.

The Committee recognizes that tools and techniques used for design and analysis change as technology progresses and expects engineers to use good judgment in the application of these tools. The designer is responsible for complying with Code rules and demonstrating compliance with Code equations when such equations are mandatory. The Code neither requires nor prohibits the use of computers for the design or analysis of components constructed to the requirements of the Code. However, designers and engineers using computer programs for design or analysis are cautioned that they are responsible for all technical assumptions inherent in the programs they use and the application of these programs to their design.

* *Construction*, as used in this Foreword, is an all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification, and pressure relief.

The rules established by the Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design, or as limiting in any way the manufacturer's freedom to choose any method of design or any form of construction that conforms to the Code rules.

The Committee meets regularly to consider revisions of the rules, new rules as dictated by technological development, Code Cases, and requests for interpretations. Only the Committee has the authority to provide official interpretations of this Code. Requests for revisions, new rules, Code Cases, or interpretations shall be addressed to the Secretary in writing and shall give full particulars in order to receive consideration and action (see Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees). Proposed revisions to the Code resulting from inquiries will be presented to the Committee for appropriate action. The action of the Committee becomes effective only after confirmation by ballot of the Committee and approval by ASME. Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute (ANSI) and published at <http://cstools.asme.org/csconnect/public/index.cfm?PublicReview=Revisions> to invite comments from all interested persons. After public review and final approval by ASME, revisions are published at regular intervals in Editions of the Code.

The Committee does not rule on whether a component shall or shall not be constructed to the provisions of the Code. The scope of each Section has been established to identify the components and parameters considered by the Committee in formulating the Code rules.

Questions or issues regarding compliance of a specific component with the Code rules are to be directed to the ASME Certificate Holder (Manufacturer). Inquiries concerning the interpretation of the Code are to be directed to the Committee. ASME is to be notified should questions arise concerning improper use of an ASME Certification Mark.

When required by context in this Section, the singular shall be interpreted as the plural, and vice versa, and the feminine, masculine, or neuter gender shall be treated as such other gender as appropriate.

STATEMENT OF POLICY ON THE USE OF THE CERTIFICATION MARK AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use the Certification Mark for marking items or constructions that have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the Certification Mark for the benefit of the users, the enforcement jurisdictions, and the holders of the Certification Mark who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the Certification Mark, Certificates of Authorization, and reference to Code construction. The American Society of Mechanical Engineers does not “approve,” “certify,” “rate,” or “endorse” any item, construction, or activity and there shall be no statements or implications that might so indicate. An organization holding the Certification Mark and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities “are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code,” or “meet the requirements of the ASME Boiler and Pressure Vessel Code.” An ASME corporate logo shall not be used by any organization other than ASME.

The Certification Mark shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of the Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the Certification Mark. General usage is permitted only when all of a manufacturer’s items are constructed under the rules.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the official Certification Mark described in the governing Section of the Code.

Markings such as “ASME,” “ASME Standard,” or any other marking including “ASME” or the Certification Mark shall not be used on any item that is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME that tend to imply that all Code requirements have been met when, in fact, they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

(13) SUBMITTAL OF TECHNICAL INQUIRIES TO THE BOILER AND PRESSURE VESSEL STANDARDS COMMITTEES

1 INTRODUCTION

(a) The following information provides guidance to Code users for submitting technical inquiries to the committees. See Guideline on the Approval of New Materials Under the ASME Boiler and Pressure Vessel Code in Section II, Parts C and D for additional requirements for requests involving adding new materials to the Code. Technical inquiries include requests for revisions or additions to the Code rules, requests for Code Cases, and requests for Code Interpretations, as described below.

(1) *Code Revisions.* Code revisions are considered to accommodate technological developments, address administrative requirements, incorporate Code Cases, or to clarify Code intent.

(2) *Code Cases.* Code Cases represent alternatives or additions to existing Code rules. Code Cases are written as a question and reply, and are usually intended to be incorporated into the Code at a later date. When used, Code Cases prescribe mandatory requirements in the same sense as the text of the Code. However, users are cautioned that not all jurisdictions or owners automatically accept Code Cases. The most common applications for Code Cases are:

(-a) to permit early implementation of an approved Code revision based on an urgent need

(-b) to permit the use of a new material for Code construction

(-c) to gain experience with new materials or alternative rules prior to incorporation directly into the Code

(3) *Code Interpretations.* Code Interpretations provide clarification of the meaning of existing rules in the Code, and are also presented in question and reply format. Interpretations do not introduce new requirements. In cases where existing Code text does not fully convey the meaning that was intended, and revision of the rules is required to support an interpretation, an Intent Interpretation will be issued and the Code will be revised.

(b) The Code rules, Code Cases, and Code Interpretations established by the committees are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Code rules.

(c) Inquiries that do not comply with these provisions or that do not provide sufficient information for a committee's full understanding may result in the request being returned to the inquirer with no action.

2 INQUIRY FORMAT

Submittals to a committee shall include:

(a) *Purpose.* Specify one of the following:

(1) revision of present Code rules

(2) new or additional Code rules

(3) Code Case

(4) Code Interpretation

(b) *Background.* Provide the information needed for the committee's understanding of the inquiry, being sure to include reference to the applicable Code Section, Division, Edition, Addenda (if applicable), paragraphs, figures, and tables. Preferably, provide a copy of the specific referenced portions of the Code.

(c) *Presentations.* The inquirer may desire or be asked to attend a meeting of the committee to make a formal presentation or to answer questions from the committee members with regard to the inquiry. Attendance at a committee meeting shall be at the expense of the inquirer. The inquirer's attendance or lack of attendance at a meeting shall not be a basis for acceptance or rejection of the inquiry by the committee.