

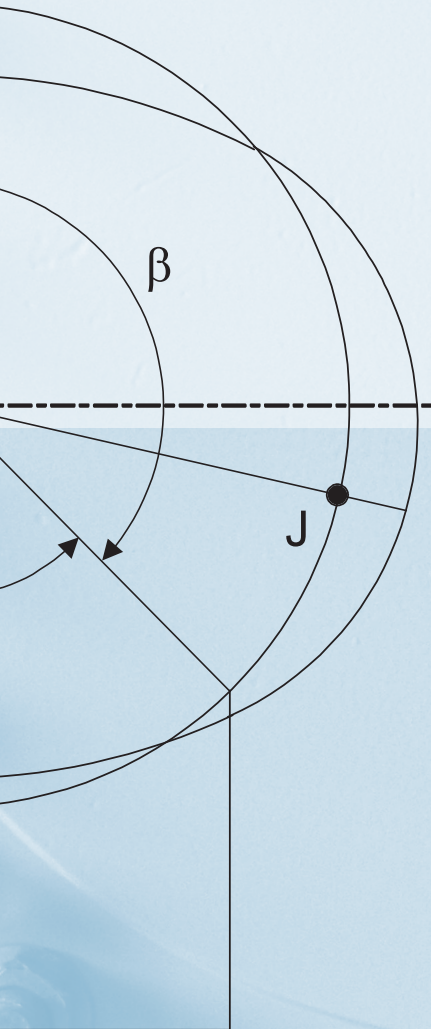
2013 ASME Boiler and Pressure Vessel Code

AN INTERNATIONAL CODE

III

Rules for Construction of Nuclear Facility Components

Division 5 High Temperature Reactors



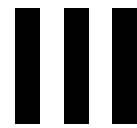
INTENTIONALLY LEFT BLANK

AN INTERNATIONAL CODE

2013 ASME Boiler & Pressure Vessel Code

2013 Edition

July 1, 2013



RULES FOR CONSTRUCTION OF NUCLEAR FACILITY COMPONENTS

Division 5

High Temperature Reactors

ASME Boiler and Pressure Vessel Committee
on Construction of Nuclear Facility Components



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	xiii
Foreword	xv
Statement of Policy on the Use of the Certification Mark and Code Authorization in Advertising	xvii
Statement of Policy on the Use of ASME Marking to Identify Manufactured Items	xvii
Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees	xviii
Personnel	xx
Organization of Section III	xxxv
Summary of Changes	xxxviii
List of Changes in Record Order Number	xl
Cross-Referencing and Stylistic Changes in the Boiler and Pressure Vessel Code	xli
Subsection HA	
General Requirements	1
Subpart A	
Metallic Materials	1
Article HAA-1000	
Introduction	1
HAA-1100	1
HAA-1110	1
HAA-1120	1
HAA-1130	1
Classification of Components and Supports	3
HAA-2100	3
HAA-2120	3
HAA-2130	3
Purpose of Classifying Items of a Nuclear Power Plant	3
Classifications and Rules of Division 5	3
Article HAA-7000	
Reference Standards	4
HAA-7100	4
General Requirements	4
Article HAA-8000	
Nameplates, Stamping with the Certification Mark, and Reports	5
HAA-8100	5
HAA-8110	5
Authorization to Perform Code Activities	5
General	5
Article HAA-9000	
Glossary	6
HAA-9100	6
HAA-9200	6
Introduction	6
Definitions	6
Subpart B	
Graphite Materials	7
Article HAB-1000	
Introduction	7
HAB-1100	7
HAB-1110	7
HAB-1120	7
HAB-1130	7
HAB-1140	7
HAB-1150	7
Limits of These Rules	7
Use of Code Editions, Addenda, and Cases	7
Units of Measurement	8
General Requirements for Items and Installation	8
HAB-1200	8
HAB-1210	8
HAB-1220	8
HAB-1280	8
Graphite Core Assembly	8
Materials	8
Installation	8

Article HAB-2000	Classification of Graphite Core Components	9
HAB-2100	General Requirements	9
HAB-2110	Scope	9
HAB-2130	Design Classes of Graphite Core Components	9
HAB-2140	Design Basis	9
Article HAB-3000	Responsibilities and Duties	11
HAB-3100	General	11
HAB-3110	Responsibilities Versus Legal Liabilities	11
HAB-3120	Certification	11
HAB-3200	Owner's Responsibilities	11
HAB-3220	Categories of the Owner's Responsibilities	11
HAB-3230	Owner's Certificate	12
HAB-3240	Provision of Adequate Supporting Structures	12
HAB-3250	Provision of Design Specifications	12
HAB-3260	Review of Design Report	13
HAB-3280	Owner's Data Report and Filing	13
HAB-3290	Owner's Responsibility for Records	13
HAB-3300	Responsibilities of a Designer	13
HAB-3320	Categories of the Designer's Responsibility	13
HAB-3340	Design Drawings and Construction Specification	14
HAB-3350	Requirements for Design Output Documents	14
HAB-3360	Certification of the Construction Specification, Design Drawings, and Design Report	14
HAB-3370	Revision of Design Drawings and Construction Specification	15
HAB-3380	Certification of Construction Report	15
HAB-3400	Responsibilities of a G Certificate Holder	15
HAB-3420	Categories of the G Certificate Holder's Responsibilities	15
HAB-3430	Obtaining a Certificate	15
HAB-3440	Compliance with This Subpart and Subsection HH, Subpart A	15
HAB-3450	Construction Documents	15
HAB-3460	Responsibility for Quality Assurance	16
HAB-3800	Graphite Material Organization's Quality System Program	16
HAB-3820	Certification or Qualification of Graphite Material Organizations	16
HAB-3830	Responsibilities of Graphite Material Organizations	17
HAB-3840	Evaluation of the Program	17
HAB-3850	Quality System Program Requirements	18
HAB-3860	Certification Requirements	22
Article HAB-4000	Quality Assurance	24
HAB-4100	Requirements	24
HAB-4110	Scope and Applicability	24
HAB-4120	Definitions	24
HAB-4130	Establishment and Implementation	24
Article HAB-5000	Authorized Inspection	28
HAB-5100	Introduction	28
HAB-5110	Applicability	28
HAB-5120	Performance of Inspection	28
HAB-5130	Access for Inspection Agency Personnel	28
HAB-5200	Duties of Graphite Inspector	29
HAB-5210	General Inspection Duties	29
HAB-5220	Categories of Graphite Inspector's Duties	29
HAB-5230	Scope of Work, Design Specifications, and Design Reports	29
HAB-5240	Quality Assurance Programs	29
HAB-5250	Qualification Records	30
HAB-5260	Materials and Graphite Core Components	30

HAB-5270	Examinations and Tests	30
HAB-5290	Data Reports and Construction Reports	30
HAB-5300	Responsibilities of the Authorized Inspection Agency	30
Article HAB-7000	Reference Standards	31
HAB-7100	General Requirements	31
Article HAB-8000	Certificates and Data Reports	32
HAB-8100	Authorization to Perform Code Activities	32
HAB-8110	General	32
HAB-8120	Scope of Certificates	32
HAB-8130	Inspection Agreement Required	32
HAB-8140	Quality Assurance Program Requirements	32
HAB-8150	Application for Certification	32
HAB-8160	Evaluation	32
HAB-8170	Issuance	32
HAB-8180	Renewal	33
HAB-8200	Nameplates	33
HAB-8400	Data Reports	33
HAB-8410	General Requirements	33
HAB-8420	Owner's Data Report	33
Article HAB-9000	Glossary	35
HAB-9100	Introduction	35
HAB-9200	Definitions	35
Mandatory Appendix HAB-I	Certificate Holder's Data Report Forms, Instructions, and Application Forms for Certificates of Authorization	37
Subpart C	Composite Materials	38
Article HAC-1000	Introduction	38
HAC-1100	General	38
HAC-1110	Scope	38
Subsection HB	Class A Metallic Pressure Boundary Components	39
Subpart A	Low Temperature Service	39
Article HBA-1000	Introduction	39
HBA-1100	General	39
HBA-1110	Scope	39
Article HBA-8000	Nameplates, Stamping with the Certification Mark, and Reports	40
HBA-8100	Requirements	40
Subpart B	Elevated Temperature Service	41
Article HBB-1000	Introduction	41
HBB-1100	General	41
HBB-1110	Scope	41
Article HBB-8000	Nameplates, Stamping with the Certification Mark, and Re- ports	43
HBB-8100	Requirements	43
Mandatory Appendix HBB-I	Use of SA-533 Type B, Class 1 Plate and SA-508 Grade 3, Class 1 Forgings and Their Weldments for Limited Elevated T emperature Service	44
Subsection HC	Class B Metallic Pressure Boundary Components	67
Subpart A	Low Temperature Service	67

Article HCA-1000	Introduction	67
HCA-1100	General	67
HCA-1110	Scope	67
Article HCA-8000	Nameplates, Stamping with the Certification Mark, and Reports	68
HCA-8100	Requirements	68
Subpart B	Elevated Temperature Service	69
Article HCB-1000	Introduction	69
HCB-1100	General	69
HCB-1110	Scope	69
HCB-1120	Alternative Design Rules	70
Article HCB-2000	Material	71
HCB-2100	General Requirements for Material	71
HCB-2400	.....	71
HCB-2430	.....	71
HCB-2500	.....	71
HCB-2570	.....	71
Article HCB-3000	Design	72
HCB-3100	General Design	72
HCB-3110	.....	72
HCB-3140	Buckling Instability Loadings	72
HCB-3150	Limitations on Use	73
HCB-3160	Components Containing Lethal or Hazardous Substances	73
HCB-3300	Vessel Design	73
HCB-3310	General Requirements	73
HCB-3400	Pump Design	73
HCB-3500	Valve Design	74
HCB-3510	General Requirements	74
HCB-3600	Piping Design	74
HCB-3630	General Requirements	74
Article HCB-4000	Fabrication and Installation	75
HCB-4100	General Requirements	75
HCB-4160	Components Containing Lethal or Hazardous Substances	75
HCB-4200	.....	75
HCB-4210	.....	75
HCB-4400	.....	76
HCB-4420	.....	76
Article HCB-5000	Examination	77
HCB-5100	General Requirements for Examination	77
HCB-5160	Components Containing Lethal or Hazardous Substances	77
Article HCB-6000	Testing	78
HCB-6100	General Requirements	78
HCB-6110	.....	78
HCB-6600	.....	78
HCB-6630	Alternative Tests of Closure Welds and Access Hatches	78
HCB-6640	Alternative Tests at Specially Designed Welded Seals	78
Article HCB-7000	Overpressure Protection	79
HCB-7100	General Requirements	79
HCB-7110	Scope	79
HCB-7140	.....	79
HCB-7200	.....	79
HCB-7220	Content of Report	79

HCB-7600	80
HCB-7610	80
HCB-7620	80
Article HCB-8000	
HCB-8100	Nameplates, Stamping with the Certification Mark, and Reports
	Requirements
Mandatory Appendix HCB-I	Stress Range Reduction Factor for Piping
Mandatory Appendix HCB-II	Allowable Stress Values for Class B Components
Mandatory Appendix HCB-III	Time-Temperature Limits for Creep and Stress-rupture Effects
Subsection HF	Class A and Class B Metallic Supports
Subpart A	Low Temperature Service
Article HFA-1000	Introduction
HFA-1100	General
HFA-1110	Scope
Subsection HG	Class A Metallic Core Support Structures
Subpart A	Low Temperature Service
Article HGA-1000	Introduction
HGA-1100	General
HGA-1110	Scope
Article HGA-8000	Nameplates, Stamping with the Certification Mark, and Reports
HGA-8100	Requirements
Subpart B	Elevated Temperature Service
Article HGB-1000	Introduction
HGB-1100	General
HGB-1110	Scope
HGB-1120 .....	.....
Article HGB-2000	Material
HGB-2100	General Requirements for Material
HGB-2120 .....	.....
HGB-2160	Deterioration of Material In Service
HGB-2400 .....	.....
HGB-2430 .....	.....
Article HGB-3000	Design
HGB-3100	General Design
HGB-3110 .....	.....
HGB-3120 .....	.....
HGB-3130 .....	.....
HGB-3200	Design by Analysis
HGB-3210	Design Criteria
HGB-3220	Design Rules and Limits or Load-controlled Stresses in Structures Other than Threaded Structural Fasteners
HGB-3230	Stress Limits for Load-Controlled Stresses in Threaded Structural Fasteners
HGB-3240	Special Requirements for Elevated Temperature Components ...
HGB-3250	Limits on Deformation-Controlled Quantities
HGB-3300 .....	.....
HGB-3350 .....	.....

Article HGB-4000	Fabrication and Installation	139
HGB-4100	General Requirements	139
HGB-4200	.....	139
HGB-4210	.....	139
HGB-4230	.....	139
HGB-4400	.....	140
HGB-4420	.....	140
Article HGB-5000	Examination	141
HGB-5100	General Requirements for Examination	141
HGB-5200	.....	141
HGB-5220	Requirements for Radiography or Ultrasonic and Liquid Penetrant or Magnetic Particle Examination	141
Article HGB-8000	Nameplates, Stamping with the Certification Mark, and Reports	147
HGB-8100	Requirements	147
Mandatory Appendix HGB-I	Rules for Strain, Deformation, and Fatigue Limits at Elevated Temperatures	148
Mandatory Appendix HGB-II	Rules for Construction of Core Support Structures, Extended for Restricted Service at Elevated Temperature, without Explicit Consideration of Creep and Stress-rupture	149
Mandatory Appendix HGB-III	Buckling and Instability	181
Mandatory Appendix HGB-IV	Time-Temperature Limits	184
Subsection HH	Class A Nonmetallic Core Support Structures	186
Subpart A	Graphite Materials	186
Article HHA-1000	Introduction	186
HHA-1100	Scope	186
HHA-1110	Aspects Covered	186
HHA-1120	Environmental Effects and Limits	186
HHA-1200	Requirements	186
HHA-1210	General	186
HHA-1220	Materials	186
HHA-1230	Design	187
HHA-1240	Graphite Core Component Machining	187
HHA-1250	Installation	187
HHA-1260	Responsibilities	187
HHA-1300	Application of These Rules	187
HHA-1400	Boundaries of Jurisdiction	187
HHA-1410	Boundary between Graphite Core Components and Core Support Structures	187
HHA-1420	Boundary between Graphite Core Components and Fuel Pebbles or Compacts	187
HHA-1430	Other Boundaries	187
Article HHA-2000	Materials	190
HHA-2100	General Requirements	190
HHA-2110	Material for Graphite Core Components	190
HHA-2120	Certification of Material	190
HHA-2130	Deterioration of Materials During Service	190
HHA-2140	Material Identification	191
HHA-2200	Material Properties for Design	191
HHA-2210	As-manufactured Material Properties	191
HHA-2220	Irradiated Material Properties	191

HHA-2230	Oxidized Material Properties	191
HHA-2300	Sampling	191
HHA-2310	General Requirements	191
HHA-2400	Material Manufacturer's Quality System Program	191
HHA-2500	Examination and Repair of Graphite Core Component Material ..	192
HHA-2510	Examination	192
HHA-2520	Repair	192
HHA-2600	Packaging, Transportation, and Storage	192
Article HHA-3000	Design	193
HHA-3100	General Design	193
HHA-3110	Graphite Core Components	193
HHA-3120	Loading Criteria	194
HHA-3130	Nomenclature	194
HHA-3140	Special Considerations	195
HHA-3200	Design by Analysis — Graphite Core Components	196
HHA-3210	Design Criteria for Graphite Core Components	196
HHA-3220	Stress Limits for Graphite Core Component — Simplified Assess- ment	200
HHA-3230	Probability of Failure Limits for Graphite Core Components — Full Assessment	202
HHA-3240	Experimental Limits — Design by Test	204
HHA-3300	Requirements for Design of the Graphite Core Assembly	204
HHA-3310	General Requirements	205
HHA-3320	Design Considerations	205
HHA-3330	Design of the Graphite Core Assembly	205
Article HHA-4000	Machining, Examination, and Testing	208
HHA-4100	General Requirements	208
HHA-4110	Introduction	208
HHA-4120	Certification of Materials and Machining by the Graphite Core Component Manufacturer	208
HHA-4130	Joining	208
HHA-4200	Machining, Examination, and Testing	208
HHA-4210	Procedures, Qualification, and Evaluation	208
HHA-4220	Graphite Core Component Machining	209
HHA-4230	Graphite Core Component Examination	209
HHA-4240	Graphite Core Component Testing	210
HHA-4250	Graphite Core Component Packaging	210
Article HHA-5000	Installation and Examination	212
HHA-5100	General Requirements	212
HHA-5110	Introduction	212
HHA-5200	Storage, Unpackaging, and Examination	212
HHA-5210	Storage and Unpackaging	212
HHA-5220	Examination of Graphite Core Components	212
HHA-5300	Installation	213
HHA-5310	Documentation	213
HHA-5400	Examination During Installation	213
HHA-5500	Examination Post-installation	213
Article HHA-8000	Nameplates, Stamping, and Reports	214
HHA-8100	Requirements	214
Mandatory Appendix HHA-I	Graphite Material Specifications	215
Mandatory Appendix HHA-II	Requirements for Preparation of a Material Data Sheet	216
Mandatory Appendix HHA-III	Requirements for Generation of Design Data for Graphite Grades	226

Nonmandatory Appendix HHA-A	Graphite as a Structural Material	231
Nonmandatory Appendix HHA-B	Effects of Fast Neutron Irradiation on Graphite	234
Nonmandatory Appendix HHA-C	Effects of Oxidation on Graphite	235
Nonmandatory Appendix HHA-D	Guidance on Defects and Flaws in Graphite	236
Subpart B	Composite Materials	237
Article HHB-1000	Introduction	237
HHB-1100	General	237
HHB-1110	Scope	237
 FIGURES		
HBB-I-3000-1	S_{mt} Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	47
HBB-I-3000-2	S_t Allowable Stress Intensity Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	48
HBB-I-3000-3	Stress-to-Rupture (Minimum) for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1 ..	49
HBB-I-3000-4	Isochronous Stress–Strain Curves for 700°F (371°C) For SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	50
HBB-I-3000-5	Isochronous Stress–Strain Curves for 750°F (399°C) For SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	51
HBB-I-3000-6	Isochronous Stress–Strain Curves for 800°F (427°C) For SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	52
HBB-I-3000-7	Isochronous Stress–Strain Curves for 850°F (454°C) For SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	53
HBB-I-3000-8	Isochronous Stress–Strain Curves for 900°F (482°C) For SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	54
HBB-I-3000-9	Isochronous Stress–Strain Curves for 950°F (510°C) For SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	55
HBB-I-3000-10	Isochronous Stress–Strain Curves for 1,000°F (538°C) For SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	56
HBB-I-3000-11	Design Fatigue Strain Range for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	57
HBB-I-3000-12	Creep–Fatigue Damage Envelope for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	58
HBB-I-3000-13	S_t Versus Time–Isothermal Curves for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	59
HBB-I-3000-14	Minimum Stress Rupture as a Function of Time and Temperature for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	60
HCB-4215-1	Permissible Time/Temperature Conditions for Material That Has Been Cold Worked > 5% and < 20% and Subjected to Short-Time, High-Temperature Transients	76
HCB-II-1000-1	Allowable Stress Flowchart for Class B Component	87
HCB-III-1000-1	Time–Temperature Limits for Service Level A and B Events	115
HGB-3224-1	Use-Fractions for Membrane Stress	134
HGB-3224-2	Use-Fractions for Membrane Plus Bending Stress	134
HGB-5223-1	Full Penetration Corner Weld Details for Category C Joints	143
HGB-5224.2-1	Nozzles Joined by Full Penetration Corner Welds	144
HGB-5224.3-1	Deposited Weld Metal Used as Reinforcement of Openings for Nozzles	145
HGB-5224.4-1	Oblique Connections	146
HGB-IV-1000-1	Time at Elevated Temperature, hr	185
HHA-1400-1	Jurisdictional Boundary for Graphite Core Components and Assemblies — Circumferential Section View	188
HHA-1400-2	Jurisdictional Boundary for Graphite Core Components and Assemblies — Longitudinal Section View	189
HHA-3141-1	Dependence of Strength on Weight Loss in Uniformly Oxidized Graphite of Classes IIHP or INHP	205
HHA-3141-2	Dependence of Strength on Weight Loss in Uniformly Oxidized Graphite of Classes EIHP, ENHP, MIHP, and MNHP	206
HHA-3221-1	Design Allowable Stresses Flowchart for SRC-1 Graphite Core Component	207
HHA-II-3100-1	Correction Factor T of the Shape Parameter M of Two-Parameter Weibull Distribution ($\gamma = 0.95$)	223

HHA-II-3100-2	Correction Factor T' of the Characteristic Value S_c of Two-Parameter Weibull Distribution ($\gamma = 0.95$)	224
HHA-A-1100-1		231
HHA-1160-1	Extrusion	232
HHA-1160-2	Molding	233

TABLES

HAA-1130-1	Values of $T_{\max}$ for Various Classes of Permitted Materials	2
HAA-7100-1	Standards and Specifications Referenced in Division 5 Associated With Metallic Components	4
HAB-3255-1	Document Distribution for Design and Construction of Graphite Core Components and Assemblies	23
HAB-4134.17-1	Lifetime Quality Assurance Records	26
HAB-4134.17-2	Nonpermanent Quality Assurance Records	27
HAB-7100-1	Standards and Specifications Referenced in This Subpart and Subsection HH, Subpart A	31
HAB-8100-1	Certificates Issued by the Society for Construction of Nuclear Graphite Core Components and Assemblies	34
HBB-I-3000-1	S_{mt} — Allowable Stress Intensity Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	60
HBB-I-3000-2	S_t — Allowable Stress Intensity Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1, ksi (MPa)	61
HBB-I-3000-3	Allowable Stress Intensity Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1, S_m Yield Strength and Tensile Strength Versus Temperature	61
HBB-I-3000-4	Expected Minimum Stress-to-Rupture Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1, ksi (MPa)	61
HBB-I-3000-5	Modulus of Elasticity Versus Temperature for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	61
HBB-I-3000-6	Instantaneous Coefficient of Thermal Expansion Versus Temperature for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	62
HBB-I-3000-7	Mean Coefficient of Thermal Expansion Versus Temperature for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	62
HBB-I-3000-8	Design Fatigue Strain Range for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1 up to 1,000°F (540°C)	62
HCB-I-2000-1	Stress Range Reduction Factor	83
HCB-I-2000-2	Maximum Number of Cycles, N_1 , Permissible With $f = 1$	84
HCB-II-2000-1	Allowable Stress Values for Ferritic Steel Class B Components	89
HCB-II-2000-2	Allowable Stress Values for Class B Bolting Materials	94
HCB-II-2000-3	Allowable Stress Values for Austenitic Steel Class B Components	96
HCB-II-2000-4	Allowable Stress Values for High-Nickel Alloy Class B Components	103
HCB-II-2000-5	Reduction Factors for Aging	104
HCB-II-3000-1	Allowable Stress Values for Ferritic Steel Class B Components	105
HCB-II-3000-2	Allowable Stress Values for Class B Bolting	107
HCB-II-3000-3	Allowable Stress Values for Austenitic Steel Class B Components	108
HCB-II-3000-4	Allowable Stress Values for High-Nickel Alloy Class B Components	111
HCB-II-3000-5	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for 304 SS Weldments	112
HCB-II-3000-6	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for 316 SS Weldments	112
HCB-II-3000-7	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for Alloy 800H Weldments	112
HCB-II-3000-8	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for 2 $\frac{1}{4}$ Cr-1Mo Weldments	113
HCB-II-3000-9	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for Modified 9Cr-1Mo Weldments	113
HCB-III-1000-1	Maximum Metal Temperatures During Level C Events	115
HGB-3217-1	Classification of Stress Intensity for Some Typical Cases	131
HGB-II-2121-1	Design Stress Intensity Values, S_m , for Ferritic Steels at Elevated Temperatures in Core Support Structure Applications	151

HGB-II-2121-2	Design Stress Intensity Values, S_m , for Ferritic Steels at Elevated Temperatures in Threaded Structural Fastener Applications	153
HGB-II-2121-3	Design Stress Intensity Values, S_m , for Austenitic and High Nickel Alloys at Elevated Temperatures in Core Support Structure Applications	155
HGB-II-2121-4	Design Stress Intensity Values, S_m , for Austenitic and High Nickel Alloys at Elevated Temperatures in Threaded Structural Fastener Applications	159
HGB-II-3222.4-1	Design Fatigue Limits for Solution Annealed Type 304SS	166
HGB-II-3222.4-2	Design Fatigue Limits for Solution Annealed Type 316SS	166
HGB-II-3222.4-3	Design Fatigue Limits for Ni-Cr-Fe Alloy 800H	168
HGB-II-3222.4-4	Design Fatigue Limits for 2 ¹ / ₄ Cr-1Mo Steel	169
HGB-II-3229-1	Yield Strength Values, S_y , for Ferritic Steels at Elevated Temperatures in Core Support Structure Applications	170
HGB-II-3229-2	Yield Strength Values, S_y , for Ferritic Steels at Elevated Temperatures in Threaded Structural Fastener Applications	172
HGB-II-3229-3	Yield Strength Values, S_y , for Austenitic and High Nickel Alloys at Elevated Temperatures in Core Support Structure and Threaded Structural Fastener Applications	174
HGB-II-3229-4	Tensile Strength Values S_u , for Ferritic Steels at Elevated Temperatures in Core Support Structure Applications	175
HGB-II-3229-5	Tensile Strength Values, S_u , for Ferritic Steels at Elevated Temperatures in Threaded Structural Fastener Applications	177
HGB-II-3229-6	Tensile Strength Values, S_u , for Austenitic and High Nickel Alloys at Elevated Temperatures in Core Support Structure and Threaded Structural Fastener Applications	178
HGB-III-2000-1	Time-Independent Buckling Limits	182
HHA-3221-1	Design Allowable Probability of Failure	206
HHA-4222-1	Prohibited and Controlled Substances	211
HHA-II-2000-1	Notes on Material Data Sheet, Forms MDS-1 and MDS-2	220
FORMS		
MDS-1	Material Data Sheet (SI Units)	218
MDS-2	Material Data Sheet (U.S. Customary)	219
ENDNOTES		239

(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, Brazing, and Fusing (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.