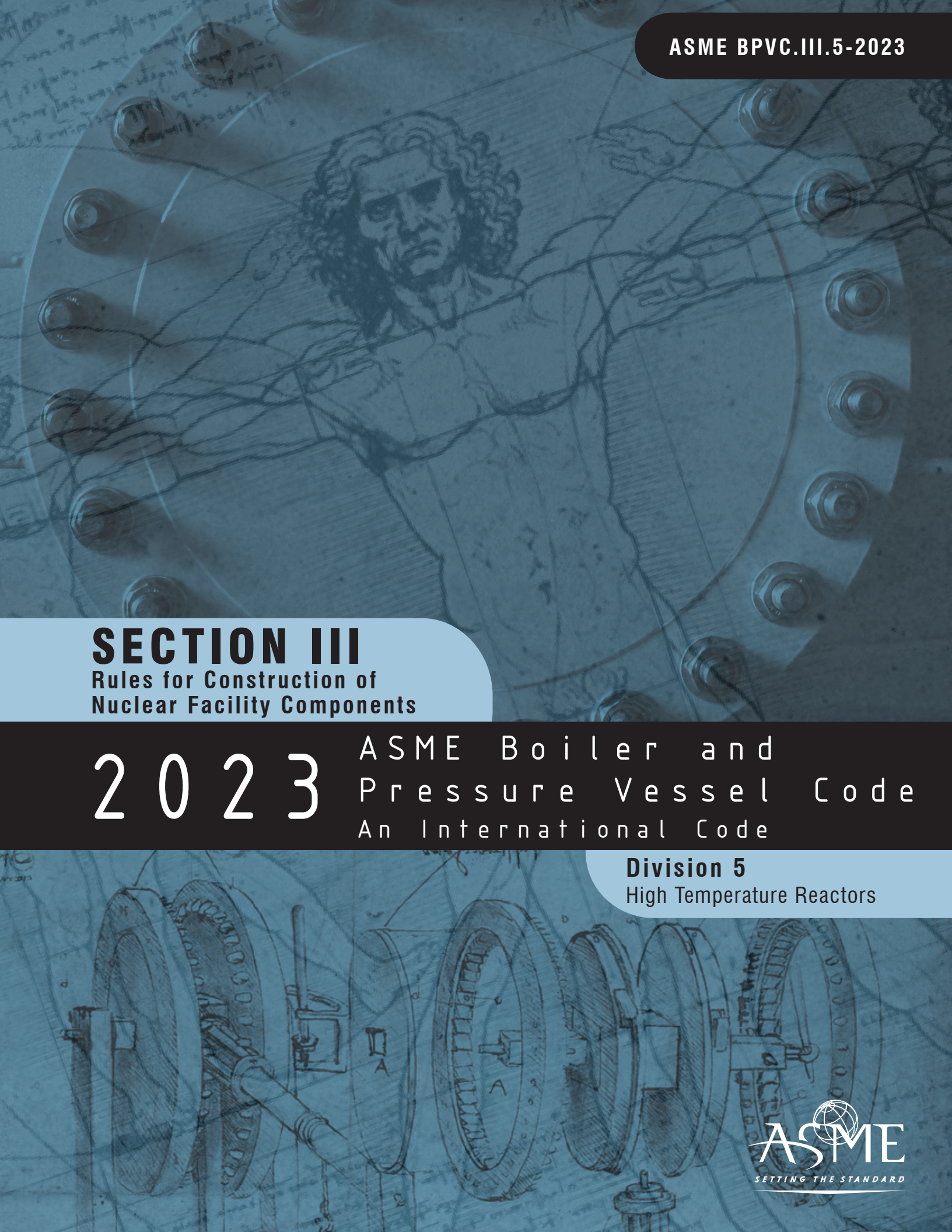

ASME BPVC.III.5-2023

SECTION III

Rules for Construction of Nuclear Facility Components

2023 ASME Boiler and Pressure Vessel Code

An International Code

Division 5

High Temperature Reactors

ASME

SETTING THE STANDARD

AN INTERNATIONAL CODE

2023 ASME Boiler & Pressure Vessel Code

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III

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

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TABLE OF CONTENTS

List of Sections xxv
Foreword xxvi
Statement of Policy on the Use of the ASME Single Certification Mark and Code Authorization in Advertising xxviii
Statement of Policy on the Use of ASME Marking to Identify Manufactured Items xxviii
Personnel xxix
Correspondence With the Committee li
Organization of Section III liii
Summary of Changes lvi
Cross-Referencing in the ASME BPVC lx

Subsection HA **General Requirements** 1

Subpart A **Metallic Materials** 1

Article HAA-1000 **Introduction** 1
HAA-1100 General 1
HAA-1110 Scope 1
HAA-1120 Definitions 1
HAA-1130 Limits of These Rules 1

Article HAA-2000 **Classification of Components and Supports** 3
HAA-2100 3
HAA-2120 Purpose of Classifying Items of a Nuclear Power Plant 3
HAA-2130 Classifications and Rules of Division 5 3

Article HAA-3000 **Responsibilities and Duties** 4
HAA-3100 4
HAA-3120 Certification 4
HAA-3200 4
HAA-3250 Provision of Design Specifications 4
HAA-3300 4
HAA-3310 4

Article HAA-7000 **Reference Standards** 5
HAA-7100 General Requirements 5

Article HAA-8000 **Nameplates, Stamping With the Certification Mark, and Reports** 6
HAA-8100 Authorization to Perform Code Activities 6
HAA-8110 General 6
HAA-8200 Nameplates and Stamping With Certification Mark 6
HAA-8210 General Requirements 6
HAA-8300 Certification Mark 6
HAA-8310 General Requirements 6
HAA-8400 Data Reports 6
HAA-8410 General Requirements 6

Article HAA-9000 **Glossary** 10
HAA-9100 Introduction 10
HAA-9200 Definitions 10

Subpart B **Graphite and Composite Materials** 11

Article HAB-1000 **Introduction** 11
HAB-1100 General 11
HAB-1110 Scope 11
HAB-1120 Definitions 11
HAB-1130 Limits of These Rules 11
HAB-1140 Use of Code Editions and Cases 11
HAB-1150 Units of Measurement 12
HAB-1200 General Requirements for Items and Installation 12
HAB-1210 Core Assembly 12
HAB-1220 Materials 12
HAB-1280 Installation 12

Article HAB-2000 **Classification of Core Components** 13
HAB-2100 General Requirements 13
HAB-2110 Scope 13
HAB-2130 Code Classes and Rules of Division 5 13
HAB-2140 Design Basis 13

Article HAB-3000 **Responsibilities and Duties** 15
HAB-3100 General 15
HAB-3110 Responsibilities Versus Legal Liabilities 15
HAB-3120 Certification 15
HAB-3200 Owner's Responsibilities 16
HAB-3220 Categories of the Owner's Responsibilities 16
HAB-3230 Owner's Certificate 16
HAB-3240 Provision of Adequate Supporting Structures 17
HAB-3250 Provision of Design Specifications 17
HAB-3260 Review of Design Report 18
HAB-3280 Owner's Data Report and Filing 18
HAB-3290 Owner's Responsibility for Records 18
HAB-3300 Responsibilities of a Designer 18
HAB-3320 Categories of the Designer's Responsibility 18
HAB-3330 Obtaining a Certificate 18
HAB-3340 Design Drawings and Construction Specification 18
HAB-3350 Requirements for Design Output Documents 19
HAB-3360 Certification of the Construction Specification, Design Drawings, and Design Report 19
HAB-3370 Revision of Design Drawings and Construction Specification 19
HAB-3380 Certification of Construction Report 19
HAB-3400 Responsibilities of a GC Certificate Holder 20
HAB-3420 Categories of the GC Certificate Holder's Responsibilities 20
HAB-3430 Obtaining a Certificate 20
HAB-3440 Compliance With This Subpart and Subsection HH 20
HAB-3450 Construction Documents 20
HAB-3460 Responsibility for Quality Assurance 21
HAB-3800 Material Organizations 21
HAB-3820 Certification or Qualification of Material Organizations 21
HAB-3830 Responsibilities of Material Organizations 21
HAB-3840 Evaluation of the Program 21
HAB-3860 Certification Requirements 23

Article HAB-4000 **Quality Assurance Requirements** 25
HAB-4100 Requirements 25
HAB-4110 Scope and Applicability 25
HAB-4120 Definitions 25
HAB-4130 Establishment and Implementation 25

HAB-4500	Graphite and Composite Material Organization Quality System Program Requirements	29
HAB-4550	Quality System Program Requirements	29
Article HAB-5000	**Authorized Inspection**	34
HAB-5100	Introduction	34
HAB-5110	Applicability	34
HAB-5120	Performance of Inspection	34
HAB-5130	Access for Inspection Agency Personnel	35
HAB-5200	Duties of Inspectors	35
HAB-5210	General Inspection Duties	35
HAB-5220	Categories of Duties for Inspectors	35
HAB-5230	Scope of Work, Design Specifications, and Design Reports	35
HAB-5240	Quality Assurance Programs	36
HAB-5250	Qualification Records	36
HAB-5260	Materials and Core Components	36
HAB-5270	Examinations and Tests	36
HAB-5290	Data Reports and Construction Reports	36
HAB-5300	Responsibilities of the Authorized Inspection Agency	37
Article HAB-7000	**Reference Standards**	38
HAB-7100	General Requirements	38
Article HAB-8000	**Certificates and Data Reports**	39
HAB-8100	Authorization to Perform Code Activities	39
HAB-8110	General	39
HAB-8120	Scope of Certificates	39
HAB-8130	Inspection Agreement Required	39
HAB-8140	Quality Assurance Program Requirements	39
HAB-8150	Application for Certification	39
HAB-8160	Evaluation	39
HAB-8170	Issuance	39
HAB-8180	Renewal	40
HAB-8200	Nameplates	40
HAB-8400	Data Reports	40
HAB-8410	General Requirements	40
HAB-8420	Owner's Data Report	40
Article HAB-9000	**Glossary**	42
HAB-9100	Introduction	42
HAB-9200	Definitions	42
Subsection HB	**Class A Metallic Pressure Boundary Components**	45
Subpart A	**Low Temperature Service**	45
Article HBA-1000	**Introduction**	45
HBA-1100	General	45
HBA-1110	Scope	45
Article HBA-2000	**Materials**	46
HBA-2600	Metallic Material Organizations' Quality System Programs	46
HBA-2610	Documentation and Maintenance of Quality System Programs	46
Article HBA-7000	**Overpressure Protection**	47
HBA-7800	Marking, Stamping With Certification Mark, and Data Reports	47
HBA-7810	Pressure Relief Valves	47
Article HBA-8000	**Nameplates, Stamping With the Certification Mark, and Reports**	48
HBA-8100	Requirements	48

Subpart B **Elevated Temperature Service** 49

Article HBB-1000 **Introduction** 49
HBB-1100 General 49
HBB-1110 Scope 49
HBB-1120 Temperature and Service Life Limits 50
HBB-1130 Organization of Subsection HB, Subpart B 50

Article HBB-2000 **Material** 51
HBB-2100 51
HBB-2120 Pressure-Retaining Materials 51
HBB-2160 Deterioration of Material in Service 51
HBB-2400 52
HBB-2430 52
HBB-2500 53
HBB-2530 53
HBB-2600 53
HBB-2610 Documentation and Maintenance of Quality System Programs 53
HBB-2800 Fatigue Acceptance Test 53

Article HBB-3000 **Design** 54
HBB-3100 General Requirements for Design 54
HBB-3110 Scope, Acceptability, and Loadings 54
HBB-3120 Special Considerations 56
HBB-3130 General Design Rules 56
HBB-3200 Design by Analysis 58
HBB-3210 Design Criteria 58
HBB-3220 Design Rules and Limits for Load-Controlled Stresses in Structures Other Than Bolts 63
HBB-3230 Stress Limits for Load-Controlled Stresses on Bolts 77
HBB-3240 Special Requirements for Elevated Temperature Components 78
HBB-3250 Limits on Deformation-Controlled Quantities 78
HBB-3300 Vessel Designs 78
HBB-3310 General Requirements 78
HBB-3330 Openings and Reinforcement 78
HBB-3350 Design of Welded Construction 79
HBB-3360 Special Vessel Requirements 82
HBB-3400 Design of Class A Pumps 83
HBB-3410 General Requirements 83
HBB-3420 Design Considerations 84
HBB-3430 Pump Types 85
HBB-3500 Design of Class A Valves 85
HBB-3510 Design Requirements 85
HBB-3520 85
HBB-3540 85
HBB-3550 Cyclic Loading Requirements 86
HBB-3600 Piping Design 86
HBB-3610 General Requirements 86
HBB-3620 Design Considerations 86
HBB-3640 Pressure Design of Components 87
HBB-3650 Analysis of Piping Components 88
HBB-3660 Design of Welds 88
HBB-3670 Special Piping Requirements 89

Article HBB-4000 **Fabrication and Installation** 90
HBB-4100 General Requirements 90
HBB-4110 Introduction 90
HBB-4200 90

HBB-4210		90
HBB-4240	Special Joints and Fittings — Added Rules for Division 1, NB-4240	90
HBB-4400		91
HBB-4420		91
Article HBB-5000	**Examination**	92
HBB-5100	General Requirements for Examination	92
HBB-5110	General Requirements	92
HBB-5130	Examination of Weld Edge Preparation Surfaces	92
HBB-5200	Required Examination of Welds	92
HBB-5210	Category A Vessel Welded Joints and Longitudinal Welded Joints in Other Components	92
HBB-5220	Category B Vessel Welded Joints and Circumferential Welded Joints in Other Components	92
HBB-5230	Category C Vessel Welded Joints and Similar Welded Joints in Other Components	93
HBB-5240	Category D Vessel Welded Joints and Branch and Piping Connections in Other Components	93
HBB-5260	Fillet, Socket, and Attachment Welds	94
Article HBB-6000	**Testing**	95
HBB-6100	General Requirements	95
HBB-6110	Scope of Testing	95
HBB-6120	Preparation for Testing	96
HBB-6200	Hydrostatic Tests	97
HBB-6210	Hydrostatic Testing Procedure	97
HBB-6220	Hydrostatic Test Pressure Requirements	97
HBB-6300	Pneumatic Tests	98
HBB-6310	Pneumatic Testing Procedures	98
HBB-6320	Pneumatic Test Pressure Requirements	98
HBB-6400	Pressure Test Gages	99
Article HBB-7000	**Overpressure Protection**	100
HBB-7100	General Requirements	100
HBB-7110	Scope	100
HBB-7130	Verification of the Operation of Pressure Relief Devices	100
HBB-7170	Permitted Use of Pressure Relief Devices	100
HBB-7200	Content of Overpressure Protection Report	100
HBB-7300	Relieving Capacity	100
HBB-7600	Nonreclosing Pressure Relief Devices	101
HBB-7610	Use of Rupture Disk Devices	101
HBB-7620		101
HBB-7800	Marking, Stamping With Certification Mark, and Data Reports	101
HBB-7810	Pressure Relief Valves	101
Article HBB-8000	**Nameplates, Stamping With the Certification Mark, and Reports**	102
HBB-8100	Requirements	102
Mandatory Appendix HBB-I-14	**Tables and Figures**	103
Mandatory Appendix HBB-II	**Use of SA-533 Type B, Class 1 Plate and SA-508 Grade 3, Class 1 Forgings and Their Weldments for Limited Elevated Temperature Service**	148
Article HBB-II-1000	**Scope**	148
Article HBB-II-2000	**Material**	149
Article HBB-II-3000	**Design**	150

Article HBB-II-4000	**Fabrication and Installation**	167
Article HBB-II-5000	**Examination**	168
Article HBB-II-6000	**Testing**	169
Article HBB-II-7000	**Overpressure Protection**	170
Nonmandatory Appendix HBB-T	**Rules for Strain, Deformation, and Fatigue Limits at Elevated Temperatures**	171
HBB-T-1100	Introduction	171
HBB-T-1200	Deformation Limits for Functional Requirements	171
HBB-T-1300	Deformation and Strain Limits for Structural Integrity	172
HBB-T-1400	Creep–Fatigue Evaluation	177
HBB-T-1500	Buckling and Instability	198
HBB-T-1700	Special Requirements	204
HBB-T-1800	Isochronous Stress–Strain Relations	205
Nonmandatory Appendix HBB-U	**Guidelines for Restricted Material Specifications to Improve Performance in Certain Service Applications**	290
HBB-U-1100	Scope	290
HBB-U-1200	Service Conditions	290
HBB-U-1300	Recommended Restrictions	290
Nonmandatory Appendix HBB-Y	**Guidelines for Design Data Needs for New Materials**	292
Article HBB-Y-1000	**Introduction**	292
HBB-Y-1100	Scope	292
Article HBB-Y-2000	**Load-Controlled Limits**	293
HBB-Y-2100	Time-Independent Data	293
HBB-Y-2200	Time-Dependent Data	293
HBB-Y-2300	Requirements for Welded Construction	294
Article HBB-Y-3000	**Deformation-Controlled Limits**	295
HBB-Y-3100	Isochronous Stress–Strain Curves	295
HBB-Y-3200	Relaxation Strength	295
HBB-Y-3300	Creep–Fatigue Data	295
HBB-Y-3400	Creep–Fatigue Data for Weldments	296
HBB-Y-3500	Cyclic Stress–Strain Curves	296
HBB-Y-3600	Inelastic Constitutive Model	297
HBB-Y-3700	Huddleston Multiaxial Failure Criterion	297
HBB-Y-3800	Time–Temperature Limits for External Pressure Charts	297
Article HBB-Y-4000	**Other Considerations**	298
HBB-Y-4100	Cold-Forming Limits	298
HBB-Y-4200	Environmental Effects	298
Nonmandatory Appendix HBB-Z	**Guidance on Constitutive Models for Design by Inelastic Analysis**	299
HBB-Z-1100	Introduction	299
HBB-Z-1200	Guidance on Constructing a Constitutive Model	299
HBB-Z-1300	Acceptable Material Models	301
Subsection HC	**Class B Metallic Pressure Boundary Components**	306
Subpart A	**Low Temperature Service**	306
Article HCA-1000	**Introduction**	306
HCA-1100	General	306
HCA-1110	Scope	306

Article HCA-8000	**Nameplates, Stamping With the Certification Mark, and Reports**	307
HCA-8100	Requirements	307
Subpart B	**Elevated Temperature Service**	308
Article HCB-1000	**Introduction**	308
HCB-1100	General	308
HCB-1110	Scope	308
HCB-1120	Alternative Rules	309
Article HCB-2000	**Material**	310
HCB-2100	General Requirements for Material	310
HCB-2400		310
HCB-2430		310
HCB-2500		310
HCB-2570		310
Article HCB-3000	**Design**	311
HCB-3100	General Design	311
HCB-3110		311
HCB-3140	Buckling Instability Loadings	311
HCB-3150	Limitations on Use	312
HCB-3160	Components Containing Lethal or Hazardous Substances	312
HCB-3300	Vessel Design	312
HCB-3310	General Requirements	312
HCB-3400	Pump Design	312
HCB-3500	Valve Design	313
HCB-3510	General Requirements	313
HCB-3600	Piping Design	313
HCB-3630	General Requirements	313
Article HCB-4000	**Fabrication and Installation**	315
HCB-4100	General Requirements	315
HCB-4160	Components Containing Lethal or Hazardous Substances	315
HCB-4200		315
HCB-4210		315
HCB-4400		316
HCB-4420		316
Article HCB-5000	**Examination**	318
HCB-5100	General Requirements for Examination	318
HCB-5160	Components Containing Lethal or Hazardous Substances	318
Article HCB-6000	**Testing**	319
HCB-6100	General Requirements	319
HCB-6110		319
HCB-6600		319
HCB-6630	Alternative Tests of Closure Welds and Access Hatches	319
HCB-6640	Alternative Tests at Specially Designed Welded Seals	319
Article HCB-7000	**Overpressure Protection**	320
HCB-7100	General Requirements	320
HCB-7110	Scope	320
HCB-7140		320
HCB-7200		320
HCB-7220	Content of Report	320
HCB-7600		321
HCB-7610		321
HCB-7620		321

Article HCB-8000	**Nameplates, Stamping With the Certification Mark, and Reports**	322
HCB-8100	Requirements	322
Mandatory Appendix HCB-I	**Stress Range Reduction Factor for Piping**	323
Article HCB-I-1000	**Stress Range Reduction Factor**	323
Article HCB-I-2000	**Maximum Number of Allowable Cycles With f = 1**	324
Article HCB-I-3000	**Equivalent Cycle**	325
Mandatory Appendix HCB-II	**Allowable Stress Values for Class B Components**	326
Article HCB-II-1000	**Scope**	326
Article HCB-II-2000	**Service With Negligible Creep Effects**	328
Article HCB-II-3000	**Service That May Include Creep Effects**	345
Mandatory Appendix HCB-III	**Time–Temperature Limits for Creep and Stress-Rupture Effects**	355
Article HCB-III-1000	**Introduction**	355
HCB-III-1100	Service Level A and B Loadings	355
HCB-III-1200	Service Level C Events	355
Subsection HF	**Class A and Class B Metallic Supports**	357
Subpart A	**Low Temperature Service**	357
Article HFA-1000	**Introduction**	357
HFA-1100	General	357
HFA-1110	Scope	357
Subsection HG	**Class SM Metallic Core Support Structures**	359
Subpart A	**Low Temperature Service**	359
Article HGA-1000	**Introduction**	359
HGA-1100	General	359
HGA-1110	Scope	359
Article HGA-8000	**Nameplates, Stamping With the Certification Mark, and Reports**	360
HGA-8100	Requirements	360
Subpart B	**Elevated Temperature Service**	361
Article HGB-1000	**Introduction**	361
HGB-1100	General	361
HGB-1110	Scope	361
HGB-1120		362
Article HGB-2000	**Material**	363
HGB-2100	General Requirements for Material	363
HGB-2120		363
HGB-2160	Deterioration of Material in Service	363
HGB-2400		363
HGB-2430		363
Article HGB-3000	**Design**	364
HGB-3100	General Design	364
HGB-3110		364
HGB-3120		365
HGB-3130		366

HGB-3200	Design by Analysis	366
HGB-3210	Design Criteria	366
HGB-3220	Design Rules and Limits for Load-Controlled Stresses in Structures Other Than Threaded Structural Fasteners	371
HGB-3230	Stress Limits for Load-Controlled Stresses in Threaded Structural Fasteners	377
HGB-3240	Special Requirements for Elevated Temperature Components	378
HGB-3250	Limits on Deformation-Controlled Quantities	378
HGB-3300		379
HGB-3350		379
Article HGB-4000	**Fabrication and Installation**	380
HGB-4100	General Requirements	380
HGB-4200		380
HGB-4210		380
HGB-4230		380
HGB-4400		381
HGB-4420		381
Article HGB-5000	**Examination**	382
HGB-5100	General Requirements for Examination	382
HGB-5200		382
HGB-5220	Requirements for Radiography or Ultrasonic and Liquid Penetrant or Magnetic Particle Examination	382
Article HGB-8000	**Nameplates, Stamping With the Certification Mark, and Reports**	388
HGB-8100	Requirements	388
Mandatory Appendix HGB-I	**Rules for Strain, Deformation, and Fatigue Limits at Elevated Temperatures**	389
Article HGB-I-1000	**Introduction**	389
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**	390
Article HGB-II-1000	**Introduction**	390
HGB-II-1100	General	390
Article HGB-II-2000	**Materials**	391
HGB-II-2100		391
HGB-II-2400		391
Article HGB-II-3000	**Design**	401
HGB-II-3100		401
HGB-II-3200		401
Article HGB-II-4000	**Fabrication and Installation Requirements**	419
HGB-II-4100		419
HGB-II-4200		419
Article HGB-II-5000	**Examination Requirements**	420
Mandatory Appendix HGB-III	**Buckling and Instability**	421
Article HGB-III-1000	**General Requirements**	421
Article HGB-III-2000	**Buckling Limits: Time-Independent Buckling**	422
Article HGB-III-3000	**Alternative Procedures**	423

Mandatory Appendix HGB-IV **Time–Temperature Limits** 424
Article HGB-IV-1000 **Time–Temperature Limits** 424
Subsection HH **Class SN Nonmetallic Core Components** 426
Subpart A **Graphite Materials** 426
Article HHA-1000 **Introduction** 426
HHA-1100 Scope 426
HHA-1110 Aspects Covered 426
HHA-1120 Environmental Effects and Limits 426
HHA-1200 Requirements 426
HHA-1210 General 426
HHA-1220 Materials 426
HHA-1230 Design 427
HHA-1240 Graphite Core Component Machining 427
HHA-1250 Installation 427
HHA-1260 Responsibilities 427
HHA-1300 Application of These Rules 427
HHA-1400 Boundaries of Jurisdiction 427
HHA-1410 Boundary Between Graphite Core Components and Core Support Structures 427
HHA-1420 Boundary Between Graphite Core Components and Fuel Pebbles or Compacts 427
HHA-1430 Other Boundaries 427
Article HHA-2000 **Materials** 430
HHA-2100 General Requirements 430
HHA-2110 Material for Graphite Core Components 430
HHA-2120 Certification of Material 430
HHA-2130 Deterioration of Materials During Service 430
HHA-2140 Material Identification 431
HHA-2200 Material Properties for Design 431
HHA-2210 As-Manufactured Material Properties 431
HHA-2220 Irradiated Material Properties 431
HHA-2230 Oxidized Material Properties 431
HHA-2300 Sampling 431
HHA-2310 General Requirements 431
HHA-2400 Material Manufacturer’s Quality System Program 432
HHA-2500 Examination and Repair of Graphite Core Component Material . 432
HHA-2510 Examination 432
HHA-2520 Repair 432
HHA-2600 Packaging, Transportation, and Storage 432
Article HHA-3000 **Design** 433
HHA-3100 General Design 433
HHA-3110 Graphite Core Components 433
HHA-3120 Loading Criteria 434
HHA-3130 Nomenclature 434
HHA-3140 Special Considerations 435
HHA-3200 Design by Analysis — Graphite Core Components 436
HHA-3210 Design Criteria for Graphite Core Components 436
HHA-3220 Stress Limits for Graphite Core Component — Simplified Assessment 440
HHA-3230 Probability of Failure Limits for Graphite Core Components — Full Assessment 443
HHA-3240 Experimental Limits — Design-by-Test 444
HHA-3300 Requirements for Design of the Graphite Core Assembly 445

HHA-3310	General Requirements	445
HHA-3320	Design Considerations	445
HHA-3330	Design of the Graphite Core Assembly	446
Article HHA-4000	**Machining, Examination, and Testing**	448
HHA-4100	General Requirements	448
HHA-4110	Introduction	448
HHA-4120	Certification of Materials and Machining by the Graphite Core Component Manufacturer	448
HHA-4130	Joining	448
HHA-4200	Machining, Examination, and Testing	448
HHA-4210	Procedures, Qualification, and Evaluation	448
HHA-4220	Graphite Core Component Machining	449
HHA-4230	Graphite Core Component Examination	449
HHA-4240	Graphite Core Component Testing	450
HHA-4250	Graphite Core Component Packaging	450
Article HHA-5000	**Installation and Examination**	452
HHA-5100	General Requirements	452
HHA-5110	Introduction	452
HHA-5200	Storage, Unpackaging, and Examination	452
HHA-5210	Storage and Unpackaging	452
HHA-5220	Examination of Graphite Core Components	452
HHA-5300	Installation	453
HHA-5310	Documentation	453
HHA-5400	Examination During Installation	453
HHA-5500	Examination Post-Installation	453
Article HHA-8000	**Nameplates, Stamping, and Reports**	454
HHA-8100	Requirements	454
Mandatory Appendix HHA-I	**Graphite Material Specifications**	455
Article HHA-I-1000	**Introduction**	455
HHA-I-1100	Scope	455
Mandatory Appendix HHA-II	**Requirements for Preparation of a Material Data Sheet**	456
Article HHA-II-1000	**Introduction**	456
Article HHA-II-2000	**Material Data Sheet Forms**	457
Article HHA-II-3000	**Detailed Requirements for Derivation of the Material Data Sheet — As-Manufactured Properties**	462
HHA-II-3100	Material Reliability Curve Parameters (Two Parameter for Simple Assessment)	462
HHA-II-3200	Material Reliability Curve Parameters (Three Parameter for Full Assessment)	463
HHA-II-3300	Design Allowable Stress Value	463
Article HHA-II-4000	**Detailed Requirements for Derivation of the Material Data Sheet — Irradiated Material Properties**	467
HHA-II-4100	General	467
Mandatory Appendix HHA-III	**Requirements for Generation of Design Data for Graphite Grades**	468
Article HHA-III-1000	**Scope**	468
Article HHA-III-2000	**General Requirements**	469
Article HHA-III-3000	**Properties to Be Determined**	470
HHA-III-3100	As-Manufactured Graphite	470

HHA-III-3200	Oxidized Graphite	470
HHA-III-3300	Irradiated Graphite	470
Article HHA-III-4000	**Requirement for Representative Data**	471
HHA-III-4100	As-Manufactured Graphite	471
HHA-III-4200	Irradiated or Oxidized Graphite	471
Article HHA-III-5000	**Use of Historical Data**	472
Nonmandatory Appendix HHA-A	**Graphite as a Structural Material**	473
Article HHA-A-1000	**Introduction**	473
HHA-A-1100	Manufacture	473
Nonmandatory Appendix HHA-B	**Environmental Effects in Graphite**	476
Article HHA-B-1000	**Introduction**	476
Article HHA-B-2000	**Radiation Damage**	477
Article HHA-B-3000	**Gas Coolant-Graphite Interactions (Oxidation)**	478
Article HHA-B-4000	**Salt Coolant-Graphite Interactions**	479
Article HHA-B-5000	**References**	480
Nonmandatory Appendix HHA-D	**Guidance on Defects and Flaws in Graphite**	482
Subpart B	**Composite Materials**	483
Article HHB-1000	**Introduction**	483
HHB-1100	Scope	483
HHB-1110	Aspects Covered	483
HHB-1120	Environmental Effects and Limits	483
HHB-1200	Requirements	483
HHB-1210	General	483
HHB-1220	Materials	483
HHB-1230	Design	483
HHB-1240	Machining and Installation	484
HHB-1250	Examination	484
HHB-1260	Testing	484
HHB-1270	Responsibilities	484
HHB-1300	Application of These Rules, and Definitions	484
HHB-1310	Application of These Rules	484
HHB-1320	Definitions	484
HHB-1400	Boundaries of Jurisdiction	484
HHB-1410	Boundary Between Composite Core Components and Other Components	484
HHB-1420	Other Boundaries	484
Article HHB-2000	**Composite Materials**	485
HHB-2100	General Requirements	485
HHB-2110	Ceramic Composite Materials for Composite Core Components	485
HHB-2120	Certification of Ceramic Composite Materials	485
HHB-2130	Deterioration of Ceramic Composite Materials During Service	486
HHB-2140	Material Identification	486
HHB-2200	Ceramic Composite Material Properties for Design	487
HHB-2210	As-Manufactured Ceramic Composite Material Properties	487
HHB-2220	Irradiated Ceramic Composite Material Properties	487
HHB-2230	Ceramic Composite Material Properties and Chemical Attack/ Oxidation	487
HHB-2240	STT Effects on Ceramic Composite Material Properties — Creep, Stress Rupture, Slow Crack Growth, and Fatigue	488

HHB-2300 Sampling . . . 488
HHB-2310 General Requirements . . . 488
HHB-2400 Material Manufacturer's Quality System Program . . . 488
HHB-2500 Examination and Repair of Composite Core Component Material 488
HHB-2510 Examination . . . 488
HHB-2520 Repair . . . 488
HHB-2600 Packaging, Transportation, and Storage . . . 488

Article HHB-3000 **Design** . . . 489
HHB-3100 General Design . . . 489
HHB-3110 Composite Core Components . . . 489
HHB-3120 Loading Criteria . . . 490
HHB-3130 Nomenclature . . . 491
HHB-3140 Special Considerations . . . 491
HHB-3200 Design by Analysis — Composite Core Components . . . 492
HHB-3210 Design Criteria for Composite Core Components . . . 492
HHB-3220 Stress Limits for Composite Core Components . . . 494
HHB-3240 Experimental Limits — Design by Test . . . 496
HHB-3300 Requirements for Design of the Core Assembly . . . 498
HHB-3310 General Requirements . . . 498

Article HHB-4000 **Machining and Installation** . . . 499
HHB-4100 Scope and General Requirements . . . 499
HHB-4110 Scope . . . 499
HHB-4120 General Requirements . . . 499
HHB-4200 Identification of Materials and Machined Composite Core Components . . . 499
HHB-4210 Materials . . . 499
HHB-4220 Machined Composite Core Components . . . 499
HHB-4300 Composite Core Component Machining . . . 499
HHB-4310 General . . . 499
HHB-4320 Machining Facilities and Tools . . . 500
HHB-4330 Joining . . . 500
HHB-4340 Rework . . . 500
HHB-4350 Other Processing Steps . . . 500
HHB-4360 Certification of Composite Core Components . . . 500
HHB-4370 Composite Core Component Packaging . . . 500
HHB-4400 Transportation, Storage, and Unpackaging . . . 501
HHB-4500 Installation . . . 501

Article HHB-5000 **Examination** . . . 502
HHB-5100 Scope . . . 502
HHB-5200 General Requirements . . . 502
HHB-5210 Nondestructive Examination Procedures . . . 502
HHB-5220 Qualifications of Examination Personnel . . . 502
HHB-5300 Examination After Machining . . . 502
HHB-5310 General . . . 502
HHB-5320 Dimensional Examination . . . 502
HHB-5330 Examination for Material Imperfections and Damage . . . 502
HHB-5400 Examination Before Installation . . . 503
HHB-5500 Examination During Installation . . . 503
HHB-5600 Examination Post-Installation . . . 503

Article HHB-6000 **Testing** . . . 504
HHB-6100 Scope . . . 504
HHB-6200 General Requirements . . . 504
HHB-6300 Specific Requirements . . . 504

Article HHB-8000 **Nameplates, Stamping, and Reports** 505
HHB-8100 Requirements 505

Mandatory Appendix HHB-I **Composite Material Specifications** 506

Article HHB-I-1000 **Introduction** 506
HHB-I-1100 Scope 506

Article HHB-I-2000 **Material Specifications for Composite Materials** 509

Mandatory Appendix HHB-II **Requirements for Preparation of a Material Data Sheet** 510

Article HHB-II-1000 **Introduction** 510

Article HHB-II-2000 **Material Data Sheet Forms** 511

Article HHB-II-3000 **Detailed Requirements for Derivation of the Material Data Sheet — As-Manufactured Properties** 545
HHB-II-3100 Introduction 545
HHB-II-3200 Definition of Material Failure Strength for Ceramic Composite Materials 545
HHB-II-3300 Damage Tolerance and Brittle Elastic and Pseudo-Ductile Stress–Strain Curves in Ceramic Composite Materials 545
HHB-II-3400 Material Reliability Curve Parameters (Two Parameters for Simple Assessment) 546
HHB-II-3500 Material Reliability Curve Parameters (Three Parameters for Full Assessment) 547
HHB-II-3600 Design Allowable Stress Value 548

Article HHB-II-4000 **Detailed Requirements for Derivation of the Material Data Sheet — Irradiated Material Properties** 549
HHB-II-4100 General 549

Article HHB-II-5000 **Detailed Requirements for Derivation of the Material Data Sheet — Material Properties Subject to Chemical Attack/Oxidation** 550
HHB-II-5100 General 550

Article HHB-II-6000 **Detailed Requirements for Derivation of the Material Data Sheet — Material Properties Subject to STT Effects** 551
HHB-II-6100 General 551

Article HHB-II-7000 **Reference** 552

Mandatory Appendix HHB-III **Requirements for Generation of Design Data for Ceramic Composite Materials** 553

Article HHB-III-1000 **Scope** 553

Article HHB-III-2000 **General Requirements** 554

Article HHB-III-3000 **Properties to Be Determined** 555
HHB-III-3100 As-Manufactured Ceramic Composite Material 555
HHB-III-3200 Irradiated Ceramic Composite Material 555
HHB-III-3300 Ceramic Composite Materials and Chemical Attack/Oxidation . . 555
HHB-III-3400 STT Exposure of Ceramic Composite Materials 556

Article HHB-III-4000 **Requirement for Representative Data** 557
HHB-III-4100 As-Manufactured Ceramic Composite Material 557
HHB-III-4200 Irradiated, Chemical Attack/Oxidation, and STT Ceramic Composite Material 557

Nonmandatory Appendix HHB-A **Classification of Ceramic Composite Materials for Nuclear Applications** . . . 558
Article HHB-A-1000 **Scope** . . . 558
Article HHB-A-2000 **Materials** . . . 559
Nonmandatory Appendix HHB-B **Composition, Structure, Manufacture, and Properties of Ceramic Matrix Composites** . . . 560
Article HHB-B-1000 **Introduction** . . . 560
HHB-B-1100 Ceramic Matrix Composites . . . 560
HHB-B-1200 Definitions . . . 561
HHB-B-1300 Composition and Structure of CMCS . . . 563
HHB-B-1400 Manufacturing of Preforms, Densification, and Postprocessing . . 563
HHB-B-1500 Mechanical, Thermal, Irradiation, and Degradation Properties . . 568
Article HHB-B-2000 **Summary** . . . 572
Article HHB-B-3000 **References** . . . 573
HHB-B-3100 Applications of CMCs . . . 573
HHB-B-3200 Fabrication and Manufacturing of CMCs . . . 573
HHB-B-3300 Mechanical Properties . . . 574
HHB-B-3400 Thermal Properties . . . 574
HHB-B-3500 Degradation — Thermal, Environmental, Irradiation . . . 575
Nonmandatory Appendix HHB-C **Fracture and Damage Mechanisms in SiC–SiC CMCs** . . . 576
Article HHB-C-1000 **Introduction** . . . 576
HHB-C-1100 Fracture and Damage Mechanisms . . . 576
HHB-C-1200 Definitions . . . 576
HHB-C-1300 Overview of Fracture and Damage Mechanisms of SiC–SiC CMCs 577
HHB-C-1400 Summary . . . 581
HHB-C-1500 References . . . 582
Nonmandatory Appendix HBB-D **Carbon–Carbon (C–C) Composite Materials** . . . 587
Nonmandatory Appendix HHB-E **Carbon-Carbon (C–C) Composite Materials Irradiation and Environmental Effects** . . . 594

FIGURES

HBB-3221-1 Flow Diagram for Elevated Temperature Analysis . . . 67
HBB-3224-1 Use-Fractions for Membrane Stress . . . 69
HBB-3224-2 Use-Fractions for Membrane Plus Bending Stress . . . 70
HBB-3351-1 Welded Joint Locations Typical of Categories A, B, C, and D . . . 80
HBB-3352-1 Typical Butt Joints . . . 81
HBB-3354-1 Permissible Attachment Weld Location . . . 82
HBB-3361-1 Category A and B Joints Between Sections of Unequal Thickness . . . 82
HBB-3410.2-1 Typical Single Volute Casing . . . 83
HBB-3410.2-2 Typical Double Volute Casing . . . 84
HBB-3421.11-1 Minimum Tangential Inlet and Outlet Wall Thickness . . . 85
HBB-4212-1 Permissible Time/Temperature Conditions for Material Which Has Been Cold Worked >5% and <20% and Subjected to Short-Time High Temperature Transients . . 91
HBB-I-14.3A S_{mt} — Type 304 SS . . . 106
HBB-I-14.3B S_{mt} — Type 316 SS . . . 108
HBB-I-14.3C S_{mt} — Ni-Fe-Cr (Alloy 800H) . . . 110
HBB-I-14.3D S_{mt} — $2^1/_4$Cr-1Mo . . . 112
HBB-I-14.3E S_{mt} — 9Cr-1Mo-V . . . 114
HBB-I-14.4A S_t — Type 304 SS . . . 115
HBB-I-14.4B S_t — Type 316 SS . . . 117
HBB-I-14.4C S_t — Ni-Fe-Cr (Alloy 800H) . . . 119

HBB-I-14.4D	S_t — $2\frac{1}{4}$Cr-1Mo	121
HBB-I-14.4E	S_t — 9Cr-1Mo-V	123
HBB-I-14.6A	Minimum Stress-to-Rupture	126
HBB-I-14.6B	Minimum Stress-to-Rupture	128
HBB-I-14.6C	Minimum Stress-to-Rupture — Ni-Fe-Cr (Alloy 800H)	130
HBB-I-14.6D	$2\frac{1}{4}$Cr-1Mo — 100% of the Minimum Stress-to-Rupture	132
HBB-I-14.6E	Minimum Stress-to-Rupture, Alloy 718	133
HBB-I-14.6F	9Cr-1Mo-V — Expected Minimum Stress-to-Rupture, ksi (MPa)	134
HBB-I-14.13A	S_{mt} — Allowable Stress Intensity, Type 304 SS, Bolting	145
HBB-I-14.13B	S_{mt} — Allowable Stress Intensity, Type 316 SS, Bolting	146
HBB-I-14.13C	S_{mt} — Allowable Stress, Alloy 718, Bolting	146
HBB-II-3000-1	S_{mt} Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	151
HBB-II-3000-2	S_t Allowable Stress Intensity Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	152
HBB-II-3000-3	Stress-to-Rupture (Minimum) for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	153
HBB-II-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	154
HBB-II-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	155
HBB-II-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	156
HBB-II-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	157
HBB-II-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	158
HBB-II-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	159
HBB-II-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	160
HBB-II-3000-11	Design Fatigue Strain Range for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	161
HBB-II-3000-12	Creep–Fatigue Damage Envelope for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	162
HBB-II-3000-13	S_t Versus Time-Isothermal Curves for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	163
HBB-II-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	164
HBB-T-1332-1	Effective Creep Stress Parameter Z for Simplified Inelastic Analysis Using Test No. B-1	176
HBB-T-1332-2	Effective Creep Stress Parameter Z for Simplified Inelastic Analysis Using Test No. B-2	177
HBB-T-1420-1A	Design Fatigue Strain Range, ϵ_t, for 304 SS	181
HBB-T-1420-1B	Design Fatigue Strain Range, ϵ_t, for 316 SS	183
HBB-T-1420-1C	Design Fatigue Strain Range, ϵ_t, for Ni-Fe-Cr Alloy 800H	185
HBB-T-1420-1D	Design Fatigue Strain Range, ϵ_t, for $2\frac{1}{4}$Cr-1Mo Steel	187
HBB-T-1420-1E	Design Fatigue Strain Range, ϵ_t, for 9Cr-1Mo-V Steel	188
HBB-T-1420-2	Creep–Fatigue Damage Envelope	190
HBB-T-1432-1	Stress–Strain Relationship	192
HBB-T-1432-2	Inelastic Multiaxial Adjustments	193
HBB-T-1432-3	Adjustment for Inelastic Biaxial Poisson's Ratio	194
HBB-T-1433-1	Methods of Determining Relaxation	196
HBB-T-1433-2	Stress-Relaxation Limits for Creep Damage	196
HBB-T-1433-3	Stress-Relaxation Limits for Creep Damage	197
HBB-T-1433-4	Envelope Stress-Time History for Creep Damage Assessment	197
HBB-T-1522-1	Time–Temperature Limits for Application of Section II External Pressure Charts	201
HBB-T-1522-2	Time–Temperature Limits for Application of Section II External Pressure Charts	202
HBB-T-1522-3	Temperature Limits for Application of Section II External Pressure Charts	203
HBB-T-1831-1	Average Isochronous Stress–Strain Curves	209
HBB-T-1831-2	Average Isochronous Stress–Strain Curves	210
HBB-T-1831-3	Average Isochronous Stress–Strain Curves	211
HBB-T-1831-4	Average Isochronous Stress–Strain Curves	212

HBB-T-1831-5	Average Isochronous Stress–Strain Curves	213
HBB-T-1831-6	Average Isochronous Stress–Strain Curves	214
HBB-T-1831-7	Average Isochronous Stress–Strain Curves	215
HBB-T-1831-8	Average Isochronous Stress–Strain Curves	216
HBB-T-1831-9	Average Isochronous Stress–Strain Curves	217
HBB-T-1831-10	Average Isochronous Stress–Strain Curves	218
HBB-T-1831-11	Average Isochronous Stress–Strain Curves	219
HBB-T-1831-12	Average Isochronous Stress–Strain Curves	220
HBB-T-1831-13	Average Isochronous Stress–Strain Curves	221
HBB-T-1831-14	Average Isochronous Stress–Strain Curves	222
HBB-T-1831-15	Average Isochronous Stress–Strain Curves	223
HBB-T-1831-16	Average Isochronous Stress–Strain Curves	224
HBB-T-1831-17	Average Isochronous Stress–Strain Curves	225
HBB-T-1832-1	Average Isochronous Stress–Strain Curves	231
HBB-T-1832-2	Average Isochronous Stress–Strain Curves	232
HBB-T-1832-3	Average Isochronous Stress–Strain Curves	233
HBB-T-1832-4	Average Isochronous Stress–Strain Curves	234
HBB-T-1832-5	Average Isochronous Stress–Strain Curves	235
HBB-T-1832-6	Average Isochronous Stress–Strain Curves	236
HBB-T-1832-7	Average Isochronous Stress–Strain Curves	237
HBB-T-1832-8	Average Isochronous Stress–Strain Curves	238
HBB-T-1832-9	Average Isochronous Stress–Strain Curves	239
HBB-T-1832-10	Average Isochronous Stress–Strain Curves	240
HBB-T-1832-11	Average Isochronous Stress–Strain Curves	241
HBB-T-1832-12	Average Isochronous Stress–Strain Curves	242
HBB-T-1832-13	Average Isochronous Stress–Strain Curves	243
HBB-T-1832-14	Average Isochronous Stress–Strain Curves	244
HBB-T-1832-15	Average Isochronous Stress–Strain Curves	245
HBB-T-1832-16	Average Isochronous Stress–Strain Curves	246
HBB-T-1832-17	Average Isochronous Stress–Strain Curves	247
HBB-T-1833-1	Average Isochronous Stress–Strain Curves	250
HBB-T-1833-2	Average Isochronous Stress–Strain Curves	251
HBB-T-1833-3	Average Isochronous Stress–Strain Curves	252
HBB-T-1833-4	Average Isochronous Stress–Strain Curves	253
HBB-T-1833-5	Average Isochronous Stress–Strain Curves	254
HBB-T-1833-6	Average Isochronous Stress–Strain Curves	255
HBB-T-1833-7	Average Isochronous Stress–Strain Curves	256
HBB-T-1833-8	Average Isochronous Stress–Strain Curves	257
HBB-T-1833-9	Average Isochronous Stress–Strain Curves	258
HBB-T-1833-10	Average Isochronous Stress–Strain Curves	259
HBB-T-1833-11	Average Isochronous Stress–Strain Curves	260
HBB-T-1833-12	Average Isochronous Stress–Strain Curves	261
HBB-T-1833-13	Average Isochronous Stress–Strain Curves	262
HBB-T-1834-1	Average Isochronous Stress–Strain Curves	266
HBB-T-1834-2	Average Isochronous Stress–Strain Curves	267
HBB-T-1834-3	Average Isochronous Stress–Strain Curves	268
HBB-T-1834-4	Average Isochronous Stress–Strain Curves	269
HBB-T-1834-5	Average Isochronous Stress–Strain Curves	270
HBB-T-1834-6	Average Isochronous Stress–Strain Curves	271
HBB-T-1834-7	Average Isochronous Stress–Strain Curves	272
HBB-T-1834-8	Average Isochronous Stress–Strain Curves	273
HBB-T-1834-9	Average Isochronous Stress–Strain Curves	274
HBB-T-1834-10	Average Isochronous Stress–Strain Curves	275
HBB-T-1834-11	Average Isochronous Stress–Strain Curves	276
HBB-T-1835-1	Average Isochronous Stress–Strain Curves	279
HBB-T-1835-2	Average Isochronous Stress–Strain Curves	280

HBB-T-1835-3	Average Isochronous Stress–Strain Curves	281
HBB-T-1835-4	Average Isochronous Stress–Strain Curves	282
HBB-T-1835-5	Average Isochronous Stress–Strain Curves	283
HBB-T-1835-6	Average Isochronous Stress–Strain Curves	284
HBB-T-1835-7	Average Isochronous Stress–Strain Curves	285
HBB-T-1835-8	Average Isochronous Stress–Strain Curves	286
HBB-T-1835-9	Average Isochronous Stress–Strain Curves	287
HBB-T-1835-10	Average Isochronous Stress–Strain Curves	288
HBB-T-1835-11	Average Isochronous Stress–Strain Curves	289
HBB-Y-3000-1	Conceptual Creep–Fatigue Damage Envelope	296
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	317
HCB-II-1000-1	Determination of Allowable Stress, S, for Class B Components	327
HCB-III-1000-1	Time–Temperature Limits for Service Level A and B Events	356
HGB-3224-1	Use-Fractions for Membrane Stress	375
HGB-3224-2	Use-Fractions for Membrane Plus Bending Stress	375
HGB-5223-1	Full Penetration Corner Weld Details for Category C Joints	384
HGB-5224.2-1	Nozzles Joined by Full Penetration Corner Welds	385
HGB-5224.3-1	Deposited Weld Metal Used as Reinforcement of Openings for Nozzles	386
HGB-5224.4-1	Oblique Connections	387
HGB-IV-1000-1	Time at Elevated Temperature, hr	425
HHA-1400-1	Jurisdictional Boundary for Graphite Core Components and Assemblies — Circumferential Section View	428
HHA-1400-2	Jurisdictional Boundary for Graphite Core Components and Assemblies — Longitudinal Section View	429
HHA-3221-1	Design Allowable Stresses Flowchart for SRC-1 Graphite Core Component	447
HHA-II-3100-1	Pivotal Quantity $t(n;0.95)$ of the Shape Parameter of the Two Parameter $m_{0.05}$ Weibull Distribution	464
HHA-II-3100-2	Pivotal Quantity $t'(n;0.95)$ of the Characteristic Stress Parameter $S_{c0.05}$ of the Two Parameter Weibull Distribution	465
HHA-A-1100-1		473
HHA-1160-1	Extrusion	475
HHA-1160-2	Molding	475
HHA-B-3000-1	Example of Dependence of Strength on Weight Loss in a Certain Graphite Grade Oxidized Uniformly	478
HHB-3221-1	Allowable Stresses Flowchart for SRC-1 and SRC-3 Composite Core Components	495
HHB-II-3300-1	Stress–Strain Curves for WIC Composites	546
HHB-II-3300-2	On-Axis (0 deg/90 deg) and Off-Axis (±45 deg) Tensile Loading	547
HHB-II-3300-3	Stress–Strain Curves for WMC Composites	547
HHB-B-1100-1	Three Commonly Accepted Classifications of Composites Based on Type of Matrix	561
HHB-B-1100-2	Comparison of Tensile Stress–Strain Response of Monolithic and Composite Ceramics Along With Fracture Surfaces of CMCs Showing Artifacts of Energy-Absorptive Mechanisms (i.e., Fiber Debond and Pullout)	562
HHB-B-1310-1	Specific Strength as a Function of Temperature (Note Advantages of CMCs)	564
HHB-B-1310-2	Damage and Fracture in a CMC Showing the Fiber Reinforcement, Interfacial Coating (Interphase), and the Matrix	564
HHB-B-1430-1	Examples of Fiber Architectures	567
HHB-B-1511-1	Tensile Stress–Strain Response of a 2D Woven CMC Showing Strain-Softening Behavior	568
HHB-B-1513-1	Circumferential (Hoop) and Longitudinal Stress–Strain Response of an Interlocked 3D Braided SiC–SiC CMC	569
HHB-B-1520-1	Thermal Conductivity Parallel and Perpendicular to Fibers in a C–C–SiC CMC	570
HHB-C-1300-1	Microcrack Initiation and Propagation in a 2D CMC Reflecting Cumulative Damage Process at Increasing Strain	578
HHB-C-1300-2	Fracture Surfaces of a CMC Resulting From Macrocrack Propagation Culminating in Fiber Debond/Pullout	578

HHB-C-1310-1 Comparison of Tensile Stress–Strain Response of Unreinforced Matrix (i.e., Monolithic) and Composite Ceramic With Callouts for Various Energy-Absorptive Fracture Surfaces in CMCs . . . 580
HHB-C-1320-1 Load/Unload/Reload Stress–Strain Curves and Cumulative Damage for a 2D Woven SiC–SiC CMC . . . 581
HHB-C-1320-2 Stress–Strain Curve, Acoustic Emission Energy, and Maximum and Residual Resistance Changes Versus Strain . . . 582
HHB-D-2000-1 Flow Diagram for a Typical Carbon-Carbon Composite Production Process . . . 589
HHB-E-2000-1 Mechanism of Radiation Damage in the Graphite Crystal . . . 596
HHB-E-2000-2 Irradiation-Induced Anisotropic Dimension Change in a HOPG Crystal . . . 596
HHB-E-2000-3 Core-Sheath Model of PAN Derived Carbon Fiber Structure . . . 596
HHB-E-2000-4 Neutron Irradiation Induced Dimensional Changes of Several C–C Composites Irradiated at 1,112°F (600°C) . . . 597
HHB-E-2000-5 Irradiation Dimensional Change in Two 3D, C–C Composites; Pitch and PAN Fibers . . . 597
HHB-E-3000-1 C–C Composite Following Irradiation at 923°F (500°C) and 1,472°F (800°C) . . . 598
HHB-E-4000-1 Temperature Dependence of Thermal Conductivity for 3D C–C Composites (a) PAN Fiber and (b) Pitch-Based Fiber . . . 599
HHB-E-4000-2 Fractional Reduction in Thermal Conductivity as a Function of Neutron Irradiation . . . 600
HHB- E-6000-1 Weight Loss as a Function of Time for Two Grades of 2D C–C Composites. . . . 604

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 . . . 5
HAA-8110-1 Certificates and Certification Mark Issued by the Society for Construction of High Temperature Reactor Metallic Components . . . 7
HAB-3255-1 Document Distribution for Design and Construction of Core Components and Assemblies 24
HAB-4134.17-1 Lifetime Quality Assurance Records . . . 28
HAB-4134.17-2 Nonpermanent Quality Assurance Records . . . 28
HAB-7100-1 Standards and Specifications Referenced in This Subpart and Subsection HH . . . 38
HAB-8100-1 Certificates Issued by the Society for Construction of Nuclear Core Components and Core Assemblies . . . 41
HBB-3133-1 Size Restrictions on Connections . . . 57
HBB-3217-1 Classification of Stress Intensity in Vessels for Some Typical Cases . . . 64
HBB-3217-2 Classification of Stress Intensity in Piping, Typical Cases . . . 66
HBB-3225-1 Tensile Strength Values, S_u . . . 72
HBB-3225-2 Tensile and Yield Strength Reduction Factor Due to Long Time Prior Elevated Temperature Service . . . 73
HBB-3225-3A Yield Strength Reduction Factors for 2¼Cr-1Mo . . . 73
HBB-3225-3B Tensile Strength Reduction Factors for 2¼Cr-1Mo . . . 74
HBB-3225-4A Yield Strength Reduction Factors for 9Cr-1Mo-V . . . 75
HBB-3225-4B Tensile Strength Reduction Factors for 9Cr-1Mo-V . . . 76
HBB-3642.1-1 Bend Radius Versus Thickness . . . 87
HBB-I-14.1(a) Permissible Base Materials for Structures Other Than Bolting . . . 103
HBB-I-14.1(b) Permissible Weld Materials . . . 104
HBB-I-14.2 S_o — Maximum Allowable Stress Intensity, ksi (MPa), for Design Condition Calculations 105
HBB-I-14.3A S_{mt} — Allowable Stress Intensity Values, 1,000 psi, Type 304 SS — 30-YS, 75-UTS (30-YS, 70-UTS) . . . 107
HBB-I-14.3B S_{mt} — Allowable Stress Intensity Values, 1,000 psi, Type 316 SS — 30-YS, 75-UTS (30-YS, 70-UTS) . . . 109
HBB-I-14.3C S_{mt} — Allowable Stress Intensity Values, ksi (MPa), Ni-Fe-Cr (Alloy 800H) . . . 111
HBB-I-14.3D S_{mt} — Allowable Stress Intensity Values, ksi (MPa), 2¼Cr-1Mo . . . 113
HBB-I-14.3E S_{mt} — Allowable Stress Intensity Values, ksi (MPa), 9Cr-1Mo-V . . . 115
HBB-I-14.4A S_t — Allowable Stress Intensity Values, 1,000 psi (MPa), Type 304 SS . . . 116
HBB-I-14.4B S_t — Allowable Stress Intensity Values, 1,000 psi (MPa), Type 316 SS . . . 118
HBB-I-14.4C S_t — Allowable Stress Intensity Values, ksi (MPa), Ni-Fe-Cr (Alloy 800H) . . . 120

HBB-I-14.4D	S_t — Allowable Stress Intensity Values, ksi (MPa), $2^1/_4$Cr-1Mo	122
HBB-I-14.4E	S_t — Allowable Stress Intensity Values, ksi (MPa), 9Cr-1Mo-V	124
HBB-I-14.5	Yield Strength Values, S_y, Versus Temperature	125
HBB-I-14.6A	Expected Minimum Stress-to-Rupture Values, 1,000 psi (MPa), Type 304 SS	127
HBB-I-14.6B	Expected Minimum Stress-to-Rupture Values, 1,000 psi (MPa), Type 316 SS	129
HBB-I-14.6C	Expected Minimum Stress-to-Rupture Values, ksi (MPa), Ni-Fe-Cr (Alloy 800H)	131
HBB-I-14.6D	$2^1/_4$Cr-1Mo — Expected Minimum Stress-to-Rupture Values, ksi (MPa)	132
HBB-I-14.6E	Expected Minimum Stress-to-Rupture Values, ksi (MPa), Ni-Cr-Fe-Mo-Cb (Alloy 718)	133
HBB-I-14.6F	9Cr-1Mo-V, S_r — Expected Minimum Stress-to-Rupture Values, ksi (MPa)	135
HBB-I-14.10A-1	Stress Rupture Factors for Type 304 Stainless Steel Welded With SFA-5.22 E 308T and E 308LT; SFA-5.4 E 308 and E 308L; and SFA-5.9 ER 308 and ER 308L	136
HBB-I-14.10A-2	Stress Rupture Factors for Type 304 Stainless Steel Welded With SFA-5.22 EXXXT-G (16-8-2 Chemistry); SFA-5.4 E 16-8-2; and SFA-5.9 ER 16-8-2	136
HBB-I-14.10A-3	Stress Rupture Factors for Type 304 Stainless Steel Welded With SFA-5.22 E 316T and E 316LT-1, -2, and -3; SFA-5.4 E 316 and E 316L; and SFA-5.9 ER 316 and ER 316L	137
HBB-I-14.10B-1	Stress Rupture Factors for Type 316 Stainless Steel Welded With SFA-5.22 E 308T and E 308L T; SFA-5.4 E 308 and E 308L; and SFA-5.9 ER 308 and ER 308L	138
HBB-I-14.10B-2	Stress Rupture Factors for Type 316 Stainless Steel Welded With SFA-5.22 EXXXT-G (16-8-2 Chemistry); SFA-5.4 E 16-8-2; and SFA-5.9 ER 16-8-2	139
HBB-I-14.10B-3	Stress Rupture Factors for Type 316 Stainless Steel Welded With SFA-5.22 E 316T and E 316LT-1 and -2; SFA-5.4 E 316 and E 316L; and SFA-5.9 ER 316 and ER 316L	140
HBB-I-14.10C-1	Stress Rupture Factors for Alloy 800H Welded With SFA-5.11 ENiCrFe-2 (INCO A)	141
HBB-I-14.10C-2	Stress Rupture Factors for Alloy 800H Welded With SFA-5.14 ERNiCr-3 (INCO 82)	142
HBB-I-14.10D-1	Stress Rupture Factors for $2^1/_4$Cr-1Mo (60/30) Welded With SFA-5.28 E 90C-B3; SFA-5.28 ER 90S-B3; SFA-5.5 E 90XX-B3 (>0.05C); SFA-5.23 EB 3; SFA-5.23 ECB 3 (>0.05C); SFA-5.29 E 90T1-B3 (>0.05C)	143
HBB-I-14.10E-1	Stress Rupture Factors for 9Cr–1Mo–V Welded With SFA-5.28 ER90S-B91; SFA-5.5 E90XX-B91; SFA-5.23 EB91	144
HBB-I-14.11	Permissible Materials for Bolting	144
HBB-I-14.12	S_o Values for Design Conditions Calculation of Bolting Materials S_o Maximum Allowable Stress Intensity, ksi (MPa)	145
HBB-I-14.13C	S_{mt} — Allowable Stress Values, ksi (MPa), Alloy 718, Bolting	147
HBB-II-3000-1	S_{mt} — Allowable Stress Intensity Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1, ksi (MPa)	164
HBB-II-3000-2	S_t — Allowable Stress Intensity Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1, ksi (MPa)	165
HBB-II-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	165
HBB-II-3000-4	Expected Minimum Stress-to-Rupture Values for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1, ksi (MPa)	165
HBB-II-3000-5	Modulus of Elasticity Versus Temperature for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	165
HBB-II-3000-6	Instantaneous Coefficient of Thermal Expansion Versus Temperature for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	166
HBB-II-3000-7	Mean Coefficient of Thermal Expansion Versus Temperature for SA-533 Type B, Class 1 and SA-508 Grade 3, Class 1	166
HBB-II-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)	166
HBB-T-1323	Temperatures at Which $S_m = S_t$ at 10^5 hr	173
HBB-T-1324	Values of the r and s Parameters	174
HBB-T-1411-1		178
HBB-T-1521-1	Time-Independent Buckling Factors	200
HBB-T-1522-1	Time-Dependent Load-Controlled Buckling Factors	200
HBB-T-1820-1	Temperature and Time Limits for Alloys in Isochronous Stress–Strain Curves	205
HBB-T-1831-1		207
HBB-T-1831-2		207

HBB-T-1831-3		207
HBB-T-1831-4		208
HBB-T-1832-1		227
HBB-T-1832-2		227
HBB-T-1832-3		228
HBB-T-1832-4		228
HBB-T-1832-5		229
HBB-T-1832-6		229
HBB-T-1832-7		230
HBB-T-1832-8		230
HBB-T-1833-1		249
HBB-T-1834-1		265
HBB-T-1834-2		265
HBB-T-1835-1		278
HBB-T-1835-2		278
HBB-U-1	Recommended Restrictions	291
HBB-Z-1212.4-1	Temperature Threshold for Class A Materials	300
HBB-Z-1322-1	Nomenclature	302
HBB-Z-1322-2	Temperature Dependent Young's Modulus	303
HBB-Z-1322.3	Temperature-Dependent Material Model Parameters	303
HBB-Z-1325-1	Nomenclature	304
HBB-Z-1325-2	Temperature-Independent Parameters	305
HBB-Z-1325-3	Temperature-Dependent Parameters	305
HCB-I-2000-1	Stress Range Reduction Factor	324
HCB-I-2000-2	Maximum Number of Cycles, N_1, Permissible With $f = 1$	324
HCB-II-2000-1	Allowable Stress Values for Ferritic Steel Class B Components	329
HCB-II-2000-2	Allowable Stress Values for Class B Bolting Materials	334
HCB-II-2000-3	Allowable Stress Values for Austenitic Steel Class B Components	336
HCB-II-2000-4	Allowable Stress Values for High-Nickel Alloy Class B Components	343
HCB-II-2000-5	Reduction Factors for Aging	344
HCB-II-3000-1	Allowable Stress Values for Ferritic Steel Class B Components	345
HCB-II-3000-2	Allowable Stress Values for Class B Bolting	348
HCB-II-3000-3	Allowable Stress Values for Austenitic Steel Class B Components	349
HCB-II-3000-4	Allowable Stress Values for High-Nickel Alloy Class B Components	352
HCB-II-3000-5	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for 304 SS Weldments	353
HCB-II-3000-6	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for 316 SS Weldments	353
HCB-II-3000-7	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for Alloy 800H Weldments	354
HCB-II-3000-8	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for $2\frac{1}{4}$Cr–1Mo Weldments	354
HCB-II-3000-9	Reduction Factors to Be Applied to Parent Metal Allowable Stresses for Modified 9Cr–1Mo Weldments	354
HCB-III-1000-1	Maximum Metal Temperatures During Level C Events	356
HGB-3217-1	Classification of Stress Intensity for Some Typical Cases	372
HGB-II-2121-1	Design Stress Intensity Values, S_m, for Ferritic Steels at Elevated Temperatures in Core Support Structure Applications	392
HGB-II-2121-2	Design Stress Intensity Values, S_m, for Ferritic Steels at Elevated Temperatures in Threaded Structural Fastener Applications	394
HGB-II-2121-3	Design Stress Intensity Values, S_m, for Austenitic and High Nickel Alloys at Elevated Temperatures in Core Support Structure Applications	396
HGB-II-2121-4	Design Stress Intensity Values, S_m, for Austenitic and High Nickel Alloys at Elevated Temperatures in Threaded Structural Fastener Applications	399
HGB-II-3222.4-1	Design Fatigue Limits for Solution Annealed Type 304 SS	406
HGB-II-3222.4-2	Design Fatigue Limits for Solution Annealed Type 316 SS	407

HGB-II-3222.4-3 Design Fatigue Limits for Ni–Cr–Fe Alloy 800H . . . 408
HGB-II-3222.4-4 Design Fatigue Limits for $2\frac{1}{4}$Cr–1Mo Steel . . . 409
HGB-II-3229-1 Yield Strength Values, S_y, for Ferritic Steels at Elevated Temperatures in Core Support Structure Applications . . . 410
HGB-II-3229-2 Yield Strength Values, S_y, for Ferritic Steels at Elevated Temperatures in Threaded Structural Fastener Applications . . . 412
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 . . . 414
HGB-II-3229-4 Tensile Strength Values, S_u, for Ferritic Steels at Elevated Temperatures in Core Support Structure Applications . . . 415
HGB-II-3229-5 Tensile Strength Values, S_u, for Ferritic Steels at Elevated Temperatures in Threaded Structural Fastener Applications . . . 417
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 . . . 418
HGB-III-2000-1 Time-Independent Buckling Limits . . . 422
HHA-3221-1 Design Allowable Probability of Failure . . . 446
HHA-4222-1 Prohibited and Controlled Substances . . . 451
HHA-II-2000-1 Notes on Material Data Sheet, Forms MDS-1 and MDS-2 . . . 460
HHA-II-3100-1 Normalized Upper Bounds on the Shape and Characteristic Stress Pivotal Quantities, Samples Sizes 5-120 . . . 466
HHB-3221-1 Allowable Probability of Failure . . . 495
HHB-I-1120-1 Mandatory Ceramic Composite Material Descriptors and Properties . . . 508
HHB-II-2000-1 Notes on Material Data Sheet, Forms MDS-3 and MDS-4 . . . 542
HHB-III-3100-1 Properties of As-Manufactured Ceramic Composite Materials . . . 556
HHB-B-1410-1 Examples of Key Properties of SiC-Based Fibers for High Temperature CMCs . . . 565
HHB-B-1512-1 Comparison of Strengths for 2D Woven CMCs . . . 569
HHB-B-1520-1 Examples of Thermal and Electrical Response for Selected 2D Woven CMCs . . . 570
HHB-B-2000-1 CMCs in Nuclear Applications . . . 572
HHB-D-3000-1 Selected Properties of Several Commercially Available C-C Composite Materials . . . 591
HHB-E-5000-1 Mechanical Properties of Three C–C Composites Materials — Post Irradiation Comparison . . . 602

FORMS

MDS-1 Material Data Sheet (SI Units) . . . 458
MDS-2 Material Data Sheet (U.S. Customary Units) . . . 459
MDS-3 Material Data Sheet — Ceramic Composite Material (SI Units) . . . 512
MDS-4 Material Data Sheet — Ceramic Composite Material (U.S. Customary Units) . . . 527

ENDNOTES . . . 607

LIST OF SECTIONS

(**23**)

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 NCD — Class 2 and Class 3 Components
  - Subsection NE — Class MC Components
  - Subsection NF — Supports
  - Subsection NG — Core Support Structures
- Division 2 — Code for Concrete Containments
- Division 3 — Containment Systems for Transportation and Storage of Spent Nuclear Fuel and High-Level Radioactive Material
- Division 4 — Fusion Energy Devices
- 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 Reactor Facility Components
- Division 1 — Rules for Inspection and Testing of Components of Light-Water-Cooled Plants
- Division 2 — Requirements for Reliability and Integrity Management (RIM) Programs for Nuclear Reactor Facilities

XII Rules for Construction and Continued Service of Transport Tanks

XIII Rules for Overpressure Protection

FOREWORD[*]

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)
(k) Committee on Overpressure Protection (XIII)
(l) Technical Oversight Management Committee (TOMC)

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 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. For nuclear items other than pressure-retaining components, the Committee also establishes rules of safety related to structural integrity. The Committee also interprets these rules when questions arise regarding their intent. The technical consistency of the Sections of the Code and coordination of standards development activities of the Committees is supported and guided by the Technical Oversight Management Committee. 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 and, for nuclear items other than pressure-retaining components, structural 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 components addressed by the Code. 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 judgment* 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

[*] The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Code.

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

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.

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://go.asme.org/BPVCPublicReview 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 the ASME Single 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.

The words "shall," "should," and "may" are used in this Standard as follows:

- *Shall* is used to denote a requirement.
- *Should* is used to denote a recommendation.
- *May* is used to denote permission, neither a requirement nor a recommendation.

STATEMENT OF POLICY ON THE USE OF THE ASME SINGLE 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 ASME Single 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 ASME Single Certification Mark for the benefit of the users, the enforcement jurisdictions, and the holders of the ASME Single 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 ASME Single 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 ASME Single 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 ASME Single 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 ASME Single Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the ASME Single Certification Mark.

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 ASME Single Certification Mark described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the ASME Single 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.

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January 1, 2023

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CORRESPONDENCE WITH THE COMMITTEE (23)

General

ASME codes and standards are developed and maintained by committees with the intent to represent the consensus of concerned interests. Users of ASME codes and standards may correspond with the committees to propose revisions or cases, report errata, or request interpretations. Correspondence for this Section of the ASME Boiler and Pressure Vessel Code (BPVC) should be sent to the staff secretary noted on the Section's committee web page, accessible at https://go.asme.org/CSCommittees.

NOTE: See ASME BPVC Section II, Part D for guidelines on requesting approval of new materials. See Section II, Part C for guidelines on requesting approval of new welding and brazing materials ("consumables").

Revisions and Errata

The committee processes revisions to this Code on a continuous basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Code. Approved revisions will be published in the next edition of the Code.

In addition, the committee may post errata and Special Notices at http://go.asme.org/BPVCerrata. Errata and Special Notices become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata and Special Notices.

This Code is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Code

(4) to permit use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases 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.

(c) The committee will consider proposed cases concerning the following topics only:

(1) equipment to be marked with the ASME Single Certification Mark, or

(2) equipment to be constructed as a repair/replacement activity under the requirements of Section XI

(d) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Code Section and the paragraph, figure, or table number(s) to which the proposed case applies

(4) the edition(s) of the Code to which the proposed case applies

(e) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Cases that have been approved will appear in the next edition or supplement of the Code Cases books, "Boilers and Pressure Vessels" or "Nuclear Components." Each Code Cases book is updated with seven Supplements. Supplements will be sent or made available automatically to the purchasers of the Code Cases books until the next edition of the Code. Annulments of Code Cases become effective six months after the first announcement of the annulment in a Code Case Supplement or Edition of the appropriate Code Case book. The status of any case is available at http://go.asme.org/BPVCCDatabase. An index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases is available at http://go.asme.org/BPVCC.

Interpretations

(a) Interpretations clarify existing Code requirements and are written as a question and reply. Interpretations do not introduce new requirements. If a revision to resolve conflicting or incorrect wording is required to support the interpretation, the committee will issue an intent interpretation in parallel with a revision to the Code.

(b) Upon request, the committee will render an interpretation of any requirement of the Code. An interpretation can be rendered only in response to a request submitted through the online Interpretation Submittal Form at http://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic e-mail confirming receipt.

(c) ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers may track the status of their requests at http://go.asme.org/Interpretations.

(d) ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME committee or subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

(e) Interpretations are published in the ASME Interpretations Database at http://go.asme.org/Interpretations as they are issued.

Committee Meetings

The ASME BPVC committees regularly hold meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the applicable committee. Information on future committee meetings can be found at http://go.asme.org/BCW.

ORGANIZATION OF SECTION III (23)

1 GENERAL

Section III consists of Division 1, Division 2, Division 3, Division 4, and Division 5. These Divisions are broken down into Subsections and are designated by capital letters preceded by the letter “N” for Division 1, by the letter “C” for Division 2, by the letter “W” for Division 3, by the letter "F" for Division 4, and by the letter “H” for Division 5. Each Subsection is published separately, with the exception of those listed for Divisions 2, 3, 4, and 5.

- Subsection NCA — General Requirements for Division 1 and Division 2
- Appendices
- Division 1
  - Subsection NB — Class 1 Components
  - Subsection NCD — Class 2 and Class 3 Components
  - Subsection NE — Class MC Components
  - Subsection NF — Supports
  - Subsection NG — Core Support Structures
- Division 2 — Code for Concrete Containments
  - Subsection CC — Concrete Containments
- Division 3 — Containment Systems for Transportation and Storage of Spent Nuclear Fuel and High-Level Radioactive Material
  - Subsection WA — General Requirements for Division 3
  - Subsection WB — Class TC Transportation Containments
  - Subsection WC — Class SC Storage Containments
  - Subsection WD — Class ISS Internal Support Structures
- Division 4 — Fusion Energy Devices
  - Subsection FA — Fusion Energy Device Facilities
  - Subsection FB — Pressure Boundary Components
- Division 5 — High Temperature Reactors
  - Subsection HA — General Requirements
    - Subpart A — Metallic Materials
    - Subpart B — Graphite Materials
    - Subpart C — Composite Materials
  - Subsection HB — Class A Metallic Pressure Boundary Components
    - Subpart A — Low Temperature Service
    - Subpart B — Elevated Temperature Service
  - Subsection HC — Class B Metallic Pressure Boundary Components
    - Subpart A — Low Temperature Service
    - Subpart B — Elevated Temperature Service
  - Subsection HF — Class A and B Metallic Supports
    - Subpart A — Low Temperature Service
  - Subsection HG — Class SM Metallic Core Support Structures
    - Subpart A — Low Temperature Service
    - Subpart B — Elevated Temperature Service
  - Subsection HH — Class SN Nonmetallic Core Components
    - Subpart A — Graphite Materials
    - Subpart B — Composite Materials

2 SUBSECTIONS

Subsections are divided into Articles, subarticles, paragraphs, and, where necessary, subparagraphs and subsubparagraphs.

3 ARTICLES

Articles are designated by the applicable letters indicated above for the Subsections followed by Arabic numbers, such as NB-1000. Where possible, Articles dealing with the same topics are given the same number in each Subsection, except NCA, in accordance with the following general scheme:

Article Number	Title
1000	Introduction or Scope
2000	Material
3000	Design
4000	Fabrication and Installation
5000	Examination
6000	Testing
7000	Overpressure Protection
8000	Nameplates, Stamping With Certification Mark, and Reports

The numbering of Articles and the material contained in the Articles may not, however, be consecutive. Due to the fact that the complete outline may cover phases not applicable to a particular Subsection or Article, the rules have been prepared with some gaps in the numbering.

4 SUBARTICLES

Subarticles are numbered in units of 100, such as NB-1100.

5 SUBSUBARTICLES

Subsubarticles are numbered in units of 10, such as NB-2130, and generally have no text. When a number such as NB-1110 is followed by text, it is considered a paragraph.

6 PARAGRAPHS

Paragraphs are numbered in units of 1, such as NB-2121.

7 SUBPARAGRAPHS

Subparagraphs, when they are *major* subdivisions of a paragraph, are designated by adding a decimal followed by one or more digits to the paragraph number, such as NB-1132.1. When they are *minor* subdivisions of a paragraph, subparagraphs may be designated by lowercase letters in parentheses, such as NB-2121(a).

8 SUBSUBPARAGRAPHS

Subsubparagraphs are designated by adding lowercase letters in parentheses to the *major* subparagraph numbers, such as NB-1132.1(a). When further subdivisions of *minor* subparagraphs are necessary, subsubparagraphs are designated by adding Arabic numerals in parentheses to the subparagraph designation, such as NB-2121(a)(1).

9 REFERENCES

References used within Section III generally fall into one of the following four categories:

(a) References to Other Portions of Section III. When a reference is made to another Article, subarticle, or paragraph, all numbers subsidiary to that reference shall be included. For example, reference to Article NB-3000 includes all material in Article NB-3000; reference to NB-3100 includes all material in subarticle NB-3100; reference to NB-3110 includes all paragraphs, NB-3111 through NB-3113.

(b) References to Other Sections. Other Sections referred to in Section III are the following:

(1) Section II, Materials. When a requirement for a material, or for the examination or testing of a material, is to be in accordance with a specification such as SA-105, SA-370, or SB-160, the reference is to material specifications in Section II. These references begin with the letter “S.”

(2) Section V, Nondestructive Examination. Section V references begin with the letter "T" and relate to the nondestructive examination of material or welds.

(3) Section IX, Welding and Brazing Qualifications. Section IX references begin with the letter "Q" and relate to welding and brazing requirements.

(4) Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components. When a reference is made to inservice inspection, the rules of Section XI shall apply.

(c) Reference to Specifications and Standards Other Than Published in Code Sections

(1) Specifications for examination methods and acceptance standards to be used in connection with them are published by the American Society for Testing and Materials (ASTM). At the time of publication of Section III, some such specifications were not included in Section II of this Code. A reference to ASTM E94 refers to the specification so designated by and published by ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

(2) Dimensional standards covering products such as valves, flanges, and fittings are sponsored and published by The American Society of Mechanical Engineers and approved by the American National Standards Institute.[*] When a product is to conform to such a standard, for example ASME B16.5, the standard is approved by the American National Standards Institute. The applicable year of issue is that suffixed to its numerical designation in Table NCA-7100-1, for example ASME B16.5-2003. Standards published by The American Society of Mechanical Engineers are available from ASME (https://www.asme.org/).

(3) Dimensional and other types of standards covering products such as valves, flanges, and fittings are also published by the Manufacturers Standardization Society of the Valve and Fittings Industry and are known as Standard Practices. When a product is required by these rules to conform to a Standard Practice, for example MSS SP-100, the Standard Practice referred to is published by the Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park Street, NE, Vienna, VA 22180. The applicable year of issue of such a Standard Practice is that suffixed to its numerical designation in Table NCA-7100-1, for example MSS SP-58-2009.

(4) Specifications for welding and brazing materials are published by the American Welding Society (AWS), 8669 NW 36 Street, No. 130, Miami, FL 33166. Specifications of this type are incorporated in Section II and are identified by the AWS designation with the prefix "SF," for example SFA-5.1.

(5) Standards applicable to the design and construction of tanks and flanges are published by the American Petroleum Institute and have designations such as API-605. When documents so designated are referred to in Section III, for example API-605–1988, they are standards published by the American Petroleum Institute and are listed in Table NCA-7100-1.

(d) References to Appendices. Section III uses two types of appendices that are designated as either Section III Appendices or Subsection Appendices. Either of these appendices is further designated as either Mandatory or Nonmandatory for use. Mandatory Appendices are referred to in the Section III rules and contain requirements that must be followed in construction. Nonmandatory Appendices provide additional information or guidance when using Section III.

(1) Section III Appendices are contained in a separate book titled "Appendices." These appendices have the potential for multiple subsection applicability. Mandatory Appendices are designated by a Roman numeral followed, when appropriate, by Arabic numerals to indicate various articles, subarticles, and paragraphs of the appendix, such as II-1500 or XIII-1210. Nonmandatory Appendices are designated by a capital letter followed, when appropriate, by Arabic numerals to indicate various articles, subarticles, and paragraphs of the appendix, such as D-1200 or Y-1440.

(2) Subsection Appendices are specifically applicable to just one subsection and are contained within that subsection. Subsection-specific mandatory and nonmandatory appendices are numbered in the same manner as Section III Appendices, but with a subsection identifier (e.g., NF, NH, D2, etc.) preceding either the Roman numeral or the capital letter for a unique designation. For example, NF-II-1100 or NF-A-1200 would be part of a Subsection NF mandatory or nonmandatory appendix, respectively. For Subsection CC, D2-IV-1120 or D2-D-1330 would be part of a Subsection CC mandatory or nonmandatory appendix, respectively.

(3) It is the intent of this Section that the information provided in both Mandatory and Nonmandatory Appendices may be used to meet the rules of any Division or Subsection. In case of conflict between Appendix rules and Division/Subsection rules, the requirements contained in the Division/Subsection shall govern. Additional guidance on Appendix usage is provided in the front matter of Section III Appendices.

[*] The American National Standards Institute (ANSI) was formerly known as the American Standards Association. Standards approved by the Association were designated by the prefix "ASA" followed by the number of the standard and the year of publication. More recently, the American National Standards Institute was known as the United States of America Standards Institute. Standards were designated by the prefix "USAS" followed by the number of the standard and the year of publication. While the letters of the prefix have changed with the name of the organization, the numbers of the standards have remained unchanged.

SUMMARY OF CHANGES

Changes listed below are identified on the pages by a margin note, **(23)**, placed next to the affected area. In addition, gender pronouns have been eliminated throughout this Division.

Page	*Location*	*Change*
xxv	List of Sections	*(1)* Under Section III, Division 4 added *(2)* Title of Section XI and subtitle of Section XI, Division 2 revised *(3)* Information on interpretations and Code cases moved to "Correspondence With the Committee"
xxix	Personnel	Updated
li	Correspondence With the Committee	Added (replaces "Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees")
liii	Organization of Section III	In para. 1, Division 4 added
lx	Cross-Referencing in the ASME BPVC	Updated
4	HAA-3300	Added
5	Table HAA-7100-1	Revised
11	HAB-1110	Subparagraph (b) revised
38	Table HAB-7100-1	Edition year for ISO/IEC 17025 revised
42	HAB-9200	*(1)* Definition of *EDN* deleted *(2)* Definition of *fluence* revised
46	Article HBA-2000	Added
53	HBB-2600	Added
73	Table HBB-3225-2	Last entry and Note (2) revised
75	Table HBB-3225-4A	Added
76	Table HBB-3225-4B	Former Table HBB-3225-4 redesignated
103	Table HBB-I-14.1(a)	*(1)* For "$2\frac{1}{4}$Cr–1Mo," SA-234, entry under "Types, Grades, or Classes" revised *(2)* For 9Cr–1Mo–V, all entries under "Types, Grades, or Classes" revised *(3)* Notes (1) and (6)(c) revised
104	Table HBB-I-14.1(b)	For 9Cr–1Mo–V, entries under "Class" revised
144	Table HBB-I-14.10E-1	Revised in its entirety
151	Figure HBB-II-3000-1	Editorially revised
152	Figure HBB-II-3000-2	Editorially revised
153	Figure HBB-II-3000-3	Editorially revised
161	Figure HBB-II-3000-11	Editorially revised
163	Figure HBB-II-3000-13	Editorially revised
164	Figure HBB-II-3000-14	Editorially revised

Page	*Location*	*Change*
177	HBB-T-1410	*(1)* In HBB-T-1411, definition of $(n)_j$ revised *(2)* In HBB-T-1413, first paragraph and Step 2 revised *(3)* In HBB-T-1414, Step 4 revised
180	HBB-T-1420	In subpara. (a), paragraph added below equation
188	Figure HBB-T-1420-1E	*(1)* In Note (2), third equation, variables to the left of the equal sign corrected by errata to N_{2S} *(2)* In Note (2) nomenclature, N_{S2} corrected by errata to N_{2S}
205	Table HBB-T-1820-1	*(1)* In second column head, "Maximum" corrected by errata to "Minimum" *(2)* Under "Maximum Time," last entry revised
205	HBB-T-1831	In subpara. (c), nomenclature corrected by errata
226	HBB-T-1832	In subpara. (c), nomenclature corrected by errata
228	Table HBB-T-1832-3	Under D, second entry "-4.499×10^{-17}" corrected by errata to "-4.499×10^{17}"
236	Figure HBB-T-1832-6	Revised
263	HBB-T-1834	*(1)* In subpara. (c), equation for ε_3, p_1 corrected by errata to p_2 *(2)* In subpara. (c), equation for a, operators corrected by errata
277	HBB-T-1835	In subpara. (c), TT corrected by errata to T in definition of Q_0
278	Table HBB-T-1835-2	Under Y, nineth entry, "410" corrected by errata to "376"
279	Figure HBB-T-1835-1	Revised
280	Figure HBB-T-1835-2	Revised
281	Figure HBB-T-1835-3	Revised
282	Figure HBB-T-1835-4	Revised
283	Figure HBB-T-1835-5	Revised
284	Figure HBB-T-1835-6	Revised
285	Figure HBB-T-1835-7	Revised
286	Figure HBB-T-1835-8	Revised
287	Figure HBB-T-1835-9	Revised
288	Figure HBB-T-1835-10	Revised
289	Figure HBB-T-1835-11	Revised
299	Nonmandatory Appendix HBB-Z	Added
363	HGB-2121	In subpara. (a), cross-reference to Section II, Part D tables corrected by errata
367	HGB-3213	Endnote 40 revised
372	Table HGB-3217-1	Note (6) revised
389	Article HGB-I-1000	Subparagraph (d) revised
391	HGB-II-2121	In subpara. (a), cross-reference to Section II, Part D tables corrected by errata
401	HGB-II-3220	Revised

Page	*Location*	*Change*
402	HGB-II-3222.4	*(1)* Endnote 46 revised *(2)* Cross-references to Subsection NG replaced by cross-references to Section III Appendices
404	HGB-II-3224	Revised
404	HGB-II-3224.1	Subparagraphs (a)(1), (a)(2), (b)(1), (b)(2), (b)(3), and (d) revised
405	HGB-II-3228.3	Revised
405	HGB-II-3229	First paragraph revised
405	HGB-II-3231	Subparagraph (b) revised
431	HHA-2230	First paragraph revised
434	HHA-3130	Revised
435	HHA-3140	Revised
435	HHA-3141	*(1)* Revised *(2)* Figure HHA-3141-1 moved to Article HHA-B-3000 and redesignated *(3)* Figure HHA-3141-2 deleted
436	HHA-3142	HHA-3142.1 and HHA-3142.2 revised
439	HHA-3215.2	Last line revised
439	HHA-3217	Subparagraphs (g)(2) and (g)(3) revised
444	HHA-3237	Revised
448	HHA-4110	Revised
449	HHA-4231	Revised
450	HHA-4241	Revised
450	HHA-4243	First line revised
450	HHA-4250	First paragraph revised
452	HHA-5110	Revised
452	HHA-5210	Subparagraph (f) revised
453	HHA-5400	Revised
453	HHA-5500	First paragraph revised
457	Article HHA-II-2000	*(1)* First paragraph revised *(2)* Forms MDS-1 and MDS-2 and Table HHA-II-2000-1 revised
462	Article HHA-II-3000	Revised in its entirety
470	HHA-III-3200	Revised
478	Article HHA-B-3000	Revised in its entirety
485	HHB-2111	In second paragraph, last line revised
486	HHB-2130	*(1)* Subparagraph (b) revised *(2)* Subparagraphs (c) and (d) added
486	HHB-2131	Subparagraphs (b) and (c) revised
487	HHB-2220	Subparagraph (c) revised
491	HHB-3130	Definition of R_{tc} deleted

Page	*Location*	*Change*
491	HHB-3142.1	Revised
494	HHB-3215.2	Last line revised
494	HHB-3220	Third paragraph revised
494	HHB-3221	Revised
495	Figure HHB-3221-1	Revised
496	HHB-3226.1	Revised
496	HHB-3227	Title and first line revised
499	HHB-4310	First paragraph revised
500	HHB-4360	Revised
502	HHB-5310	Revised
504	HHB-6200	Revised
506	HHB-I-1111	Subparagraph (d) revised
508	Table HHB-I-1120-1	Items (13), (14), and (23) revised
512	Form MDS-3	On seventh page of form, entries below "Design Strength and Material Reliability Curve Values" revised
527	Form MDS-4	On seventh page of form, entries below "Design Strength and Material Reliability Curve Values" revised
542	Table HHB-II-2000-1	*(1)* Items (13), (14), and (23) revised *(2)* Item (27) deleted
545	HHB-II-3100	First sentence revised
545	HHB-II-3200	Third paragraph revised
546	HHB-II-3400	In eq. (4), "= $-m \cdot \ln(x)$ + m·ln(S_c)" corrected by errata to "= $m \cdot \ln(x) - m \cdot \ln(S_c)$"
548	HHB-II-3600	In subpara. (a), first sentence revised
561	HHB-B-1200	Definition of *ceramic matrix composite (CMC)* revised
576	HHB-C-1100	Third sentence revised
579	HHB-C-1320	Fifth paragraph revised
587	Nonmandatory Appendix HBB-D	Added
594	Nonmandatory Appendix HHB-E	Added

(**23**)

CROSS-REFERENCING IN THE ASME BPVC

Paragraphs within the ASME BPVC may include subparagraph breakdowns, i.e., nested lists. The following is a guide to the designation and cross-referencing of subparagraph breakdowns:

(a) Hierarchy of Subparagraph Breakdowns

(1) First-level breakdowns are designated as (a), (b), (c), etc.

(2) Second-level breakdowns are designated as (1), (2), (3), etc.

(3) Third-level breakdowns are designated as (-a), (-b), (-c), etc.

(4) Fourth-level breakdowns are designated as (-1), (-2), (-3), etc.

(5) Fifth-level breakdowns are designated as (+a), (+b), (+c), etc.

(6) Sixth-level breakdowns are designated as (+1), (+2), etc.

(b) Cross-References to Subparagraph Breakdowns. Cross-references within an alphanumerically designated paragraph (e.g., PG-1, UIG-56.1, NCD-3223) do not include the alphanumerical designator of that paragraph. The cross-references to subparagraph breakdowns follow the hierarchy of the designators under which the breakdown appears. The following examples show the format:

(1) If X.1(c)(1)(-a) is referenced in X.1(c)(1), it will be referenced as (-a).

(2) If X.1(c)(1)(-a) is referenced in X.1(c)(2), it will be referenced as (1)(-a).

(3) If X.1(c)(1)(-a) is referenced in X.1(e)(1), it will be referenced as (c)(1)(-a).

(4) If X.1(c)(1)(-a) is referenced in X.2(c)(2), it will be referenced as X.1(c)(1)(-a).

SUBSECTION HA
GENERAL REQUIREMENTS

SUBPART A
METALLIC MATERIALS

ARTICLE HAA-1000
INTRODUCTION

HAA-1100 GENERAL

HAA-1110 SCOPE

The rules of this Subsection HA, Subpart A constitute the general requirements associated with metallic components used in the construction of high temperature reactor systems and their supporting systems.

(a) The rules of Subsection HA, Subpart A are contained in Divisions 1 and 2, Subsection NCA, except for those paragraphs or subparagraphs (with numbered headers) replaced by corresponding numbered HAA paragraphs or subparagraphs in this Subpart or new numbered HAA paragraphs or subparagraphs added to this Subpart.

(b) Division 1 rules may use different terminology than Division 5 (e.g., Class 1 and Class 2 versus Class A and Class B, etc.) but the application and use of these rules is identical for Division 5 construction.

(c) Division 1, Class 1 requirements are applicable to Division 5 construction but shall be referred to as Division 5, Class A.

(d) Division 1, Class CS requirements are applicable to Division 5 construction but shall be referred to as Division 5, Class SM.

(e) Division 1, Class 2 requirements are applicable to Division 5 construction but shall be referred to as Division 5, Class B.

(f) Division 1, Class 3 and Class MC requirements are not applicable to Division 5 construction.

(g) References to Appendices are to the Section III Appendices, unless otherwise identified.

HAA-1120 DEFINITIONS

Definitions of key terms used in this Division for metallic components are included in Article HAA-9000. The definitions in Article HAA-9000 shall prevail should a conflict exist with definitions found in Division 1 or in other documents referenced in this Division. Unless defined in Article HAA-9000, the definitions of Divisions 1 and 2, Article NCA-9000 shall apply.

HAA-1130 LIMITS OF THESE RULES

(a) The rules of this Division for metallic materials provide requirements for new construction and include consideration of mechanical and thermal stresses due to cyclic operation and high temperature creep. They do not cover deterioration that may occur in service as a result of radiation effects, corrosion, erosion, thermal embrittlement, or instability of the material. These effects shall be taken into account with a view to realizing the design or the specified life of the components and supports. The changes in properties of materials subjected to neutron radiation may be checked periodically by means of material surveillance programs.

(b) The rules are not intended to be applicable to valve operators, controllers, position indicators, pump impellers, pump drivers, or other accessories and devices, unless they are pressure-retaining parts or act as core support structures or supports. If such items are in a support load path, the provisions of HFA-1100 apply.