

SECTION VIII

Rules for Construction of Pressure Vessels

2023

ASME Boiler and
Pressure Vessel Code
An International Code

Division 3

Alternative Rules for Construction
of High Pressure Vessels

Markings such as “ASME,” “ASME Standard,” or any other marking including “ASME,” ASME logos, 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 or Standard. Use of the ASME Single Certification Mark requires formal ASME certification; if no certification program is available, such ASME markings may not be used. (For Certification and Accreditation Programs, see <https://www.asme.org/certification-accreditation>.)

Items produced by parties not formally possessing an ASME Certificate may not be described, either explicitly or implicitly, as ASME certified or approved in any code forms or other document.

AN INTERNATIONAL CODE

2023 ASME Boiler & Pressure Vessel Code

2023 Edition

July 1, 2023

VIII RULES FOR CONSTRUCTION OF PRESSURE VESSELS

Division 3

Alternative Rules for Construction of High Pressure Vessels

ASME Boiler and Pressure Vessel Committee
on Pressure Vessels



The American Society of
Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: July 1, 2023

This international code or standard was developed under procedures accredited as meeting the criteria for American National Standards and it is an American National Standard. The standards committee that approved the code or standard was balanced to ensure that individuals from competent and concerned interests had an opportunity to participate. The proposed code or standard was made available for public review and comment, which provided an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity. ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable letters patent, nor does ASME assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representatives or persons affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations of this document issued in accordance with the established ASME procedures and policies, which precludes the issuance of interpretations by individuals.

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



ASME Collective Membership Mark



ASME Single Certification Mark

“ASME” and the above ASME symbols are registered trademarks of The American Society of Mechanical Engineers.

No part of this document may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Library of Congress Catalog Card Number: 56-3934

Adopted by the Council of The American Society of Mechanical Engineers, 1914; latest edition 2023.

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

Copyright © 2023 by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
All rights reserved
Printed in U.S.A.

TABLE OF CONTENTS

List of Sections	xv
Foreword	xvi
Statement of Policy on the Use of the ASME Single Certification Mark and Code Authorization in Advertising	xviii
Statement of Policy on the Use of ASME Marking to Identify Manufactured Items	xviii
Personnel	xix
Correspondence With the Committee	xli
Summary of Changes	xliii
Cross-Referencing in the ASME BPVC	xlvi
Part KG	
General Requirements	1
Article KG-1	
Scope and Jurisdiction	1
KG-100 Scope	1
KG-110 Geometric Scope of This Division	1
KG-120 Classifications Outside the Scope of This Division	2
KG-130 Assembly and Testing of Vessels at Field or Intermediate Sites	2
KG-140 Standards Referenced by This Division	3
KG-150 Units of Measurement	3
KG-160 Tolerances	5
Article KG-2	
Organization of This Division	6
KG-200 Organization	6
Article KG-3	
Responsibilities and Duties	7
KG-300 General	7
KG-310 User's Responsibility	7
KG-320 Manufacturer's Responsibility	10
KG-330 Designer	12
Article KG-4	
General Rules for Inspection	14
KG-400 General Requirements for Inspection and Examination	14
KG-410 Manufacturer's Responsibilities	14
KG-420 Certification of Subcontracted Services	15
KG-430 The Inspector	15
KG-440 Inspector's Duties	15
Article KG-5	
Additional General Requirements for Composite Reinforced Pressure Vessels (CRPV)	17
KG-500 General Requirements	17
KG-510 Scope	17
KG-520 Supplemental General Requirements for CRPV	18
Article KG-6	
Additional General Requirements for Impulsively Loaded Vessels	19
KG-600 General Requirements	19
KG-610 Scope	19
Part KM	
Material Requirements	20
Article KM-1	
General Requirements	20
KM-100 Materials Permitted	20
Article KM-2	
Mechanical Property Test Requirements for Metals	24
KM-200 General Requirements	24

KM-210	Procedure for Obtaining Test Specimens and Coupons	24
KM-220	Procedure for Heat Treating Separate Test Specimens	26
KM-230	Mechanical Testing Requirements	26
KM-240	Heat Treatment Certification/Verification Tests for Fabricated Components	29
KM-250	Additional Toughness Requirements for Pressure-Retaining Component Materials	30
KM-260	Retests	31
KM-270	Notch Tensile Testing Procedure and Acceptance Criterion	31
Article KM-3	Supplementary Requirements for Bolting	37
KM-300	Requirements for All Bolting Materials	37
Article KM-4	Material Design Data	38
KM-400	Contents of Tables of Material Design Data	38
Article KM-5	Requirements for Laminate Materials	61
Article KM-6	Analytical Material Models	62
KM-600	Scope	62
KM-610	Ideally Elastic-Plastic (Non-Strain Hardening) Material Model	62
KM-620	Elastic-Plastic Stress-Strain Curve Model	62
KM-630	Cyclic Stress-Strain Curve	62
Article KM-7	Rules for Covers on Impulsively Loaded Vessels	67
KM-700	General	67
Part KD	Design Requirements	68
Article KD-1	General	68
KD-100	Scope	68
KD-110	Loadings	68
KD-120	Design Basis	69
KD-130	Design Criteria	70
KD-140	Fatigue Evaluation	70
Article KD-2	Basic Design Requirements	71
KD-200	Scope	71
KD-210	Terms Relating to Stress Analysis	71
KD-220	Equations for Cylindrical and Spherical Shells	73
KD-230	Elastic-Plastic Analysis	75
Article KD-3	Fatigue Evaluation	82
KD-300	Scope	82
KD-310	Stress Analysis for Fatigue Evaluation	82
KD-320	Calculated Number of Design Cycles	85
KD-330	Calculated Cumulative Effect Number of Design Cycles	87
KD-340	Fatigue Assessment of Welds — Elastic Analysis and Structural Stress ...	88
KD-350	Histogram Development and Cycle Counting for Fatigue Analysis	91
KD-370	Welded Joint Design Fatigue Curves	93
Article KD-4	Fracture Mechanics Evaluation	116
KD-400	Scope	116
KD-410	Crack Size Criteria	116
KD-420	Stress Intensity Factor K_I Calculation	117
KD-430	Calculation of Crack Growth Rates	117
KD-440	Calculated Number of Design Cycles	118
Article KD-5	Design Using Autofrettage	119
KD-500	Scope	119
KD-510	Limits on Autofrettage Pressure	120
KD-520	Calculation of Residual Stresses	120
KD-530	Design Calculations	122

Article KD-6	Design Requirements for Closures, Integral Heads, Threaded Fasteners, and Seals	123
KD-600	Scope	123
KD-620	Threaded Fasteners and Components	123
KD-630	Load-Carrying Shell With Single Threaded End Closures	124
KD-640	Integral Heads	125
KD-650	Quick-Actuating Closures	125
KD-660	Requirements for Closures and Seals	125
Article KD-7	Design Requirements for Attachments, Supports, and External Heating and Cooling Jackets	126
KD-700	General Requirements	126
KD-710	Materials for Attachments	126
KD-720	Welds Attaching Nonpressure Parts to Pressure Parts	126
KD-730	Design of Attachments	128
KD-740	Design of Supports	128
KD-750	Jacketed Vessels	128
Article KD-8	Special Design Requirements for Layered Vessels	129
KD-800	General	129
KD-810	Rules for Shrink-Fit Layered Vessels	130
KD-820	Rules for Concentrically Wrapped and Welded Layered Vessels	131
KD-830	Design of Welded Joints	133
KD-840	Openings and Their Reinforcement	133
KD-850	Supports	133
Article KD-9	Special Design Requirements for Wire-Wound Vessels and Wire-Wound Frames	140
KD-900	Scope	140
KD-910	Stress Analysis	140
KD-920	Stress Limits	142
KD-930	Fatigue Evaluation	142
Article KD-10	Special Requirements for Vessels in Hydrogen Service	145
KD-1000	Scope	145
KD-1010	Fatigue Life Evaluation Using Fracture Mechanics	146
KD-1020	Fracture Mechanics Properties	146
KD-1040	Test Method for K_{IH} Determination	147
KD-1050	Fatigue Crack Growth Rate Tests	148
Article KD-11	Design Requirements for Welded Vessels	150
KD-1100	Scope	150
KD-1110	Types of Joints Permitted	150
KD-1120	Transition Joints Between Sections of Unequal Thickness	150
KD-1130	Nozzle Attachments	151
Article KD-12	Experimental Design Verification	156
KD-1200	General Requirements	156
KD-1210	Types of Tests	156
KD-1220	Strain Measurement Test Procedure	156
KD-1230	Photoelastic Test Procedure	157
KD-1240	Test Procedures	157
KD-1250	Interpretation of Results	157
KD-1260	Experimental Determination of Allowable Number of Operating Cycles ..	158
KD-1270	Determination of Fatigue Strength Reduction Factors	162
Article KD-13	Additional Design Requirements for Composite Reinforced Pressure Vessels (CRPV)	163
KD-1300	Scope	163
KD-1310	General	163

Part KF	Fabrication Requirements	165
Article KF-1	General Fabrication Requirements	165
KF-100	General	165
KF-110	Material	165
KF-120	Material Forming	166
KF-130	Tolerances for Cylindrical and Spherical Shells and Heads	167
Article KF-2	Supplemental Welding Fabrication Requirements	168
KF-200	General Requirements for All Welds	168
KF-210	Welding Qualifications and Records	168
KF-220	Weld Joints Permitted and Their Examination	169
KF-230	Requirements During Welding	170
KF-240	Repair of Weld Defects	172
Article KF-3	Fabrication Requirements for Materials With Protective Linings	173
KF-300	Scope	173
KF-310	Qualification of Welding Procedures	173
KF-320	Integrally Clad Materials	174
KF-330	Postweld Heat Treatment of Linings	174
KF-340	Examination Requirements	174
KF-350	Inspection and Tests	174
KF-360	Stamping and Reports	175
Article KF-4	Heat Treatment of Weldments	176
KF-400	Heat Treatment of Weldments	176
KF-410	Heating Procedures for Postweld Heat Treatment	179
KF-420	Postweld Heat Treatment After Repairs	180
Article KF-5	Additional Fabrication Requirements for Autofrettaged Vessels	181
KF-500	General	181
KF-510	Examination and Repair	181
KF-520	Autofrettage Procedures	181
KF-530	Examination After Autofrettage	181
KF-540	Repair of Defects After Autofrettage	181
KF-550	Stamping and Reports	181
Article KF-6	Additional Fabrication Requirements for Quenched and Tempered Steels	182
KF-600	General	182
KF-610	Welding Requirements	182
KF-620	Temporary Welds Where Not Prohibited	183
KF-630	Postweld Heat Treatment	183
KF-640	Examination and Testing	184
KF-650	Stamping and Reports	184
Article KF-7	Supplementary Requirements for Materials With Welding Restrictions	185
KF-700	Scope	185
KF-710	Repair of Defects	185
KF-720	Methods of Forming Forged Heads	185
Article KF-8	Specific Fabrication Requirements for Layered Vessels	186
KF-800	Scope	186
KF-810	Rules for Shrink-Fit Vessels	186
KF-820	Rules for Concentrically Wrapped Welded Layered Vessels	186
KF-830	Heat Treatment of Weldments	192
Article KF-9	Special Fabrication Requirements for Wire-Wound Vessels and Frames	194
KF-900	Scope	194
KF-910	Fabrication Requirements	194

Article KF-10	Additional Fabrication Requirements for Aluminum Alloys	195
Article KF-11	Additional Fabrication Requirements for Welding Age-Hardening Stainless Steels	196
KF-1100	Scope	196
KF-1110	Welding Requirements	196
KF-1120	Base Metal Heat Treatment Condition	196
KF-1130	Temporary Welds Where Not Prohibited	196
KF-1140	Postweld Heat Treatment	196
KF-1150	Production Weld Testing	196
KF-1160	Examination and Testing	197
KF-1170	Repair Welding	197
KF-1180	Postweld Heat Treatment After Weld Repairs	197
Article KF-12	Additional Fabrication Requirements for Composite Reinforced Pres- sure Vessels (CRPV)	198
KF-1200	Scope	198
KF-1210	Welding	198
Part KR	Pressure Relief Devices	200
Part KOP	Overpressure Protection	201
Article KOP-1	General Requirements	201
KOP-100	General Requirements	201
KOP-110	Definitions	201
KOP-120	Responsibilities	201
KOP-130	Determination of Pressure Relieving Requirements	202
KOP-140	Overpressure Limits	202
KOP-150	Permitted Pressure Relief Devices and Methods	202
KOP-160	Pressure Settings and Performance Requirements	203
KOP-170	Installation	203
Article KOP-2	Requirements for Power-Actuated Pressure Relief Systems	205
KOP-200	General Requirements	205
KOP-210	System Requirements	205
KOP-220	Flow Capacity Testing	205
Article KOP-3	Overpressure Protection for Impulsively Loaded Vessels	207
KOP-300	General	207
Part KE	Examination Requirements	208
Article KE-1	Requirements for Examination Procedures and Personnel Qualification	208
KE-100	General	208
KE-110	Qualification and Certification of Nondestructive Examination Personnel ..	208
Article KE-2	Requirements for Examination and Repair of Material	211
KE-200	General Requirements	211
KE-210	General Requirements for Repair of Defects	211
KE-220	Examination and Repair of Plate	212
KE-230	Examination and Repair of Forgings and Bars	212
KE-240	Examination and Repair of Seamless and Welded (Without Filler Metal) Tubular Products and Fittings	214
KE-250	Examination and Repair of Tubular Products and Fittings Welded With Filler Metal	215
KE-260	Examination of Bolts, Studs, and Nuts	216
Article KE-3	Examination of Welds and Acceptance Criteria	217
KE-300	Examination of Welds and Weld Overlay	217
KE-310	Examination of Weld Edge Preparation Surfaces	230

KE-320	Types of Welds and Their Examination	230
KE-330	Acceptance Standards	231
Article KE-4	Final Examination of Vessels	234
KE-400	Surface Examination After Hydrotest	234
KE-410	Inspection of Lined Vessel Interior After Hydrotest	234
Article KE-5	Additional Examination Requirements for Composite Reinforced Pressure Vessels (CRPV)	235
KE-500	Scope	235
Part KT	Testing Requirements	236
Article KT-1	Testing Requirements	236
KT-100	Scope	236
KT-110	Requirements for Sample Test Coupons	236
Article KT-2	Impact Testing for Welded Vessels	237
KT-200	Impact Tests	237
KT-210	Location and Orientation of Specimens	237
KT-220	Impact Tests for Welding Procedure Qualifications	237
KT-230	Impact Test of Production Test Plates	237
KT-240	Basis for Rejection	238
Article KT-3	Hydrostatic Tests	239
KT-300	Scope	239
KT-310	Limits of Hydrostatic Test Pressure	239
KT-320	Fluid Media for Hydrostatic Tests	240
KT-330	Test Procedure	240
KT-340	Exemption for Autofrettagged Vessels	240
KT-350	Additional Requirements for Impulsively Loaded Vessels	240
Article KT-4	Pressure Test Gages and Transducers	241
KT-400	Type and Number of Gages or Transducers	241
KT-410	Pressure Range of Test Gages and Transducers	241
KT-420	Calibration of Test Gages and Transducers	241
Article KT-5	Additional Testing Requirements for Composite Reinforced Pressure Vessels (CRPV)	242
KT-500	Responsibility	242
KT-510	Testing Requirements	242
Part KS	Marking, Stamping, Reports, and Records	243
Article KS-1	Contents and Method of Stamping	243
KS-100	Required Marking for Vessels	243
KS-110	Application of Certification Mark	244
KS-120	Part Marking	244
KS-130	Application of Markings	244
KS-140	Attachment of Nameplate or Tag	245
KS-150	Special Stamping Requirements for Composite Reinforced Pressure Vessels (CRPV)	245
Article KS-2	Obtaining and Using Certification Marks	246
KS-200	Certification Mark Bearing Official Symbol	246
KS-210	Application for Certificate of Authorization	246
KS-220	Issuance of Authorization	246
KS-230	Designated Oversight	246
KS-240	Quality Control System	246
KS-250	Evaluation of the Quality Control System	246
KS-260	Code Construction Before Receipt of Certificate of Authorization	246

KS-270	Special Requirements Regarding Manufacturer's Certificates for Manufacture of Composite Reinforced Pressure Vessels (CRPV)	246
Article KS-3	Report Forms and Maintenance of Records	247
KS-300	Manufacturer's Data Reports	247
KS-310	Maintenance of Radiographs	248
KS-320	Maintenance of Records	248
Mandatory Appendix 1	Nomenclature	249
1-100	Nomenclature	249
Mandatory Appendix 2	Quality Control System	257
2-100	General	257
2-110	Outline of Features to Be Included in the Written Description of the Quality Control System	257
2-111	Authority and Responsibility	257
2-112	Organization	257
2-113	Drawings, Design Calculations, and Specification Control	257
2-114	Material Control	258
2-115	Examination and Inspection Program	258
2-116	Correction of Nonconformities	258
2-117	Welding	258
2-118	Nondestructive Examination	258
2-119	Heat Treatment	258
2-120	Calibration of Measurement and Test Equipment	258
2-121	Records Retention	258
2-122	Sample Forms	258
2-123	Inspection of Vessels and Vessel Parts	258
2-124	Certifications	258
Mandatory Appendix 5	Adhesive Attachment of Nameplates	259
5-100	Scope	259
5-200	Nameplate Application Procedure Qualification	259
Mandatory Appendix 6	Rounded Indications Charts Acceptance Standard for Radiographically Determined Rounded Indications in Welds	260
6-100	Applicability of These Standards	260
6-110	Terminology	260
6-120	Acceptance Criteria	260
Mandatory Appendix 8	Establishing Governing Code Editions and Cases for Pressure Vessels and Parts	269
8-100	General	269
8-200	Construction	269
8-300	Materials	269
Mandatory Appendix 9	Linear Elastic Analysis	270
9-100	General	270
9-110	Load Combinations	270
9-200	Derivation of Equivalent Stress	270
9-210	Stress Limits	270
9-220	Primary Membrane and Bending Stresses	273
9-230	Pure Shear Stress	273
9-240	Bearing Stress	273
9-250	Secondary Stresses	273
9-260	Simplified Elastic-Plastic Analysis	273
9-270	Thermal Stress Ratcheting Assessment	273
9-280	Triaxial Stresses	274
9-290	Upper Limit for Hydrostatic Test Pressure	274
9-300	Principal Stresses in Monobloc Vessels	274

9-400	Analysis of Threaded Fasteners and Components	274
Nonmandatory Appendix A	Guide for Preparing Manufacturer's Data Reports	276
A-100	Introduction	276
Nonmandatory Appendix B	Suggested Practice Regarding Extending Life Beyond the Cyclic Design	
	Life	290
B-100	Extending Allowed Cyclic Limits While in Operation	290
Nonmandatory Appendix D	Fracture Mechanics Calculations	291
D-100	Scope	291
D-200	Crack Location and Stressing	291
D-300	Crack Orientation and Shape	291
D-400	Methods for Determining Stress Intensity Factor	293
D-500	Calculation of Fatigue Crack Growth Rates	299
D-700	References	300
Nonmandatory Appendix E	Construction Details	301
E-100	Integral Heads (Blind Ends)	301
E-110	Thick Wall Proportions	301
E-120	Thin Wall Proportions	302
E-200	Threaded End Closures	302
E-210	Nomenclature (See Figures E-210.1 , E-210.2 , and E-210.3)	302
E-220	Thread Load Distribution	303
Nonmandatory Appendix G	Design Rules for Clamp Connections	308
G-100	Scope	308
G-200	Materials	308
G-300	Nomenclature	308
G-400	Bolt Loads	314
G-500	Longitudinal Loads	316
G-600	Hub Moments	316
G-700	Calculation of Hub Stresses	317
G-800	Calculation of Clamp Stresses	317
G-900	Allowable Design Stresses for Clamp Connections	317
Nonmandatory Appendix H	Openings and Their Reinforcement	318
H-100	Scope	318
H-110	Circular Openings Not Requiring Reinforcement	318
H-120	Reinforcement for Openings in Shells and Formed Heads	318
H-130	Reinforcement for Openings in Flat Heads	320
H-140	Limits of Reinforcement	320
H-150	Metal Available for Reinforcement	321
Nonmandatory Appendix I	Guidance for the Use of U.S. Customary and SI Units in the ASME Boiler	
	and Pressure Vessel Code	323
I-100	Use of Units in Equations	323
I-200	Guidelines Used to Develop SI Equivalents	323
I-300	Soft Conversion Factors	325
Nonmandatory Appendix J	Stress Concentration Factors for Cross-Bores in Closed-End Cylinders	
	and Square Blocks	326
J-100	Scope	326
J-110	Methodology	326
Nonmandatory Appendix K	Fatigue and Fracture Assessment of Impulsively Loaded Vessels	329
K-100	Scope	329
K-110	Nomenclature	329
K-200	Analysis	329
Nonmandatory Appendix L	Linearization of Stress Results for Stress Classification	331

FIGURES

KM-212	Examples of Acceptable Impact Test Specimens	27
KM-270.1	Machine Sharp Edge-Notch Specimen	33
KM-270.1M	Machine Sharp Edge-Notch Specimen	33
KM-270.2	Reinforcing Plate for Specimen Head	34
KM-270.2M	Reinforcing Plate for Specimen Head	35
KM-270.3	Standard Test Sections	36
KM-270.3M	Standard Test Sections	36
KD-320.1	Design Fatigue Curves $S_a = f(N_f)$ for Nonwelded Machined Parts Made of Forged Carbon or Low Alloy Steels for Temperatures Not Exceeding 700°F	95
KD-320.1M	Design Fatigue Curves $S_a = f(N_f)$ for Nonwelded Machined Parts Made of Forged Carbon or Low Alloy Steels for Temperatures Not Exceeding 371°C	98
KD-320.2	Design Fatigue Curve $S_a = f(N_f)$ for Nonwelded Parts Made of Carbon or Low Alloy Steels for Temperatures Not Exceeding 700°F	101
KD-320.2M	Design Fatigue Curve $S_a = f(N_f)$ for Nonwelded Parts Made of Carbon or Low Alloy Steels for Temperatures Not Exceeding 371°C	102
KD-320.3	Fatigue Curve for Nonwelded Series 3XX High Alloy Steel, Nickel–Chromium–Iron Alloy, Nickel–Iron–Chromium Alloy, and Nickel–Copper Alloy for Temperatures Not Exceeding 800°F	103
KD-320.3M	Fatigue Curve for Nonwelded Series 3XX High Alloy Steel, Nickel–Chromium–Iron Alloy, Nickel–Iron–Chromium Alloy, and Nickel–Copper Alloy for Temperatures Not Exceeding 427°C	104
KD-320.4	Design Fatigue Curve $S_a = f(N_f)$ for Nonwelded Machined Parts Made of 17-4PH/15-5PH Stainless Steel Bar or Forgings, for Temperatures Not Exceeding 550°F	105
KD-320.4M	Design Fatigue Curve $S_a = f(N_f)$ for Nonwelded Machined Parts Made of 17-4PH/15-5PH Stainless Steel Bar or Forgings, for Temperatures Not Exceeding 290°C	106
KD-320.5	Design Fatigue Curve for High-Strength Steel Bolting for Temperatures Not Exceeding 700°F	107
KD-320.5M	Design Fatigue Curve for High-Strength Steel Bolting for Temperatures Not Exceeding 371°C	108
KD-320.6(a)	Roughness Factor K_r Versus Average Surface Roughness R_a (μin.) AA	109
KD-320.6M(a)	Roughness Factor K_r Versus Average Surface Roughness R_a (μm) AA	110
KD-320.6(b)	Roughness Factor K_r Versus Maximum Surface Roughness R_{max} (μin.)	111
KD-320.6M(b)	Roughness Factor K_r Versus Maximum Surface Roughness R_{max} (μm)	112
KD-320.7	Design Fatigue Curve for Nonwelded 6061-T6 and 6061-T651 Aluminum for Temperatures Not Exceeding 225°F	113
KD-320.7M	Design Fatigue Curve for Nonwelded 6061-T6 and 6061-T651 Aluminum for Temperatures Not Exceeding 107°C	114
KD-372.1	Burr Grinding of Weld Toe	115
KD-700	Some Illustrative Weld Attachment Details	127
KD-812	Diameters and Layer Numbers for Concentric Shrink-Fit Layered Cylinder	131
KD-830.1	Acceptable Layered Shell Types	133
KD-830.2	Some Acceptable Solid-to-Layered Attachments	134
KD-830.3	Some Acceptable Flat Heads With Hubs Joining Layered Shell Sections	135
KD-830.4	Some Acceptable Flanges for Layered Shells	136
KD-830.5	Some Acceptable Welded Joints of Layered-to-Layered and Layered-to-Solid Sections	137
KD-830.6	Some Acceptable Nozzle Attachments in Layered Shell Sections	138
KD-850	Some Acceptable Supports for Layered Vessels	139
KD-900	Wire-Wound Vessel and Frame Construction	141
KD-911	Nomenclature for Wire-Wound Cylinders	142
KD-932	Derivation of Design Fatigue Curve From Wire Fatigue Curve	144
KD-1112	Typical Pressure Parts With Butt-Welded Hubs	151
KD-1121	Joints Between Formed Heads and Shells	152
KD-1122	Nozzle Necks Attached to Piping of Lesser Wall Thickness	153

KD-1130	Some Acceptable Welded Nozzle Attachments	154
KD-1131	An Acceptable Full-Penetration Welded Nozzle Attachment Not Readily Radiographable ..	155
KD-1260.1	Construction of Testing Parameter Ratio Diagram	160
KD-1260.2	Construction of Testing Parameter Ratio Diagram for Accelerated Tests	161
KF-131	Example of the Maximum and Minimum Inside Diameters in a Cylindrical Shell	167
KF-822(a)	Solid-to-Layered and Layered-to-Layered Test Plates	188
KF-822(b)	Test Specimens for Weld Procedure Qualification	189
KF-825.4	Indications of Layer Wash	190
KF-826	Gap Area Between Layers	191
KE-242.1	Axial Propagation of Sound in Tube Wall	214
KE-301-1	Flaw Classification of Single Indication	221
KE-301-2	Surface Flaw Acceptance Criteria	222
KE-301-3	Subsurface Flaw Acceptance Criteria	224
KE-301-4	Multiple Planar Flaws Oriented in Plane Normal to Pressure-Retaining Surface	226
KE-301-5	Parallel Planar Flaws	227
KE-301-6	Nonaligned Coplanar Flaws in Plane Normal to Pressure-Retaining Surface (Illustrative Flaw Configurations)	228
KE-301-7	Multiple Aligned Planar Flaws	229
KE-321	Illustration of Welded Joint Locations Typical of Categories A, B, C, and D	231
KS-100	Official New Certification Mark to Denote the American Society of Mechanical Engineers' Standard	243
KS-132	Form of Stamping	245
6-1	Aligned Rounded Indications	261
6-2	Groups of Aligned Rounded Indications	262
6-3.1	Charts for t $\frac{1}{8}$ in. (3 mm) to $\frac{1}{4}$ in. (6 mm), Inclusive	263
6-3.2	Charts for t Over $\frac{1}{4}$ in. (6 mm) to $\frac{3}{8}$ in. (10 mm), Inclusive	264
6-3.3	Charts for t Over $\frac{3}{8}$ in. (10 mm) to $\frac{3}{4}$ in. (19 mm), Inclusive	265
6-3.4	Charts for t Over $\frac{3}{4}$ in. (19 mm) to 2 in. (50 mm), Inclusive	266
6-3.5	Charts for t Over 2 in. (50 mm) to 4 in. (100 mm), Inclusive	267
6-3.6	Charts for t Over 4 in. (100 mm)	268
9-200.1	Stress Categories and Limits of Equivalent Stress	272
D-200	Typical Crack Types	292
D-300	Idealizations of a Crack Propagating From a Cross-Bore Corner	293
D-403.1	Magnification Factors for Circumferential Crack	298
D-403.2	Polynomial Representation of Stress Distribution	298
D-403.3	Method of Correcting K_I at Discontinuities Between Regions	299
E-110	Thick Wall Blind End Proportions Not Requiring Detailed Analysis	301
E-120	Thin Wall Blind End Proportions Not Requiring Detailed Analysis	302
E-210.1	Typical Threaded End Closure	304
E-210.2	Thread Loading Distribution	305
E-210.3	Detail of First Thread	305
G-100.1	Clamp Nomenclature	309
G-100.2	Typical Clamp Lug Configurations	310
G-100.3	Typical Hub Design With the Bolts Contained Within the Body of the Clamp	311
G-300	Typical Self-Energizing Gaskets Used in This Division, Showing Diameter at Location of Gasket Load Reaction G	315
G-300.1	Values of f	316
H-101	Straight Drill Connections for Thick-Walled Cylinders	319
H-120.1	Chart for Determining Value of F	320
H-142	Nozzle Nomenclature and Dimensions	322
J-110-1	Geometries of Square Blocks and Cylinders With Cross-Bores	327
J-110-2	Tangential Stress Concentration Factors for Openings in Cylinders	327
J-110-3	Tangential Stress Concentration Factors for Openings in Square Cross-Section Blocks	328
K-200-1	Stress History	330
K-200-2	Toughness Temperature Curve	330

TABLES

KG-141	Referenced Standards in This Division and Year of Acceptable Edition	4
KG-150	Standard Units for Use in Equations	5
KM-212	Charpy Impact Test Temperature Reduction Below Minimum Design Metal Temperature ..	25
KM-234.2(a)	Minimum Required Charpy V-Notch Impact Values for Pressure-Retaining Component Materials	29
KM-234.2(b)	Minimum Required Charpy V-Notch Impact Values for Bolting Materials	29
KM-400-1	Carbon and Low Alloy Steels	39
KM-400-1M	Carbon and Low Alloy Steels (Metric)	45
KM-400-2	High Alloy Steels	52
KM-400-2M	High Alloy Steels (Metric)	55
KM-400-3	Nickel and Nickel Alloys	58
KM-400-3M	Nickel and Nickel Alloys (Metric)	59
KM-400-4	Aluminum Alloys	60
KM-400-4M	Aluminum Alloys (Metric)	60
KM-620	Tabular Values for Coefficients	63
KM-630	Cyclic Stress–Strain Curve Data	63
KM-630M	Cyclic Stress–Strain Curve Data	65
KM-630.1	Coefficients for the Welded Joint Fatigue Curves	66
KM-630.1M	Coefficients for the Welded Joint Fatigue Curves	66
KD-230.1	Loads and Load Cases to Be Considered in Design	76
KD-230.2	Load Descriptions	77
KD-230.3	Combination for Analysis Exemption of Hydrostatic Test Criterion	77
KD-230.4	Load Combinations and Load Factors for an Elastic–Plastic Analysis	78
KD-320.1	Tabulated Values of S_a , ksi, From Figures Indicated	96
KD-320.1M	Tabulated Values of S_a , MPa, From Figures Indicated	99
KD-320.7	Tabulated Values of S_a Alternating Stress Intensity From Figures KD-320.7 and KD-320.7M	112
KD-322.1	Fatigue Penalty Parameters	114
KD-430	Room-Temperature Crack Growth Rate Factors (U.S. Customary Units)	118
KD-430M	Room-Temperature Crack Growth Rate Factors (SI Units)	118
KF-234	Maximum Allowable Offset in Welded Joints	172
KF-402.1	Requirements for Postweld Heat Treatment of Pressure Parts and Attachments (U.S. Customary Units)	177
KF-402.1M	Requirements for Postweld Heat Treatment of Pressure Parts and Attachments (SI Units) ..	178
KF-630	Postweld Heat Treatment Requirements for Quenched and Tempered Materials in Table KM-400-1 (U.S. Customary Units)	183
KF-630M	Postweld Heat Treatment Requirements for Quenched and Tempered Materials in Table KM-400-1M (SI Units)	184
KF-1211	Permitted Weld Reinforcement	198
KE-101	Thickness, Image Quality Indicator Designations, Essential Holes, and Wire Diameters (U.S. Customary Units)	209
KE-101M	Thickness, Image Quality Indicator Designations, Essential Holes, and Wire Diameters (SI Units)	210
KE-301-1	Flaw Acceptance Criteria for 1 in. (25 mm) to 12 in. (300 mm) Thick Weld	219
KE-301-2	Flaw Acceptance Criteria for 16 in. (400 mm) Thick Weld	220
KE-332	Radiographic Acceptance Standards for Rounded Indications (Examples Only)	232
9-100.1	Load Case Combinations and Allowable Stresses for an Elastic Analysis	271
A-100.1	Instructions for the Preparation of Manufacturer’s Data Reports	282
A-100.2	Instructions for the Preparation of Manufacturer’s Data Reports Form CRPV-1A	286
D-401.1	Coefficients G_0 Through G_3 for Surface Crack at Deepest Point	295
D-401.2	Coefficients G_0 Through G_3 for Surface Crack at Free Surface	296
D-500	Crack Growth Rate Factors	300
E-222.1	Continuous Thread Example	306
E-222.2	Interrupted Thread Example	307
G-900	Allowable Design Stress for Clamp Connections	317

J-110-2	Tangential Stress Concentration Factors for Openings in Cylinders (Tabulated Values From Figure J-110-2)	328
J-110-3	Tangential Stress Concentration Factors for Openings in Square Cross-Section Blocks (Tabulated Values From Figure J-110-3)	328
FORMS		
KG-311.15	Typical Certification of Compliance of the User's Design Specification	11
KG-324.1	Typical Certification of Compliance of the Manufacturer's Design Report	13
K-1	Manufacturer's Data Report for High Pressure Vessels	277
K-2	Manufacturer's Partial Data Report for High Pressure Vessels	279
K-3	Manufacturer's Data Report Supplementary Sheet	281
CRPV-1A	Manufacturer's Data Report for Composite Reinforced Pressure Vessels	284
CRPV-2A	Recommended Form for Qualifying the Laminate Design and the Laminate Procedure Specification Used in Manufacturing Composite Reinforced Pressure Vessels	288
ENDNOTES	333

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 only to pressure integrity, which govern the construction* of boilers, pressure vessels, transport tanks, and nuclear components, and the inservice inspection of nuclear components and transport tanks. The Committee also interprets these rules when questions arise regarding their intent. 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. Except for Sections XI and XII, and with a few other exceptions, the rules do not, of practical necessity, reflect the likelihood and consequences of deterioration in service related to specific service fluids or external operating environments. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property, and to provide a margin for deterioration in service to give a reasonably long, safe period of usefulness. Advancements in design and materials and evidence of experience have been recognized.

This Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities and inservice inspection and testing activities. The Code does not address all aspects of these activities and those aspects that are not specifically addressed should not be considered prohibited. The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment. The phrase *engineering 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 neither requires nor prohibits the use of computers for the design or analysis of components constructed to the

* 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.

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.

PERSONNEL

ASME Boiler and Pressure Vessel Standards Committees, Subgroups, and Working Groups

January 1, 2023

TECHNICAL OVERSIGHT MANAGEMENT COMMITTEE (TOMC)

R. E. McLaughlin, <i>Chair</i>	W. M. Lundy
N. A. Finney, <i>Vice Chair</i>	D. I. Morris
S. J. Rossi, <i>Staff Secretary</i>	T. P. Pastor
G. Aurioles, Sr.	M. D. Rana
R. W. Barnes	S. C. Roberts
T. L. Bedeaux	F. J. Schaaf, Jr.
C. Brown	G. Scribner
D. B. DeMichael	W. J. Sperko
R. P. Deubler	D. Sronic
J. G. Feldstein	R. W. Swayne
G. W. Galanes	J. Vattappilly
J. A. Hall	M. Wadkinson
T. E. Hansen	B. K. Nutter, <i>Ex-Officio Member</i>
G. W. Hembree	M. J. Pischke, <i>Ex-Officio Member</i>
R. B. Keating	J. F. Henry, <i>Honorary Member</i>
B. Linnemann	

Subgroup on Research and Development (TOMC)

S. C. Roberts, <i>Chair</i>	R. B. Keating
S. J. Rossi, <i>Staff Secretary</i>	R. E. McLaughlin
R. W. Barnes	T. P. Pastor
N. A. Finney	D. Andrei, <i>Contributing Member</i>
W. Hoffelner	

Subgroup on Strategic Initiatives (TOMC)

N. A. Finney, <i>Chair</i>	M. H. Jawad
S. J. Rossi, <i>Staff Secretary</i>	R. B. Keating
R. W. Barnes	R. E. McLaughlin
T. L. Bedeaux	T. P. Pastor
G. W. Hembree	S. C. Roberts

Task Group on Remote Inspection and Examination (SI-TOMC)

S. C. Roberts, <i>Chair</i>	M. Tannenbaum
P. J. Coco	J. Cameron, <i>Alternate</i>
N. A. Finney	A. Byk, <i>Contributing Member</i>
S. A. Marks	J. Pang, <i>Contributing Member</i>
R. Rockwood	S. J. Rossi, <i>Contributing Member</i>
C. Stevens	C. A. Sanna, <i>Contributing Member</i>

Special Working Group on High Temperature Technology (TOMC)

D. Dewees, <i>Chair</i>	B. F. Hantz
F. W. Brust	R. I. Jetter
T. D. Burchell	P. Smith
P. R. Donavin	

ADMINISTRATIVE COMMITTEE

R. E. McLaughlin, <i>Chair</i>	M. J. Pischke
N. A. Finney, <i>Vice Chair</i>	M. D. Rana
S. J. Rossi, <i>Staff Secretary</i>	S. C. Roberts
J. Cameron	R. R. Stevenson
R. B. Keating	R. W. Swayne
B. Linnemann	M. Wadkinson
B. K. Nutter	

MARINE CONFERENCE GROUP

J. Oh, <i>Staff Secretary</i>	H. N. Patel
J. G. Hungerbuhler, Jr.	N. Prokopuk
G. Nair	J. D. Reynolds

CONFERENCE COMMITTEE

R. D. Troutt — Texas, <i>Chair</i>	J. LeSage, Jr. — Louisiana
J. T. Amato — Ohio, <i>Secretary</i>	A. M. Lorimor — South Dakota
W. Anderson — Mississippi	M. Mailman — Northwest Territories, Canada
R. Becker — Colorado	W. McGivney — City of New York, New York
T. D. Boggs — Missouri	S. F. Noonan — Maryland
R. A. Boillard — Indiana	C. L. O'Guin — Tennessee
D. P. Brockerville — Newfoundland and Labrador, Canada	B. S. Oliver — New Hampshire
R. J. Bunte — Iowa	J. L. Oliver — Nevada
J. H. Burpee — Maine	P. B. Polick — Illinois
M. Carlson — Washington	J. F. Porcella — West Virginia
T. G. Clark — Oregon	B. Ricks — Montana
B. J. Crawford — Georgia	W. J. Ross — Pennsylvania
E. L. Creaser — New Brunswick, Canada	M. H. Sansone — New York
J. J. Dacanay — Hawaii	T. S. Seime — North Dakota
R. DeLury — Manitoba, Canada	C. S. Selinger — Saskatchewan, Canada
A. Denham — Michigan	J. E. Sharier — Ohio
C. Dinic — Ontario, Canada	R. Spiker — North Carolina
D. A. Ehler — Nova Scotia, Canada	D. Sronic — Alberta, Canada
S. D. Frazier — Washington	D. J. Stenrose — Michigan
T. J. Granneman II — Oklahoma	R. J. Stimson II — Kansas
S. Harder — Arizona	R. K. Sturm — Utah
M. L. Jordan — Kentucky	D. K. Sullivan — Arkansas
R. Kamboj — British Columbia, Canada	J. Taveras — Rhode Island
E. Kawa — Massachusetts	G. Teel — California
A. Khassasi — Quebec, Canada	D. M. Warburton — Florida
D. Kinney — North Carolina	M. Washington — New Jersey
K. S. Lane — Alaska	E. Wiggins — Alabama

INTERNATIONAL INTEREST REVIEW GROUP

V. Felix	C. Minu
Y.-G. Kim	Y.-W. Park
S. H. Leong	A. R. Reynaga Nogales
W. Lin	P. Williamson
O. F. Manafa	

COMMITTEE ON POWER BOILERS (BPV I)

R. E. McLaughlin, <i>Chair</i>	M. Wadkinson
E. M. Ortman, <i>Vice Chair</i>	R. V. Wielgoszinski
U. D'Urso, <i>Staff Secretary</i>	F. Zeller
D. I. Anderson	H. Michael, <i>Delegate</i>
J. L. Arnold	D. L. Berger, <i>Honorary Member</i>
K. K. Coleman	P. D. Edwards, <i>Honorary Member</i>
J. G. Feldstein	D. N. French, <i>Honorary Member</i>
S. Fincher	J. Hainsworth, <i>Honorary Member</i>
G. W. Galanes	J. F. Henry, <i>Honorary Member</i>
T. E. Hansen	W. L. Lowry, <i>Honorary Member</i>
J. S. Hunter	J. R. MacKay, <i>Honorary Member</i>
M. Ishikawa	P. A. Molvie, <i>Honorary Member</i>
M. Lemmons	J. T. Pillow, <i>Honorary Member</i>
L. Moedinger	B. W. Roberts, <i>Honorary Member</i>
Y. Oishi	R. D. Schueler, Jr., <i>Honorary Member</i>
M. Ortolani	
A. Spangenberg	J. M. Tanzosh, <i>Honorary Member</i>
D. E. Tompkins	R. L. Williams, <i>Honorary Member</i>
D. E. Tuttle	L. W. Yoder, <i>Honorary Member</i>
J. Vattappilly	

Executive Committee (BPV I)

E. M. Ortman, <i>Chair</i>	U. D'Urso
R. E. McLaughlin, <i>Vice Chair</i>	P. F. Gilston
D. I. Anderson	K. Hayes
J. L. Arnold	P. Jennings
J. R. Braun	A. Spangenberg
K. K. Coleman	D. E. Tompkins
H. Dalal	M. Wadkinson
T. Dhanraj	

Subgroup on Design (BPV I)

D. I. Anderson, <i>Chair</i>	N. S. Ranck
L. S. Tsai, <i>Secretary</i>	J. Vattappilly
P. Becker	M. Wadkinson
L. Krupp	D. Dewees, <i>Contributing Member</i>
C. T. McDaris	J. P. Glaspie, <i>Contributing Member</i>

Subgroup on Fabrication and Examination (BPV I)

J. L. Arnold, <i>Chair</i>	P. Jennings
P. F. Gilston, <i>Vice Chair</i>	M. Lewis
P. Becker, <i>Secretary</i>	C. T. McDaris
K. K. Coleman	R. E. McLaughlin
S. Fincher	R. J. Newell
G. W. Galanes	Y. Oishi
T. E. Hansen	R. V. Wielgoszinski

Subgroup on General Requirements and Piping (BPV I)

D. E. Tompkins, <i>Chair</i>	B. J. Mollitor
M. Wadkinson, <i>Vice Chair</i>	Y. Oishi
M. Lemmons, <i>Secretary</i>	E. M. Ortman
R. Antoniuk	D. E. Tuttle
T. E. Hansen	J. Vattappilly
M. Ishikawa	R. V. Wielgoszinski
R. E. McLaughlin	W. L. Lowry, <i>Contributing Member</i>
L. Moedinger	

Subgroup on Locomotive Boilers (BPV I)

J. R. Braun, <i>Chair</i>	S. A. Lee
S. M. Butler, <i>Secretary</i>	L. Moedinger
G. W. Galanes	G. M. Ray
D. W. Griner	M. W. Westland
M. A. Janssen	

Subgroup on Materials (BPV I)

K. K. Coleman, <i>Chair</i>	L. S. Nicol
K. Hayes, <i>Vice Chair</i>	M. Ortolani
M. Lewis, <i>Secretary</i>	D. W. Rahoi
S. H. Bowes	F. Zeller
G. W. Galanes	B. W. Roberts, <i>Contributing Member</i>
P. F. Gilston	J. M. Tanzosh, <i>Contributing Member</i>
J. S. Hunter	
E. Liebl	
F. Masuyama	

Subgroup on Solar Boilers (BPV I)

P. Jennings, <i>Chair</i>	J. S. Hunter
R. E. Hearne, <i>Secretary</i>	P. Swarnkar
S. Fincher	

Task Group on Modernization (BPV I)

D. I. Anderson, <i>Chair</i>	T. E. Hansen
U. D'Urso, <i>Staff Secretary</i>	R. E. McLaughlin
J. L. Arnold	E. M. Ortman
D. Dewees	D. E. Tuttle
G. W. Galanes	J. Vattappilly
J. P. Glaspie	

Germany International Working Group (BPV I)

A. Spangenberg, <i>Chair</i>	R. A. Meyers
P. Chavdarov, <i>Secretary</i>	H. Michael
B. Daume	F. Miunske
J. Fleischfresser	M. Sykora
C. Jaekel	R. Helmholdt, <i>Contributing Member</i>
R. Kauer	J. Henrichsmeyer, <i>Contributing Member</i>
D. Koelbl	
S. Krebs	
T. Ludwig	B. Müller, <i>Contributing Member</i>

India International Working Group (BPV I)

H. Dalal, <i>Chair</i>	S. Purkait
T. Dhanraj, <i>Vice Chair</i>	M. G. Rao
K. Thanupillai, <i>Secretary</i>	G. U. Shanker
P. Brahma	D. K. Shrivastava
S. Chakrabarti	K. Singha
A. Hantodkar	R. Sundararaj
A. J. Patil	S. Venkataramana

Subgroup on International Material Specifications (BPV II)

M. Ishikawa, <i>Chair</i>	F. Zeller
P. Chavdarov, <i>Vice Chair</i>	C. Zhou
A. Chaudouet	O. Oldani, <i>Delegate</i>
H. Chen	H. Lorenz, <i>Contributing Member</i>
A. F. Garbolevsky	T. F. Miskell, <i>Contributing Member</i>
D. O. Henry	E. Upitis, <i>Contributing Member</i>
W. M. Lundy	

COMMITTEE ON MATERIALS (BPV II)

J. Cameron, <i>Chair</i>	D. W. Rahoi
G. W. Galanes, <i>Vice Chair</i>	W. Ren
C. E. Rodrigues, <i>Staff Secretary</i>	E. Shapiro
A. Appleton	R. C. Sutherlin
P. Chavdarov	F. Zeller
K. K. Coleman	O. Oldani, <i>Delegate</i>
D. W. Gandy	A. Chaudouet, <i>Contributing Member</i>
J. F. Grubb	J. D. Fritz, <i>Contributing Member</i>
J. A. Hall	W. Hoffelner, <i>Contributing Member</i>
D. O. Henry	K. E. Orie, <i>Contributing Member</i>
K. M. Hottle	D. T. Peters, <i>Contributing Member</i>
M. Ishikawa	B. W. Roberts, <i>Contributing Member</i>
K. Kimura	J. M. Tanzosh, <i>Contributing Member</i>
M. Kowalczyk	E. Upitis, <i>Contributing Member</i>
D. L. Kurle	R. G. Young, <i>Contributing Member</i>
F. Masuyama	
S. Neilsen	
L. S. Nicol	
M. Ortolani	

Subgroup on Nonferrous Alloys (BPV II)

E. Shapiro, <i>Chair</i>	J. A. McMaster
W. MacDonald, <i>Vice Chair</i>	D. W. Rahoi
J. Robertson, <i>Secretary</i>	W. Ren
R. M. Beldyk	R. C. Sutherlin
J. M. Downs	R. Wright
J. F. Grubb	S. Yem
J. A. Hall	D. B. Denis, <i>Contributing Member</i>
D. Maitra	D. T. Peters, <i>Contributing Member</i>

Subgroup on Physical Properties (BPV II)

P. K. Rai, <i>Chair</i>	R. D. Jones
S. Neilsen, <i>Vice Chair</i>	P. K. Lam
G. Aurioles, Sr.	D. W. Rahoi
D. Chandiramani	E. Shapiro
P. Chavdarov	D. K. Verma
H. Eshraghi	S. Yem
J. F. Grubb	D. B. Denis, <i>Contributing Member</i>
B. F. Hantz	

Executive Committee (BPV II)

J. Cameron, <i>Chair</i>	W. Hoffelner
C. E. Rodrigues, <i>Staff Secretary</i>	M. Ishikawa
A. Appleton	M. Ortolani
K. K. Coleman	P. K. Rai
G. W. Galanes	J. Robertson
J. F. Grubb	E. Shapiro
S. Guzey	

Subgroup on Strength, Ferrous Alloys (BPV II)

M. Ortolani, <i>Chair</i>	M. Osterfoss
L. S. Nicol, <i>Secretary</i>	D. W. Rahoi
G. W. Galanes	S. Rosinski
J. A. Hall	M. Ueyama
M. Ishikawa	F. Zeller
S. W. Knowles	F. Abe, <i>Contributing Member</i>
F. Masuyama	R. G. Young, <i>Contributing Member</i>

Subgroup on External Pressure (BPV II)

S. Guzey, <i>Chair</i>	M. H. Jawad
E. Alexis, <i>Vice Chair</i>	S. Krishnamurthy
J. A. A. Morrow, <i>Secretary</i>	D. L. Kurle
L. F. Campbell	R. W. Mikitka
H. Chen	P. K. Rai
D. S. Griffin	M. Wadkinson
J. F. Grubb	

Subgroup on Strength of Weldments (BPV II & BPV IX)

K. K. Coleman, <i>Chair</i>	J. Penso
K. L. Hayes, <i>Vice Chair</i>	D. W. Rahoi
S. H. Bowes, <i>Secretary</i>	W. J. Sperko
M. Denault	J. P. Swezy, Jr.
G. W. Galanes	M. Ueyama
D. W. Gandy	P. D. Flenner, <i>Contributing Member</i>
M. Ghahremani	B. W. Roberts, <i>Contributing Member</i>
W. F. Newell, Jr.	

Subgroup on Ferrous Specifications (BPV II)

A. Appleton, <i>Chair</i>	S. G. Lee
K. M. Hottle, <i>Vice Chair</i>	W. C. Mack
C. Hyde, <i>Secretary</i>	J. Nickel
D. Amire-Brahimi	K. E. Orie
G. Cuccio	D. Poweleit
O. Elkadim	E. Upitis
D. Fialkowski	L. Watzke
J. F. Grubb	J. D. Fritz, <i>Contributing Member</i>
D. S. Janikowski	C. Meloy, <i>Contributing Member</i>
Y.-J. Kim	

Working Group on Materials Database (BPV II)

W. Hoffelner, <i>Chair</i>	J. Cameron, <i>Contributing Member</i>
C. E. Rodrigues, <i>Staff Secretary</i>	J. F. Grubb, <i>Contributing Member</i>
F. Abe	D. T. Peters, <i>Contributing Member</i>
W. MacDonald	W. Ren, <i>Contributing Member</i>
R. C. Sutherlin	B. W. Roberts, <i>Contributing Member</i>
D. Andrei, <i>Contributing Member</i>	
J. L. Arnold, <i>Contributing Member</i>	E. Shapiro, <i>Contributing Member</i>

Working Group on Creep Strength Enhanced Ferritic Steels (BPV II)

M. Ortolani, <i>Chair</i>	W. F. Newell, Jr.
G. W. Galanes, <i>Vice Chair</i>	J. J. Sanchez-Hanton
P. Becker, <i>Secretary</i>	J. A. Siefert
S. H. Bowes	W. J. Sperko
K. K. Coleman	F. Zeller
K. Kimura	F. Abe, <i>Contributing Member</i>
M. Lang	P. D. Flenner, <i>Contributing Member</i>
S. Luke	J. M. Tanzosh, <i>Contributing Member</i>
F. Masuyama	
T. Melfi	

Executive Committee (BPV III)

R. B. Keating, <i>Chair</i>	K. A. Manoly
A. Maslowski, <i>Secretary</i>	D. E. Matthews
T. M. Adams	S. McKillop
P. R. Donavin	J. McLean
J. V. Gardiner	T.-L. Sham
J. Grimm	W. K. Sowder, Jr.
D. W. Lewis	K. A. Kavanagh, <i>Alternate</i>

Working Group on Data Analysis (BPV II)

J. F. Grubb, <i>Chair</i>	F. Abe, <i>Contributing Member</i>
W. Ren, <i>Vice Chair</i>	W. Hoffelner, <i>Contributing Member</i>
K. Kimura	W. C. Mack, <i>Contributing Member</i>
F. Masuyama	D. T. Peters, <i>Contributing Member</i>
S. Neilsen	B. W. Roberts, <i>Contributing Member</i>
M. Ortolani	
M. J. Swindeman	

Argentina International Working Group (BPV III)

M. F. Liendo, <i>Chair</i>	A. J. Dall'Osto
J. Fernández, <i>Vice Chair</i>	J. I. Duo
O. Martinez, <i>Staff Secretary</i>	M. M. Gamizo
O. A. Verastegui, <i>Secretary</i>	I. M. Guerreiro
E. H. Aldaz	I. A. Knorr
G. O. Anteri	D. E. Matthews
A. P. Antipasti	A. E. Pastor
D. O. Bordato	M. Rivero
G. Bourguigne	M. D. Vigliano
M. Brusa	P. Yamamoto
A. Claus	M. Zunino
R. G. Cocco	

China International Working Group (BPV II)

T. Xu, <i>Secretary</i>	S. Tan
W. Cai	C. Wang
W. Fang	Jinguang Wang
Q. C. Feng	Jiongxiang Wang
S. Huo	Q.-J. Wang
F. Kong	X. Wang
H. Leng	H.-C. Yang
Hli Li	J. Yang
Hongbin Li	L. Yin
J. Li	H. Zhang
S. Liu	X.-H. Zhang
Z. Rongcan	Y. Zhang

China International Working Group (BPV III)

Y. Wang, <i>Chair</i>	C. Peiyin
H. Yu, <i>Secretary</i>	Z. Sun
L. Feng	G. Tang
J. Gu	L. Ting
L. Guo	F. Wu
C. Jiang	C. Yang
D. Kang	P. Yang
Y. Li	W. Yang
H. Lin	H. Yin
S. Liu	D. Yuangang
W. Liu	G. Zhang
J. Ma	D. Zhao
K. Mao	Z. Zhong
D. E. Matthews	Q. Zhou
J. Ming	H. Zhu
W. Pei	

COMMITTEE ON CONSTRUCTION OF NUCLEAR FACILITY COMPONENTS (BPV III)

R. B. Keating, <i>Chair</i>	K. Matsunaga
T. M. Adams, <i>Vice Chair</i>	B. McGlone
D. E. Matthews, <i>Vice Chair</i>	S. McKillop
A. Maslowski, <i>Staff Secretary</i>	J. McLean
A. Appleton	J. C. Minichiello
S. Asada	M. N. Mitchell
R. W. Barnes	T. Nagata
W. H. Borter	J. B. Ossmann
M. E. Cohen	S. Pellet
R. P. Deubler	E. L. Pleins
P. R. Donavin	T.-L. Sham
A. C. Eberhardt	W. J. Sperko
J. V. Gardiner	W. Windes
J. Grimm	C. Basavaraju, <i>Alternate</i>
S. Hunter	C. T. Smith, <i>Contributing Member</i>
R. M. Jessee	W. K. Sowder, Jr., <i>Contributing Member</i>
R. I. Jetter	
C. C. Kim	M. Zhou, <i>Contributing Member</i>
G. H. Koo	E. B. Branch, <i>Honorary Member</i>
D. W. Lewis	G. D. Cooper, <i>Honorary Member</i>
M. A. Lockwood	D. F. Landers, <i>Honorary Member</i>
K. A. Manoly	C. Pieper, <i>Honorary Member</i>

Germany International Working Group (BPV III)

J. Wendt, <i>Chair</i>	C. Kuschke
D. Koelbl, <i>Vice Chair</i>	H.-W. Lange
R. Gersinska, <i>Secretary</i>	T. Ludwig
P. R. Donavin	X. Pitoiset
R. Döring	M. Reichert
C. G. Fratescu	G. Roos
A. Huber	J. Rudolph
R. E. Hueggenberg	L. Sybertz
C. Huttner	I. Tewes
E. Iacopetta	R. Tiete
M. H. Koeppen	F. Wille

India International Working Group (BPV III)

R. N. Sen, <i>Chair</i>	R. Kumar
S. B. Parkash, <i>Vice Chair</i>	S. Kumar
A. D. Bagdare, <i>Secretary</i>	M. Lakshminarasimhan
S. Aithal	T. Mukherjee
S. Benhur	D. Narain
N. M. Borwankar	A. D. Paranjpe
M. Brijlani	J. R. Patel
H. Dalal	E. L. Pleins
S. K. Goyal	T. J. P. Rao
A. Johori	V. Sehgal
A. P. Kishore	S. Singh
D. Kulkarni	B. K. Sreedhar

Korea International Working Group (BPV III)

G. H. Koo, <i>Chair</i>	Y.-S. Kim
O.-S. Kim, <i>Secretary</i>	D. Kwon
H. Ahn	B. Lee
S. Cho	D. Lee
G.-S. Choi	S. Lee
M.-j. Choi	S.-G. Lee
S. Choi	H. Lim
J. Y. Hong	I.-K. Nam
N.-S. Huh	C.-K. Oh
J.-K. Hwang	C.-Y. Oh
S. S. Hwang	E.-J. Oh
C. Jang	C. Park
I. I. Jeong	H. Park
S. H. Kang	Y. S. Pyun
J.-I. Kim	T. Shin
J.-S. Kim	S. Song
M.-W. Kim	W. J. Sperko
S.-S. Kim	J. S. Yang
Y.-B. Kim	O. Yoo

Seismic Design Steering Committee (BPV III)

T. M. Adams, <i>Chair</i>	G. H. Koo
F. G. Abatt, <i>Secretary</i>	A. Maekawa
G. A. Antaki	K. Matsunaga
C. Basavaraju	J. McLean
D. Chowdhury	R. M. Pace
R. Döring	D. Watkins

Task Group on Alternate Requirements (BPV III)

J. Wen, <i>Chair</i>	D. E. Matthews
R. R. Romano, <i>Secretary</i>	S. McKillop
P. J. Coco	B. P. Nolan
P. R. Donavin	J. B. Ossmann
J. V. Gardiner	E. C. Renaud
J. Grimm	M. A. Richter
R. S. Hill III	I. H. Tseng
M. Kris	Y. Wang
M. A. Lockwood	

United Kingdom International Working Group (BPV III)

C. D. Bell, <i>Chair</i>	G. Innes
P. M. James, <i>Vice Chair</i>	S. A. Jones
C. B. Carpenter, <i>Secretary</i>	B. Pellereau
T. M. Adams	C. R. Schneider
T. Bann	J. W. Stairmand
M. J. Chevalier	J. Sulley
A. J. Cole-Baker	J. Talamantes-Silva
M. Consonni	A. J. Holt, <i>Contributing Member</i>
M. J. Crathorne	

Special Working Group on New Plant Construction Issues (BPV III)

J. B. Ossmann, <i>Chair</i>	R. E. McLaughlin
A. Maslowski, <i>Staff Secretary</i>	E. L. Pleins
M. C. Buckley, <i>Secretary</i>	D. W. Sandusky
M. Arcaro	M. C. Scott
A. Cardillo	R. R. Stevenson
P. J. Coco	H. Xu
K. Harris	J. Yan
J. Honcharik	J. C. Minichiello, <i>Contributing Member</i>
M. Kris	

Special Working Group on Editing and Review (BPV III)

D. E. Matthews, <i>Chair</i>	S. Hunter
R. P. Deubler	J. C. Minichiello
A. C. Eberhardt	J. F. Strunk
J. V. Gardiner	C. Wilson

Special Working Group on HDPE Stakeholders (BPV III)

S. Patterson, <i>Secretary</i>	D. P. Munson
S. Choi	T. M. Musto
C. M. Faigy	J. E. O'Sullivan
M. Golliet	V. Rohatgi
R. M. Jessee	F. J. Schaaf, Jr.
J. Johnston, Jr.	R. Stakenborghs
M. Kuntz	M. Troughton
M. Lashley	B. Lin, <i>Alternate</i>
K. A. Manoly	

Special Working Group on Honors and Awards (BPV III)

J. C. Minichiello, <i>Chair</i>	R. M. Jessee
A. Appleton	D. E. Matthews
R. W. Barnes	

Special Working Group on International Meetings and IWG Liaisons (BPV III)

D. E. Matthews, <i>Chair</i>	P. R. Donavin
A. Maslowski, <i>Staff Secretary</i>	E. L. Pleins
T. M. Adams	W. J. Sperko
R. W. Barnes	

Joint ACI-ASME Committee on Concrete Components for Nuclear Service (BPV III)

J. McLean, *Chair*
L. J. Colarusso, *Vice Chair*
J. Cassamassino, *Staff Secretary*
A. Dinizulu, *Staff Secretary*
C. J. Bang
A. C. Eberhardt
B. D. Hovis
T. C. Inman
C. Jones
T. Kang
N.-H. Lee
J. A. Munshi
T. Muraki
J. S. Saini
J. F. Strunk

G. Thomas
A. Varma
S. Wang
A. Istar, *Alternate*
A. Adediran, *Contributing Member*
S. Bae, *Contributing Member*
J.-B. Domage, *Contributing Member*
P. S. Ghosal, *Contributing Member*
B. B. Scott, *Contributing Member*
M. R. Senecal, *Contributing Member*
Z. Shang, *Contributing Member*
M. Sircar, *Contributing Member*
C. T. Smith, *Contributing Member*

Special Working Group on Modernization (BPV III-2)

S. Wang, *Chair*
J. McLean, *Vice Chair*
A. Adediran
S. Malushte
J. S. Saini

A. Varma
F. Lin, *Contributing Member*
J. A. Pires, *Contributing Member*
I. Zivanovic, *Contributing Member*

Task Group on Steel-Concrete Composite Containments (BPV III-2)

A. Varma, *Chair*
S. Malushte
J. McLean

J. A. Pires
J. S. Saini

Working Group on Design (BPV III-2)

N.-H. Lee, *Chair*
S. Wang, *Vice Chair*
M. Allam
S. Bae
L. J. Colarusso
A. C. Eberhardt
B. D. Hovis
T. C. Inman
C. Jones
J. A. Munshi
T. Muraki
J. S. Saini

G. Thomas
A. Istar, *Alternate*
P. S. Ghosal, *Contributing Member*
S.-Y. Kim, *Contributing Member*
J. Kwon, *Contributing Member*
S. E. Ohler-Schmitz, *Contributing Member*
B. B. Scott, *Contributing Member*
Z. Shang, *Contributing Member*
M. Shin, *Contributing Member*
M. Sircar, *Contributing Member*

Working Group on Materials, Fabrication, and Examination (BPV III-2)

C. Jones, *Chair*
A. Eberhardt, *Vice Chair*
C. J. Bang
B. Birch
J.-B. Domage
T. Kang
N.-H. Lee

Z. Shang
J. F. Strunk
A. A. Aboelmagd, *Contributing Member*
P. S. Ghosal, *Contributing Member*
B. B. Scott, *Contributing Member*
I. Zivanovic, *Contributing Member*

Subcommittee on Design (BPV III)

P. R. Donavin, *Chair*
S. McKillop, *Vice Chair*
R. P. Deubler
M. A. Gray
R. I. Jetter
R. B. Keating
J.-I. Kim
K. A. Manoly
D. E. Matthews
M. N. Mitchell

B. Pellereau
T.-L. Sham
W. F. Weitzel
C. Basavaraju, *Alternate*
G. L. Hollinger, *Contributing Member*
M. H. Jawad, *Contributing Member*
W. J. O'Donnell, Sr., *Contributing Member*
K. Wright, *Contributing Member*

Subgroup on Component Design (SC-D) (BPV III)

D. E. Matthews, *Chair*
P. Vock, *Vice Chair*
S. Pellet, *Secretary*
T. M. Adams
D. J. Ammerman
G. A. Antaki
J. J. Arthur
S. Asada
J. F. Ball
C. Basavaraju
D. Chowdhury
N. A. Costanzo
R. P. Deubler
M. Kassar
D. Keck
T. R. Liskai
K. A. Manoly
J. C. Minichiello

T. Mitsuhashi
D. Murphy
T. M. Musto
T. Nagata
G. Z. Tokarski
S. Willoughby-Braun
C. Wilson
A. A. Dermenjian, *Contributing Member*
P. Hirschberg, *Contributing Member*
R. B. Keating, *Contributing Member*
O.-S. Kim, *Contributing Member*
R. J. Masterson, *Contributing Member*
H. S. Mehta, *Contributing Member*
I. Saito, *Contributing Member*
J. P. Tucker, *Contributing Member*

Task Group to Improve Section III/XI Interface (SG-CD) (BPV III)

P. Vock, *Chair*
E. Henry, *Secretary*
G. A. Antaki
A. Cardillo
D. Chowdhury
J. Honcharik
J. Hurst
J. Lambin

C. A. Nove
T. Nuoffer
J. B. Ossmann
A. T. Roberts III
J. Sciulli
A. Udyawar
S. Willoughby-Braun

Working Group on Core Support Structures (SG-CD) (BPV III)

D. Keck, *Chair*
R. Z. Ziegler, *Vice Chair*
R. Martin, *Secretary*
G. W. Delpont
L. C. Hartless
T. R. Liskai
M. Nakajima

M. D. Snyder
R. Vollmer
T. M. Wiger
C. Wilson
Y. Wong
H. S. Mehta, *Contributing Member*

Working Group on Design of Division 3 Containment Systems (SG-CD) (BPV III)

D. J. Ammerman, *Chair*
S. Klein, *Secretary*
G. Bjorkman
V. Broz
D. W. Lewis
J. M. Piotter
A. Rigato
P. Sakalaukus, Jr.

D. Siromani
R. Sypulski
X. Zhai
X. Zhang
C. R. Sydnor, *Alternate*
J. C. Minichiello, *Contributing Member*

Working Group on HDPE Design of Components (SG-CD) (BPV III)

T. M. Musto, *Chair*
 J. B. Ossmann, *Secretary*
 M. Brandes
 S. Choi
 J. R. Hebeisen
 P. Krishnaswamy
 M. Kuntz

K. A. Manoly
 D. P. Munson
 F. J. Schaaf, Jr.
 R. Stakenborghs
 M. T. Audrain, *Alternate*
 J. C. Minichiello, *Contributing Member*

Working Group on Valves (SG-CD) (BPV III)

P. Vock, *Chair*
 S. Jones, *Secretary*
 M. C. Buckley
 A. Cardillo
 G. A. Jolly
 J. Lambin
 T. Lippucci
 C. A. Mizer

H. O'Brien
 J. O'Callaghan
 M. Rain
 K. E. Reid II
 J. Sulley
 I. H. Tseng
 J. P. Tucker
 Y. Wong, *Alternate*

Working Group on Piping (SG-CD) (BPV III)

G. A. Antaki, *Chair*
 G. Z. Tokarski, *Secretary*
 C. Basavaraju
 J. Catalano
 F. Claeys
 C. M. Faidy
 R. G. Gilada
 N. M. Graham
 M. A. Gray
 R. J. Gurdal
 R. W. Haupt
 A. Hirano
 P. Hirschberg
 M. Kassab
 J. Kawahata
 D. Lieb
 I.-K. Nam
 J. O'Callaghan

K. E. Reid II
 D. Vlaicu
 S. Weindorf
 T. M. Adams, *Contributing Member*
 R. B. Keating, *Contributing Member*
 T. B. Littleton, *Contributing Member*
 Y. Liu, *Contributing Member*
 J. F. McCabe, *Contributing Member*
 J. C. Minichiello, *Contributing Member*
 A. N. Nguyen, *Contributing Member*
 M. S. Sills, *Contributing Member*
 N. C. Sutherland, *Contributing Member*
 E. A. Wais, *Contributing Member*
 C.-I. Wu, *Contributing Member*

Working Group on Vessels (SG-CD) (BPV III)

D. Murphy, *Chair*
 S. Willoughby-Braun, *Secretary*
 J. J. Arthur
 C. Basavaraju
 M. Brijlani
 L. Constantinescu
 J. I. Kim
 O.-S. Kim
 D. E. Matthews
 T. Mitsuhashi

T. J. Schriefer
 M. C. Scott
 P. K. Shah
 D. Vlaicu
 C. Wilson
 R. Z. Ziegler
 R. J. Huang, *Alternate*
 B. Basu, *Contributing Member*
 R. B. Keating, *Contributing Member*
 W. F. Weitze, *Contributing Member*

Working Group on Pressure Relief (SG-CD) (BPV III)

K. R. May, *Chair*
 R. Krithivasan, *Secretary*
 M. Brown
 J. W. Dickson
 S. Jones
 R. Lack
 D. Miller
 T. Patel
 K. Shores

I. H. Tseng
 B. J. Yonsky
 Y. Wong, *Alternate*
 J. Yu, *Alternate*
 S. T. French, *Contributing Member*
 D. B. Ross, *Contributing Member*
 S. Ruesenberg, *Contributing Member*

Subgroup on Design Methods (SC-D) (BPV III)

S. McKillop, *Chair*
 P. R. Donavin, *Vice Chair*
 J. Wen, *Secretary*
 K. Avrithi
 L. Davies
 M. A. Gray
 J. V. Gregg, Jr.
 K. Hsu
 R. Kalnas
 D. Keck
 J. I. Kim
 B. Pellereau
 W. D. Reinhardt

P. Smith
 R. Vollmer
 W. F. Weitze
 T. M. Adams, *Contributing Member*
 C. W. Bruny, *Contributing Member*
 S. R. Gosselin, *Contributing Member*
 H. T. Harrison III, *Contributing Member*
 W. J. O'Donnell, Sr., *Contributing Member*
 K. Wright, *Contributing Member*

Working Group on Pumps (SG-CD) (BPV III)

D. Chowdhury, *Chair*
 J. V. Gregg, Jr., *Secretary*
 B. Busse
 M. D. Eftychiou
 R. A. Fleming
 K. J. Noel
 J. Sulley

K. B. Wilson
 Y. Wong
 I. H. Tseng, *Alternate*
 X. Di, *Contributing Member*
 C. Gabhart, *Contributing Member*
 R. Ladefian, *Contributing Member*

Working Group on Supports (SG-CD) (BPV III)

N. A. Costanzo, *Chair*
 U. S. Bandyopadhyay, *Secretary*
 K. Avrithi
 N. M. Bisceglia
 R. P. Deubler
 N. M. Graham
 Y. Matsubara
 S. Pellet

G. Thomas
 G. Z. Tokarski
 L. Vandersip
 P. Wiseman
 R. J. Masterson, *Contributing Member*
 J. R. Stinson, *Contributing Member*

Special Working Group on Computational Modeling for Explicit Dynamics (SG-DM) (BPV III)

G. Bjorkman, *Chair*
 D. J. Ammerman, *Vice Chair*
 V. Broz, *Secretary*
 S. Kuehner
 D. Molitoris
 W. D. Reinhardt

D. Siromani
 C.-F. Tso
 M. C. Yaksh
 U. Zencker
 X. Zhang
 Y. Wong, *Contributing Member*

Working Group on Design Methodology (SG-DM) (BPV III)

B. Pellereau, <i>Chair</i>	T. M. Wiger
R. Vollmer, <i>Secretary</i>	K. Hsu, <i>Alternate</i>
K. Avrithi	G. Banyay, <i>Contributing Member</i>
C. Basavaraju	D. S. Bartran, <i>Contributing Member</i>
F. Berkepile	R. D. Blevins, <i>Contributing Member</i>
C. M. Faidy	M. R. Breach, <i>Contributing Member</i>
Y. Gao	C. W. Bruny, <i>Contributing Member</i>
M. Kassar	D. L. Caldwell, <i>Contributing Member</i>
J. I. Kim	H. T. Harrison III, <i>Contributing Member</i>
T. R. Liszkai	C. F. Heberling II, <i>Contributing Member</i>
D. Lytle	P. Hirschberg, <i>Contributing Member</i>
K. Matsunaga	R. B. Keating, <i>Contributing Member</i>
S. McKillop	A. Walker, <i>Contributing Member</i>
S. Ranganath	K. Wright, <i>Contributing Member</i>
W. D. Reinhardt	
P. K. Shah	
S. Wang	
W. F. Weitze	
J. Wen	

Working Group on Environmental Fatigue Evaluation Methods (SG-DM) (BPV III)

M. A. Gray, <i>Chair</i>	B. Pellereau
W. F. Weitze, <i>Secretary</i>	D. Vlaicu
S. Asada	K. Wang
K. Avrithi	R. Z. Ziegler
R. C. Cipolla	S. Cuvilliez, <i>Contributing Member</i>
T. M. Damiani	T. D. Gilman, <i>Contributing Member</i>
C. M. Faidy	S. R. Gosselin, <i>Contributing Member</i>
A. Hirano	Y. He, <i>Contributing Member</i>
P. Hirschberg	H. S. Mehta, <i>Contributing Member</i>
K. Hsu	K. Wright, <i>Contributing Member</i>
J.-S. Park	

Working Group on Fatigue Strength (SG-DM) (BPV III)

P. R. Donavin, <i>Chair</i>	J. I. Kim
M. S. Shelton, <i>Secretary</i>	S. H. Kleinsmith
R. S. Bass	B. Pellereau
T. M. Damiani	S. Ranganath
D. W. DeJohn	Y. Wang
C. M. Faidy	W. F. Weitze
P. Gill	Y. Zou
S. R. Gosselin	S. Majumdar, <i>Contributing Member</i>
R. J. Gurdal	H. S. Mehta, <i>Contributing Member</i>
C. F. Heberling II	W. J. O'Donnell, Sr., <i>Contributing Member</i>
C. E. Hinnant	K. Wright, <i>Contributing Member</i>
P. Hirschberg	
K. Hsu	

Working Group on Probabilistic Methods in Design (SG-DM) (BPV III)

M. Golliet, <i>Chair</i>	A. Hirano
R. Kalnas, <i>Vice Chair</i>	K. A. Manoly
K. Avrithi	P. J. O'Regan
G. Brouette	B. Pellereau
J. Hakii	M. Yagodich
D. O. Henry	R. S. Hill III, <i>Contributing Member</i>

Subgroup on Containment Systems for Spent Nuclear Fuel and High-Level Radioactive Material (BPV III)

D. W. Lewis, <i>Chair</i>	R. Sypulski
D. J. Ammerman, <i>Vice Chair</i>	J. Wellwood
S. Klein, <i>Secretary</i>	X. J. Zhai
G. Bjorkman	X. Zhang
V. Broz	D. Dunn, <i>Alternate</i>
A. Rigato	W. H. Borter, <i>Contributing Member</i>
P. Sakalaukus, Jr.	E. L. Pleins, <i>Contributing Member</i>
D. Siromani	N. M. Simpson, <i>Contributing Member</i>
D. B. Spencer	

Subgroup on Fusion Energy Devices (BPV III)

W. K. Sowder, Jr., <i>Chair</i>	C. J. Lammi
A. Maslowski, <i>Staff Secretary</i>	S. Lawler
M. Ellis, <i>Secretary</i>	P. Mokaria
M. Bashir	D. J. Roszman
J. P. Blanchard	F. J. Schaaf, Jr.
T. P. Davis	P. Smith
B. R. Doshi	Y. Song
L. El-Guebaly	C. Vangaasbeek
G. Holtmeier	I. J. Zatz
D. Johnson	R. W. Barnes, <i>Contributing Member</i>
I. Kimihiro	

Special Working Group on Fusion Stakeholders (BPV III-4)

T. P. Davis, <i>Chair</i>	S. C. Middleburgh
R. W. Barnes	R. J. Pearson
V. Chugh	W. K. Sowder, Jr.
S. S. Desai	D. A. Sutherland
F. Deschamps	N. Young
M. Hua	J. Zimmermann
S. Lawler	

Working Group on General Requirements (BPV III-4)

D. J. Roszman, <i>Chair</i>	P. Mokaria
M. Ellis	W. K. Sowder, Jr.

Working Group on In-Vessel Components (BPV III-4)

M. Bashir, <i>Chair</i>	M. Kalsey
Y. Carin	S. T. Madabusi
T. P. Davis	

Working Group on Magnets (BPV III-4)

W. K. Sowder, Jr., <i>Chair</i>	D. S. Bartran
---------------------------------	---------------

Working Group on Materials (BPV III-4)

M. Porton, <i>Chair</i>	P. Mummery
T. P. Davis	

Working Group on Vacuum Vessels (BPV III-4)

I. Kimihiro, <i>Chair</i>	D. Johnson
L. C. Cadwallader	Q. Shijun
B. R. Doshi	Y. Song

Subgroup on General Requirements (BPV III)

J. V. Gardiner, *Chair*
 N. DeSantis, *Secretary*
 V. Apostolescu
 A. Appleton
 S. Bell
 J. R. Berry
 G. Brouette
 G. C. Deleanu
 J. W. Highlands
 E. V. Imbro
 K. A. Kavanagh
 Y.-S. Kim
 B. McGlone
 E. C. Renaud

T. N. Rezk
 J. Rogers
 R. Spuhl
 D. M. Vickery
 J. DeKleine, *Contributing Member*
 H. Michael, *Contributing Member*
 D. J. Roszman, *Contributing Member*
 C. T. Smith, *Contributing Member*
 W. K. Sowder, Jr., *Contributing Member*
 G. E. Szabatura, *Contributing Member*

Subgroup on High Temperature Reactors (BPV III)

T.-L. Sham, *Chair*
 Y. Wang, *Secretary*
 M. Ando
 N. Broom
 F. W. Brust
 P. Carter
 M. E. Cohen
 W. J. Geringer
 B. F. Hantz
 M. H. Jawad
 W. T. Jessup
 R. I. Jetter
 K. Kimura
 G. H. Koo

A. Mann
 M. C. Messner
 X. Wei
 W. Windes
 R. Wright
 G. L. Zeng
 D. S. Griffin, *Contributing Member*
 X. Li, *Contributing Member*
 W. O'Donnell, Sr., *Contributing Member*
 L. Shi, *Contributing Member*
 R. W. Swindeman, *Contributing Member*

Special Working Group on General Requirements Consolidation (SG-GR) (BPV III)

J. V. Gardiner, *Chair*
 J. Grimm, *Vice Chair*
 G. C. Deleanu
 A. C. Eberhardt

E. C. Renaud
 J. L. Williams
 C. T. Smith, *Contributing Member*

Special Working Group on High Temperature Reactor Stakeholders (SG-HTR) (BPV III)

M. E. Cohen, *Chair*
 M. C. Albert
 M. Arcaro
 R. W. Barnes
 N. Broom
 R. Christensen
 V. Chugh
 W. Corwin
 G. C. Deleanu
 R. A. Fleming
 K. Harris
 R. I. Jetter
 Y. W. Kim

G. H. Koo
 N. J. McTiernan
 T. Nguyen
 K. J. Noel
 T.-L. Sham
 B. Song
 X. Wei
 G. L. Zeng
 T. Asayama, *Contributing Member*
 X. Li, *Contributing Member*
 L. Shi, *Contributing Member*
 G. Wu, *Contributing Member*

Working Group on General Requirements (SG-GR) (BPV III)

B. McGlone, *Chair*
 J. Grimm, *Secretary*
 V. Apostolescu
 A. Appleton
 S. Bell
 J. R. Berry
 G. Brouette
 P. J. Coco
 N. DeSantis
 Y. Diaz-Castillo
 O. Elkadim
 J. Harris
 J. W. Highlands
 E. V. Imbro
 K. A. Kavanagh
 Y.-S. Kim
 Y. K. Law

D. T. Meisch
 E. C. Renaud
 T. N. Rezk
 J. Rogers
 B. S. Sandhu
 R. Spuhl
 J. F. Strunk
 D. M. Vickery
 J. L. Williams
 J. DeKleine, *Contributing Member*
 S. F. Harrison, Jr., *Contributing Member*
 D. J. Roszman, *Contributing Member*
 G. E. Szabatura, *Contributing Member*

Task Group on Division 5 AM Components (SG-HTR) (BPV III)

R. Wright, *Chair*
 R. Bass, *Secretary*
 M. C. Albert
 R. W. Barnes
 F. W. Brust
 Z. Feng
 S. Lawler
 X. Lou

M. McMurtrey
 M. C. Messner
 T. Patterson
 E. C. Renaud
 D. Rudland
 T.-L. Sham
 I. J. Van Rooyen
 X. Wei

Working Group on General Requirements for Graphite and Ceramic Composite Core Components and Assemblies (SG-GR) (BPV III)

W. J. Geringer, *Chair*
 A. Appleton
 J. R. Berry
 C. Cruz
 Y. Diaz-Castillo
 J. Lang

M. N. Mitchell
 J. Potgieter
 E. C. Renaud
 R. Spuhl
 W. Windes
 B. Lin, *Alternate*

Working Group on Allowable Stress Criteria (SG-HTR) (BPV III)

R. Wright, *Chair*
 M. McMurtrey, *Secretary*
 R. Bass
 K. Kimura
 D. Maitra
 R. J. McReynolds
 M. C. Messner
 J. C. Poehler

W. Ren
 T.-L. Sham
 Y. Wang
 X. Wei
 M. Yoo, *Alternate*
 R. W. Swindeman, *Contributing Member*

Working Group on Analysis Methods (SG-HTR) (BPV III)

M. C. Messner, <i>Chair</i>	T.-L. Sham
H. Mahajan, <i>Secretary</i>	X. Wei
R. W. Barnes	S. X. Xu
J. A. Blanco	J. Young
P. Carter	M. R. Breach, <i>Contributing Member</i>
W. T. Jessup	T. Hassan, <i>Contributing Member</i>
R. I. Jetter	S. Krishnamurthy, <i>Contributing Member</i>
G. H. Koo	M. J. Swindeman, <i>Contributing Member</i>
H. Qian	
T. Riordan	

Working Group on Creep-Fatigue and Negligible Creep (SG-HTR) (BPV III)

Y. Wang, <i>Chair</i>	M. C. Messner
M. Ando	T. Nguyen
P. Carter	J. C. Poehler
M. E. Cohen	H. Qian
J. I. Duo	R. Rajasekaran
R. I. Jetter	T.-L. Sham
G. H. Koo	X. Wei
H. Mahajan	J. Young
M. McMurtrey	M. Yoo, <i>Alternate</i>

Working Group on High Temperature Flaw Evaluation (SG-HTR) (BPV III)

C. J. Sallaberry, <i>Chair</i>	H. Qian
F. W. Brust	D. A. Scarth
P. Carter	D. J. Shim
S. Kalyanam	A. Udyawar
B.-L. Lyow	X. Wei
M. C. Messner	S. X. Xu
J. C. Poehler	M. Yoo, <i>Alternate</i>

Working Group on Nonmetallic Design and Materials (SG-HTR) (BPV III)

W. Windes, <i>Chair</i>	J. Parks
W. J. Geringer, <i>Vice Chair</i>	T.-L. Sham
J. Potgieter, <i>Secretary</i>	A. Tzelepi
G. Beirnaert	G. L. Zeng
C. Chen	M. Yoo, <i>Alternate</i>
A. N. Chereskin	A. Appleton, <i>Contributing Member</i>
V. Chugh	R. W. Barnes, <i>Contributing Member</i>
C. Contescu	A. A. Campbell, <i>Contributing Member</i>
N. Gallego	S.-H. Chi, <i>Contributing Member</i>
S. T. Gonczy	Y. Katoh, <i>Contributing Member</i>
K. Harris	A. Mack, <i>Contributing Member</i>
M. G. Jenkins	J. B. Ossmann, <i>Contributing Member</i>
J. Lang	
M. P. Metcalfe	
M. N. Mitchell	

Subgroup on Materials, Fabrication, and Examination (BPV III)

J. Grimm, <i>Chair</i>	M. Kris
S. Hunter, <i>Secretary</i>	D. W. Mann
W. H. Borter	T. Melfi
M. Brijlani	I.-K. Nam
G. R. Cannell	J. B. Ossmann
A. Cardillo	J. E. O'Sullivan
S. Cho	M. C. Scott
P. J. Coco	W. J. Sperko
R. H. Davis	J. R. Stinson
D. B. Denis	J. F. Strunk
B. D. Frew	W. Windes
D. W. Gandy	R. Wright
S. E. Gingrich	S. Yee
M. Golliet	H. Michael, <i>Delegate</i>
L. S. Harbison	A. L. Hiser, Jr., <i>Alternate</i>
R. M. Jessee	R. W. Barnes, <i>Contributing Member</i>
C. C. Kim	

Task Group on Advanced Manufacturing (BPV III)

D. W. Mann, <i>Chair</i>	T. Melfi
D. W. Gandy, <i>Secretary</i>	E. C. Renaud
R. Bass	W. J. Sperko
D. Chowdhury	J. F. Strunk
P. J. Coco	J. Sulley
B. D. Frew	S. Tate
J. Grimm	S. Wolbert
A. L. Hiser, Jr.	H. Xu
J. Lambin	D. W. Pratt, <i>Alternate</i>
T. Lippucci	S. Malik, <i>Contributing Member</i>
K. Matsunaga	

Joint Working Group on HDPE (SG-MFE) (BPV III)

M. Brandes, <i>Chair</i>	K. Manoly
T. M. Musto, <i>Chair</i>	D. P. Munson
J. B. Ossmann, <i>Secretary</i>	J. O'Sullivan
G. Brouette	V. Rohatgi
M. C. Buckley	F. Schaaf, Jr.
S. Choi	S. Schuessler
M. Golliet	R. Stakenborghs
J. Hebeisen	M. Troughton
J. Johnston, Jr.	P. Vibien
P. Krishnaswamy	J. Wright
M. Kuntz	T. Adams, <i>Contributing Member</i>
B. Lin	

COMMITTEE ON HEATING BOILERS (BPV IV)

M. Wadkinson, <i>Chair</i>	C. Dinic
J. L. Kleiss, <i>Vice Chair</i>	J. M. Downs
C. R. Ramcharran, <i>Staff Secretary</i>	J. A. Hall
B. Ahee	M. Mengon
L. Badziagowski	D. Nelson
T. L. Bedeaux	H. Michael, <i>Delegate</i>
B. Calderon	D. Picart, <i>Delegate</i>
J. P. Chicoine	P. A. Molvie, <i>Contributing Member</i>

Executive Committee (BPV IV)

M. Wadkinson, <i>Chair</i>	J. P. Chicoine
C. R. Ramcharran, <i>Staff Secretary</i>	J. A. Hall
L. Badziagowski	J. L. Kleiss
T. L. Bedeaux	