

SECTION II
MATERIALS

2021

ASME Boiler and
Pressure Vessel Code
An International Code

Part D
Properties (Customary)

Currently in preview, click buy full version

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

2021 ASME Boiler & Pressure Vessel Code

2021 Edition

July 1, 2021

II MATERIALS

Part D

Properties (Customary)

ASME Boiler and Pressure Vessel Committee
on Materials



The American Society of
Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: July 1, 2021

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

ASME does not "approve," "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 assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

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

The endnotes 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
Printed in the United States of America

Adopted by the Council of The American Society of Mechanical Engineers, 1914; latest edition 2021.

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

Copyright © 2021 by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
All rights reserved

TABLE OF CONTENTS

List of Sections		xi
Foreword		v
Statement of Policy on the Use of the ASME Single Certification Mark and Code Authorization in Advertising		vi
Statement of Policy on the Use of ASME Marking to Identify Manufactured Items		xvii
Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees		xviii
Personnel		xxi
Summary of Changes		xlii
List of Changes in Record Number Order		xlix
Cross-Referencing and Stylistic Changes in the Boiler and Pressure Vessel Code		1
Subpart 1	Stress Tables	1
	Statement of Policy on Information Provided in the Stress Tables	1
	Guideline on Locating Materials in Stress Tables, and in Tables of Mechanical and Physical Properties	3
Subpart 2	Physical Properties Tables	1091
	Introduction	1091
Subpart 3	Charts and Tables for Determining Shell Thickness of Components Under External Pressure	1132
Mandatory Appendix 1	Basis for Establishing Stress Values in Tables 1A and 1B	1262
1-100	Derivation of Allowable Stress Values	1262
Mandatory Appendix 2	Basis for Establishing Design Stress Intensity Values for Tables 2A, 2B, and 4, and Allowable Stress Values for Table 3	1264
2-100	Derivation of Stress Intensity Values	1264
Mandatory Appendix 3	Basis for Establishing External Pressure Charts	1267
3-100	General	1267
3-200	Basis of Charts in Subpart 3	1267
3-300	Use of Charts in Subpart 3	1267
3-400	Background and Development of Theory	1267
3-500	Design Basis	1267
3-600	Criteria for Allowable Stresses	1268
3-700	Procedure and Responsibility for Chart Development	1271
3-800	Alternate Procedure for Determining Allowable Compressive Stresses	1272
3-900	References	1272
Mandatory Appendix 4	Guidelines on the Approval of New Materials Under the ASME Boiler and Pressure Vessel Code	1274
5-100	Code Policy	1274
5-200	Application	1274
5-300	Chemical Composition	1276
5-400	Metallurgical Structure and Heat Treatment	1276
5-500	Mechanical Properties	1276
5-600	Definitions for Data Collection Purposes	1276
5-700	Required Sampling	1276
5-800	Time-Independent Properties	1277
5-900	Time-Dependent Properties	1277
5-1000	Low-Temperature Properties	1279
5-1100	Toughness Data	1279

5-1200	Stress–Strain Curves	1279
5-1300	Fatigue Data	1279
5-1400	Physical Properties	1279
5-1500	Data Requirements for Welds, Weldments, and Weldability	1280
5-1600	Long-Term Properties Stability	1280
5-1700	Requests for Additional Data	1280
5-1800	New Materials Checklist	1280
5-1900	Requirements for Recognized National or International Specifications	1282
5-2000	Publication of Recognized National or International Specifications	1282
5-2100	CEN Specifications	1282
Mandatory Appendix 6	Basis for Establishing Stress Values in Tables 6A, 6B, 6C, and 6D	1284
6-100	Derivation of Allowable Stress Values	1284
Mandatory Appendix 7	Guidelines on Multiple Marking of Materials	1286
7-100	Background	1286
7-200	Guidelines	1286
Mandatory Appendix 9	Standard Units for Use in Equations	1288
Mandatory Appendix 10	Basis for Establishing Maximum Allowable Stress Values for Tables 5A and 5B	1289
10-100	Derivation of Allowable Stress Values	1289
Nonmandatory Appendix A	Issues Associated With Materials Used in ASME Code Construction	1291
A-100	General	1291
A-200	Metallurgical Changes That Can Occur in Service	1292
A-300	Uniform Corrosion	1299
A-400	Localized Corrosion	1302
A-500	Metallurgically Influenced Corrosion	1303
A-600	Mechanically Assisted Corrosion	1304
A-700	Environmentally Induced Embrittlement and Cracking	1305
A-800	Mechanical Damage Mechanisms	1309
Nonmandatory Appendix B	Developing Nominal Composition Designations for ASME Code Materials	1311
B-100	Background	1311
B-200	General Guidelines for All Materials	1311
B-300	Guidelines for Developing Nominal Composition Designations for Ferrous Materials	1312
B-400	Guidelines for Developing Nominal Composition Designations for Nonferrous Materials	1312
B-500	Summary	1313
Nonmandatory Appendix C	Guidance for the Use of U.S. Customary and SI Units in the ASME Boiler and Pressure Vessel Code	1314
C-100	Use of Units in Equations	1314
C-200	Guidelines Used to Develop SI Equivalents	1314
C-300	Soft Conversion Factors	1316
Nonmandatory Appendix D	Guidelines for Rounding Minimum Specified Tensile and Yield Strength Values and for Establishing Anchor Points for Tensile and Yield Strength Trend Curves in Tables 1A, 1B, 2A, 2B, 3, 4, 5A, 5B, U, and Y-1	1317
D-100	Minimum Tensile Strength and Minimum Yield Strength Columns	1317
D-200	Selecting Anchor Point for Tensile and Yield Strength Trend Curves for All Situations in Which the Minimum RT Specified Values in One Unit System Are Not Precise Conversions of the Units in the Other System	1317
D-300	Significant Figures in the Allowable Stress, Tensile Strength, and Yield Strength Tables in Section II, Part D and in Code Cases	1318

Nonmandatory Appendix E	Material Data for Stress Analysis in the Time-Dependent Regime	1319
E-100	Introduction	1319

FIGURES

G	Geometric Chart for Components Under External or Compressive Loadings (for All Materials)	1133
CS-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Carbon or Low Alloy Steels With Specified Minimum Yield Strength Less Than 30,000 psi	1135
CS-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Carbon or Low Alloy Steels With Specified Minimum Yield Strength 30,000 psi and Higher	1136
CS-3	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Carbon Steel and Low Alloy Steels With Specified Minimum Yield Strength 38,000 psi and Higher for Temperatures 300°F and Less	1137
CS-4	Chart for Determining Shell Thickness of Components Under External Pressure Developed for SA-537 Thickness 2½ in. and Less	1138
CS-5	Chart for Determining Shell Thickness of Components Under External Pressure Developed for SA-508 Class 1, Grades 2 and 3; SA-508 Class 2, Grade 2; SA-533 Class 1, Grades A, B, C, and D; SA-533 Class 2, Grades A, B, C, and D; or SA-541 Grades 2 and 3	1139
CS-6	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Carbon Steel With Specified Minimum Yield Strength of 20,000 psi	1140
HT-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Quenched and Tempered Low Alloy Steel With Specified Minimum Yield Strength of 100,000 psi and Thickness 2½ in. and Less	1141
HT-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for SA-508 Grade 4N, Class 2 or SA-543 Types B and C, Class 2 With Specified Minimum Yield Strength of 100,000 psi	1142
HA-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic Steel 18Cr-8Ni, Type 304	1143
HA-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic Steel 16Cr-12Ni-2Mo, Type 31	1144
HA-3	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic Steel 18Cr-8Ni-0.035 Maximum Carbon, Type 304L	1145
HA-4	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic Steel 18Cr-8Ni-Mo-0.035 Maximum Carbon, Type 316L	1146
HA-5	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic-Ferritic Steel 18Cr-8Ni-3Mo S31500 and Austenitic-Ferritic Steel 25Cr-6Ni-Mo-N S32053	1147
HA-6	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic Steel 25Cr-11Ni-N S30815	1148
HA-7	Chart for Determining Shell Thickness of Components Under External Pressure Developed for SA-564 Type 630 H1150 (17Cr-4Ni-4Cu S17400)	1149
HA-8	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic-Ferritic Steel 25Cr-7Ni-3Mo-2W-0.28N S39274	1150
HA-9	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic Steel 25Cr-7.5Ni-3.5Mo-N-Cu-W S32760	1151
HA-10	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Austenitic Stainless Steel 24Cr-17Ni-6Mn-4.5Mo-N S34565	1152
CI-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Cast Iron	1153
CD	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Cast Ductile Iron With a Specified Minimum Yield Strength of 40,000 psi	1154
CD	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Cast Ductile Iron With a Specified Minimum Yield Strength of 29,000 psi	1155
NFA-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 3003 in O Temper	1156
NFA-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 3003 in H14 Temper	1157

NFA-3	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 3004 in O Temper	1158
NFA-4	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 3004 in H34 Temper	1159
NFA-5	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 5154 in O Temper	1160
NFA-6	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 5454 in O Temper	1161
NFA-7	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 1060 in O Temper	1162
NFA-8	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 5052 in O Temper	1163
NFA-9	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 5086 in O Temper	1164
NFA-10	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 5456 in O Temper	1165
NFA-11	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Alloy 5083 in O Temper	1166
NFA-12	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Welded Aluminum Alloy 6061-T6	1167
NFA-13	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Welded Aluminum Alloy 6061-T4	1168
NFC-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Copper, Type DHP	1169
NFC-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Copper-Silicon Alloy C65500	1170
NFC-3	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed 90-10 Copper-Nickel Alloy	1171
NFC-4	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed 70-30 Copper-Nickel Alloy	1172
NFC-5	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Welded Copper-Iron Alloy Tube C19000 (SB-443 Welded)	1173
NFC-6	Chart for Determining Shell Thickness of Components Under External Pressure Developed for SB-75 and SB-111 Light Drawn Seamless Copper Tubes, Alloys C10200, C12000, C12200, and C14200	1174
NFC-7	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Copper, SB-75 UNS C12200, Temper O50	1175
NFC-8	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Aluminum Bronze Alloy C61400	1176
NFN-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Low Carbon Nickel N02201	1177
NFN-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Nickel N02200	1178
NFN-3	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Nickel-Copper Alloy N04400	1179
NFN-4	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Nickel-Chromium-Iron Alloy N06600	1180
NFN-5	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel-Molybdenum Alloy N10001	1181
NFN-6	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel-Molybdenum-Chromium-Iron Alloy N10003	1182
NFN-7	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel-Iron-Chromium-Molybdenum-Copper Alloy N08825	1183
NFN-8	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Nickel-Iron-Chromium Alloy N08800	1184

NFN-9	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Nickel–Iron–Chromium Alloy N08810	1185
NFN-10	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Low Carbon Nickel–Molybdenum–Chromium Alloy N10276	1186
NFN-11	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Solution Treated Nickel–Chromium–Iron–Molybdenum–Copper Alloy N06007	1187
NFN-12	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Chromium–Nickel–Iron–Molybdenum–Copper–Columbium Alloy N08020	1188
NFN-13	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel–Iron–Chromium–Silicon Alloy N08330	1189
NFN-14	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel–Chromium–Molybdenum Alloy N06455	1190
NFN-15	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel–Molybdenum Alloy N06002	1191
NFN-16	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel–Molybdenum Alloy N10665	1192
NFN-17	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Annealed Nickel–Chromium–Molybdenum–Columbium Alloy N06625 (SA-44, SB-444, and SB-446)	1193
NFN-18	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel–Molybdenum–Chromium–Iron–Copper Alloy N06985 Having a Minimum Yield Strength of 35 ksi	1194
NFN-19	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel–Molybdenum–Chromium–Iron–Copper Alloy N06987 Having a Minimum Yield Strength of 30 ksi	1195
NFN-20	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Work-Hardened Nickel	1196
NFN-21	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel–Chromium–Iron Alloy N06600 (Specific Minimum Yield Strength 40,000 psi)	1197
NFN-22	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Solution Annealed Ni–Cr–Mo–Cb Alloy, Grade 2 N06625	1198
NFN-23	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Cold Worked Nickel–Iron–Chromium Alloy N08800	1199
NFN-24	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Nickel Alloy N06230	1200
NFN-25	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Stress Relieved Nickel Alloy N02200	1201
NFN-26	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Alloy S31277	1202
NFN-27	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Alloy N06005	1203
NFT-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Unalloyed Titanium Grade 3 (UNS R50550)	1204
NFT-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Unalloyed Titanium Grade 2 (UNS R50400)	1205
NFT-3	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Titanium Grade 1 (UNS R50250)	1206
NFT-4	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Titanium Grade 9 Alloy (UNS R56320)	1207
NFT-5	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Titanium Grade 12 Alloy (UNS R53400)	1208
NFT-6	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Titanium Grade 38 (UNS R54250)	1209
NFZ-1	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Zirconium Alloy (UNS R60702)	1210

NFZ-2	Chart for Determining Shell Thickness of Components Under External Pressure Developed for Zirconium Alloy (UNS R60705)	1211
3-500.1	Temperature Limits for Application of Section II External Pressure Charts for Cylinder Under External Pressure	1269
3-500.2	Temperature Limits for Application of Section II External Pressure Charts for Cylinder Under Axial Compression	1270
3-500.3	Temperature Limits for Application of Section II External Pressure Charts for Sphere Under External Pressure	1271
3-700.1	Normalization of Test σ - ϵ to σ_{ymin} and E_{code}	1273
E-100.2-1	Permissible Time/Temperature Conditions for Material That Has Been Cold Worked >5% and <20% and Subjected to Short-Time High Temperature Transients	1321
E-100.4-1	S_{mt} — Allowable Stress Intensity Values, ksi, Type 304 SS — 30-YS, 75-UTS (30-YS, 70-UTS)	1324
E-100.4-2	S_{mt} — Allowable Stress Intensity Values, ksi, Type 316 SS — 30-YS, 75-UTS (30-YS, 70-UTS)	1325
E-100.4-3	S_{mt} — Allowable Stress Intensity Values, ksi, Ni-Fe-Cr (Alloy 800H)	1326
E-100.4-4	S_{mt} — Allowable Stress Intensity Values, ksi, 2 ¹ / ₄ Cr-1Mo	1328
E-100.4-5	S_{mt} — Allowable Stress Intensity Values, ksi, 9Cr-1Mo-V	1329
E-100.5-1	S_t — Allowable Stress Intensity Values, ksi, Type 304 SS	1330
E-100.5-2	S_t — Allowable Stress Intensity Values, ksi, Type 316 SS	1331
E-100.5-3	S_t — Allowable Stress Intensity Values, ksi, Ni-Fe-Cr (Alloy 800H)	1332
E-100.5-4	S_t — Allowable Stress Intensity Values, ksi, 2 ¹ / ₄ Cr-1Mo	1333
E-100.5-5	S_t — Allowable Stress Intensity Values, ksi, 9Cr-1Mo-V	1334
E-100.7-1	Expected Minimum Stress-to-Rupture Values, ksi, Type 304 SS	1336
E-100.7-2	Expected Minimum Stress-to-Rupture Values, ksi, Type 316 SS	1337
E-100.7-3	Expected Minimum Stress-to-Rupture Values, ksi, Ni-Fe-Cr (Alloy 800H)	1338
E-100.7-4	Expected Minimum Stress-to-Rupture Values, ksi, 2 ¹ / ₄ Cr-1Mo	1339
E-100.7-5	Expected Minimum Stress-to-Rupture Values, ksi, Ni-Cr-Fe-Mo-Cb (Alloy 718)	1340
E-100.7-6	Expected Minimum Stress-to-Rupture Values, ksi, 9Cr-1Mo-V	1341
E-100.15-1	S_{mt} — Allowable Stress Intensity, Type 304 SS, Bolting	1346
E-100.15-2	S_{mt} — Allowable Stress Intensity, Type 316 SS, Bolting	1347
E-100.15-3	S_{mt} — Allowable Stress Values, ksi, Alloy 718, Bolting	1348
E-100.16-1	Design Fatigue Strain Range, ϵ_f , for 304 SS	1349
E-100.16-2	Design Fatigue Strain Range, ϵ_f , for 316 SS	1350
E-100.16-3	Design Fatigue Strain Range, ϵ_f , for Ni-Fe-Cr Alloy 800H	1351
E-100.16-4	Design Fatigue Strain Range, ϵ_f , for 2 ¹ / ₄ Cr-1Mo Steel	1352
E-100.16-5	Design Fatigue Strain Range, ϵ_f , for 9Cr-1Mo-V Steel	1353
E-100.17-1	Time-Temperature Limits for Application of Section II External Pressure Charts for Cylinder Under Axial Compression	1354
E-100.17-2	Time-Temperature Limits for Application of Section II External Pressure Charts for Sphere Under External Pressure	1355
E-100.17-3	Temperature Limits for Application of Section II External Pressure Charts for Cylinder Under External Pressure	1356
E-100.18-1	Average Isochronous Stress-Strain Curves for Type 304 SS at 800°F	1357
E-100.18-2	Average Isochronous Stress-Strain Curves for Type 304 SS at 850°F	1358
E-100.18-3	Average Isochronous Stress-Strain Curves for Type 304 SS at 900°F	1359
E-100.18-4	Average Isochronous Stress-Strain Curves for Type 304 SS at 950°F	1360
E-100.18-5	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,000°F	1361
E-100.18-6	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,050°F	1362
E-100.18-7	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,100°F	1363
E-100.18-8	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,150°F	1364
E-100.18-9	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,200°F	1365
E-100.18-10	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,250°F	1366
E-100.18-11	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,300°F	1367
E-100.18-12	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,350°F	1368
E-100.18-13	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,400°F	1369
E-100.18-14	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,450°F	1370
E-100.18-15	Average Isochronous Stress-Strain Curves for Type 304 SS at 1,500°F	1371

E-100.19-1	Average Isochronous Stress–Strain Curves for Type 316 SS at 800°F	1372
E-100.19-2	Average Isochronous Stress–Strain Curves for Type 316 SS at 850°F	1373
E-100.19-3	Average Isochronous Stress–Strain Curves for Type 316 SS at 900°F	1374
E-100.19-4	Average Isochronous Stress–Strain Curves for Type 316 SS at 950°F	1375
E-100.19-5	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,000°F	1376
E-100.19-6	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,050°F	1377
E-100.19-7	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,100°F	1378
E-100.19-8	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,150°F	1379
E-100.19-9	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,200°F	1380
E-100.19-10	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,250°F	1381
E-100.19-11	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,300°F	1382
E-100.19-12	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,350°F	1383
E-100.19-13	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,400°F	1384
E-100.19-14	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,450°F	1385
E-100.19-15	Average Isochronous Stress–Strain Curves for Type 316 SS at 1,500°F	1386
E-100.20-1	Average Isochronous Stress–Strain Curves for Alloy 800H at 800°F and 850°F	1387
E-100.20-2	Average Isochronous Stress–Strain Curves for Alloy 800H at 900°F	1388
E-100.20-3	Average Isochronous Stress–Strain Curves for Alloy 800H at 950°F	1389
E-100.20-4	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,000°F	1390
E-100.20-5	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,050°F	1391
E-100.20-6	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,100°F	1392
E-100.20-7	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,150°F	1393
E-100.20-8	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,200°F	1394
E-100.20-9	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,250°F	1395
E-100.20-10	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,300°F	1396
E-100.20-11	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,350°F	1397
E-100.20-12	Average Isochronous Stress–Strain Curves for Alloy 800H at 1,400°F	1398
E-100.21-1	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 700°F	1399
E-100.21-2	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 750°F	1400
E-100.21-3	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 800°F	1401
E-100.21-4	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 850°F	1402
E-100.21-5	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 900°F	1403
E-100.21-6	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 950°F	1404
E-100.21-7	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 1,000°F	1405
E-100.21-8	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 1,050°F	1406
E-100.21-9	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 1,100°F	1407
E-100.21-10	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 1,150°F	1408
E-100.21-11	Average Isochronous Stress–Strain Curves for Annealed 2 ¹ / ₄ Cr–1Mo at 1,200°F	1409
E-100.22-1	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 700°F	1410
E-100.22-2	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 750°F	1410
E-100.22-3	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 800°F	1411
E-100.22-4	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 850°F	1411
E-100.22-5	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 900°F	1412
E-100.22-6	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 950°F	1412
E-100.22-7	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 1,000°F	1413
E-100.22-8	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 1,050°F	1413
E-100.22-9	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 1,100°F	1414
E-100.22-10	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 1,150°F	1414
E-100.22-11	Average Isochronous Stress–Strain Curves for 9Cr–1Mo–V at 1,200°F	1415

TABLES

1A	Section I; Section III, Division 1, Classes 2 and 3; Section VIII, Division 1; and Section XII Maximum Allowable Stress Values, S , for Ferrous Materials	8
1B	Section I; Section III, Division 1, Classes 2 and 3; Section VIII, Division 1; and Section XII Maximum Allowable Stress Values, S , for Nonferrous Materials	164
2A	Section III, Division 1, Classes 1, MC, and CS; Section III, Division 3; and Section III, Division 5 Design Stress Intensity Values, S_m , and Section VIII, Division 2, Class 1 Maximum Allowable Stress Values, S , for Ferrous Materials	296
2B	Section III, Division 1, Classes 1, MC, and CS; Section III, Division 3; and Section III, Division 5 Design Stress Intensity Values, S_m , and Section VIII, Division 2, Class 1 Maximum Allowable Stress Values, S , for Nonferrous Materials	382
3	Section III, Division 1, Classes 2 and 3; Section VIII, Divisions 1 and 2; and Section XII Maximum Allowable Stress Values, S , for Bolting Materials	410
4	Section III, Division 1, Classes 1 and MC; Section III, Division 3; and Section III, Division 5 Design Stress Intensity Values, S_m , and Section VIII, Division 2 Maximum Allowable Stress Values, S , for Bolting Materials	440
5A	Section VIII, Division 2, Class 2 Maximum Allowable Stress Values, S , for Ferrous Materials	452
5B	Section VIII, Division 2, Class 2 Maximum Allowable Stress Values, S , for Nonferrous Materials	514
6A	Section IV Maximum Allowable Stress Values, S , for Ferrous Materials	540
6B	Section IV Maximum Allowable Stress Values, S , for Nonferrous Materials	548
6C	Section IV Maximum Allowable Stress Values, S , for Lined Water Heater Materials	556
6D	Section IV Maximum Allowable Stress Values, S , for Unlined Water Heater Materials	562
U	Tensile Strength Values, S_u , for Ferrous and Nonferrous Materials	568
Y-1	Yield Strength Values, S_y , for Ferrous and Nonferrous Materials	772
Y-2	Factors for Limiting Permanent Strain in Austenitic Stainless Steels, High-Nickel Alloy Steels, Nickel, and Nickel Alloys	1090
TE-1	Thermal Expansion for Ferrous Materials	1092
TE-2	Thermal Expansion for Aluminum Alloys	1097
TE-3	Thermal Expansion for Copper Alloys	1098
TE-4	Thermal Expansion for Nickel Alloys	1099
TE-5	Thermal Expansion for Titanium Alloys	1109
TCD	Nominal Coefficients of Thermal Conductivity (TC) and Thermal Diffusivity (TD)	1110
TM-1	Moduli of Elasticity E of Ferrous Materials for Given Temperatures	1124
TM-2	Moduli of Elasticity E of Aluminum and Aluminum Alloys for Given Temperatures	1127
TM-3	Moduli of Elasticity E of Copper and Copper Alloys for Given Temperatures	1128
TM-4	Moduli of Elasticity E of High Nickel Alloys for Given Temperatures	1129
TM-5	Moduli of Elasticity E of Titanium and Zirconium for Given Temperatures	1130
PRD	Poisson's Ratio and Density of Materials	1130
G	Tabular Values for Figure G	1212
CS-1	Tabular Values for Figure CS-1	1214
CS-2	Tabular Values for Figure CS-2	1215
CS-3	Tabular Values for Figure CS-3	1216
CS-4	Tabular Values for Figure CS-4	1217
CS-5	Tabular Values for Figure CS-5	1217
CS-6	Tabular Values for Figure CS-6	1218
HT-1	Tabular Values for Figure HT-1	1218
HT-2	Tabular Values for Figure HT-2	1219
HA-1	Tabular Values for Figure HA-1	1219
HA-2	Tabular Values for Figure HA-2	1220
HA-3	Tabular Values for Figure HA-3	1220
HA-4	Tabular Values for Figure HA-4	1221
HA-5	Tabular Values for Figure HA-5	1221
HA-6	Tabular Values for Figure HA-6	1222
HA-7	Tabular Values for Figure HA-7	1223
HA-8	Tabular Values for Figure HA-8	1223

HA-9	Tabular Values for Figure HA-9	1224
HA-10	Tabular Values for Figure HA-10	1225
CI-1	Tabular Values for Figure CI-1	1226
CD-1	Tabular Values for Figure CD-1	1226
CD-2	Tabular Values for Figure CD-2	1226
NFA-1	Tabular Values for Figure NFA-1	1227
NFA-2	Tabular Values for Figure NFA-2	1228
NFA-3	Tabular Values for Figure NFA-3	1229
NFA-4	Tabular Values for Figure NFA-4	1230
NFA-5	Tabular Values for Figure NFA-5	1230
NFA-6	Tabular Values for Figure NFA-6	1231
NFA-7	Tabular Values for Figure NFA-7	1231
NFA-8	Tabular Values for Figure NFA-8	1232
NFA-9	Tabular Values for Figure NFA-9	1232
NFA-10	Tabular Values for Figure NFA-10	1233
NFA-11	Tabular Values for Figure NFA-11	1233
NFA-12	Tabular Values for Figure NFA-12	1234
NFA-13	Tabular Values for Figure NFA-13	1234
NFC-1	Tabular Values for Figure NFC-1	1234
NFC-2	Tabular Values for Figure NFC-2	1235
NFC-3	Tabular Values for Figure NFC-3	1235
NFC-4	Tabular Values for Figure NFC-4	1236
NFC-5	Tabular Values for Figure NFC-5	1236
NFC-6	Tabular Values for Figure NFC-6	1237
NFC-7	Tabular Values for Figure NFC-7	1237
NFC-8	Tabular Values for Figure NFC-8	1238
NFN-1	Tabular Values for Figure NFN-1	1238
NFN-2	Tabular Values for Figure NFN-2	1239
NFN-3	Tabular Values for Figure NFN-3	1239
NFN-4	Tabular Values for Figure NFN-4	1240
NFN-5	Tabular Values for Figure NFN-5	1240
NFN-6	Tabular Values for Figure NFN-6	1241
NFN-7	Tabular Values for Figure NFN-7	1241
NFN-8	Tabular Values for Figure NFN-8	1242
NFN-9	Tabular Values for Figure NFN-9	1243
NFN-10	Tabular Values for Figure NFN-10	1244
NFN-11	Tabular Values for Figure NFN-11	1244
NFN-12	Tabular Values for Figure NFN-12	1245
NFN-13	Tabular Values for Figure NFN-13	1245
NFN-14	Tabular Values for Figure NFN-14	1246
NFN-15	Tabular Values for Figure NFN-15	1247
NFN-16	Tabular Values for Figure NFN-16	1248
NFN-17	Tabular Values for Figure NFN-17	1249
NFN-18	Tabular Values for Figure NFN-18	1250
NFN-19	Tabular Values for Figure NFN-19	1251
NFN-20	Tabular Values for Figure NFN-20	1252
NFN-22	Tabular Values for Figure NFN-22	1252
NFN-23	Tabular Values for Figure NFN-23	1253
NFN-24	Tabular Values for Figure NFN-24	1253
NFN-25	Tabular Values for Figure NFN-25	1254
NFN-26	Tabular Values for Figure NFN-26	1254
NFN-27	Tabular Values for Figure NFN-27	1255
NFT-1	Tabular Values for Figure NFT-1	1256
NFT-2	Tabular Values for Figure NFT-2	1257
NFT-3	Tabular Values for Figure NFT-3	1257
NFT-4	Tabular Values for Figure NFT-4	1258

NFT-5	Tabular Values for Figure NFT-5	1259
NFT-6	Tabular Values for Figure NFT-6	1260
NFZ-1	Tabular Values for Figure NFZ-1	1261
NFZ-2	Tabular Values for Figure NFZ-2	1261
1-100	Criteria for Establishing Allowable Stress Values for Tables 1A and 1B	1263
2-100(a)	Criteria for Establishing Design Stress Intensity Values for Tables 2A and 2B	1265
2-100(b)	Criteria for Establishing Allowable Stress Values for Table 3	1266
2-100(c)	Criteria for Establishing Allowable Stress or Design Stress Intensity Values for Table 4	1266
5-100	Hot Isostatically Pressed Component Requirements for Austenitic Stainless Steels, Austenitic-Ferritic (Duplex) Stainless Steels, Martensitic Stainless Steels, Ferritic Steels, and Nickel Alloys	1275
5-800	ASTM Test Methods and Units for Reporting	1278
5-1500	Example of a Comparison of Allowable Stresses of Base Metals With Compositions Similar to Those of Selected Welding Consumables and the Proposed New Base Metal	1281
6-100(a)	Criteria for Establishing Allowable Stress Values for Tables 6A and 6B	1285
6-100(b)	Criteria for Establishing Allowable Stress Values for Table 6C	1285
6-100(c)	Criteria for Establishing Allowable Stress Values for Table 6D	1285
9-100	Standard Units for Use in Equations	1288
10-100	Criteria for Establishing Allowable Stress Values for Tables 5A and 5B	1290
E-100.1-1	Tensile Strength Values, S_u	1319
E-100.1-2	Tensile and Yield Strength Reduction Factor Due to Long Time Prior Elevated Temperature Service	1320
E-100.1-3	Yield Strength Reduction Factors for 2 ¹ / ₄ Cr-1Mo	1320
E-100.1-4	Tensile Strength Reduction Factors for 2 ¹ / ₄ Cr-1Mo	1320
E-100.1-5	Tensile Strength Reduction Factors for 9Cr-1Mo-V	1321
E-100.3-1	Permissible Base Materials for Structures Other Than Bolting	1322
E-100.3-2	Permissible Weld Materials	1323
E-100.3-3	S_o — Maximum Allowable Stress Intensity, ksi, for Design Condition Calculations	1323
E-100.6-1	Yield Strength Values, S_y , Versus Temperature	1335
E-100.8-1	Stress Rupture Factors for Type 304 Stainless Steel Welded With SFA-5.22 E308T and E308LT, SFA-5.4 E308 and E308L, and SFA-5.9 ER308 and ER308L	1342
E-100.8-2	Stress Rupture Factors for Type 304 Stainless Steel Welded With SFA-5.22 EXXXT-G (16-8-2 Chemistry), SFA-5.4 E16-8-2, and SFA-5.9 ER16-8-2	1342
E-100.8-3	Stress Rupture Factors for Type 304 Stainless Steel Welded With SFA-5.22 E316T and E316LT-1, -2, and -3; SFA-5.4 E316 and E316L; and SFA-5.9 ER316 and ER316L	1342
E-100.9-1	Stress Rupture Factors for Type 316 Stainless Steel Welded With SFA-5.22 E308T and E308LT, SFA-5.4 E308 and E308L, and SFA-5.9 ER308 and ER308L	1343
E-100.9-2	Stress Rupture Factors for Type 316 Stainless Steel Welded With SFA-5.22 EXXXT-G (16-8-2 Chemistry), SFA-5.4 E16-8-2, and SFA-5.9 ER16-8-2	1343
E-100.9-3	Stress Rupture Factors for Type 316 Stainless Steel Welded With SFA-5.22 E316T and E316LT-1 and -2, SFA-5.4 E316 and E316L, and SFA-5.9 ER316 and ER316L	1343
E-100.10-1	Stress Rupture Factors for Alloy 800H Welded With SFA-5.11 ENiCrFe-2 (INCO A)	1344
E-100.10-2	Stress Rupture Factors for Alloy 800H Welded With SFA-5.14 ERNiCr-3 (INCO 82)	1344
E-100.11-1	Stress Rupture Factors for 2 ¹ / ₄ Cr-1Mo (60/30) Welded With SFA-5.28 E90C-B3, SFA-5.28 ER90S-B3, SFA-5.5 E90XX-B3 (>0.05C), SFA-5.23 EB3, SFA-5.23 ECB3 (>0.05C), and SFA-5.29 E90T1-B3 (>0.05C)	1344
E-100.12-1	Stress Rupture Factors for 9Cr-1Mo-V Welded With SFA-5.28 ER90S-B9, SFA-5.5 E90XX-B9, and SFA-5.23 EB9	1345
E-100.13-1	Permissible Materials for Bolting	1345
E-100.14-1	S_o — Maximum Allowable Stress Intensity, ksi, for Design Condition Calculations of Bolting Materials	1346
E-100.23-1	Recommended Restrictions	1416
E-100.24-1	Cross-Reference Table of Section II, Part D and Section III, Subsection NH 2015 Edition	1416
ENDNOTES	1421

LIST OF SECTIONS

(21)

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 5 — High Temperature Reactors
- IV Rules for Construction of Heating Boilers
- V Nondestructive Examination
- VI Recommended Rules for the Care and Operation of Heating Boilers
- VII Recommended Guidelines for the Care of Power Boilers
- VIII Rules for Construction of Pressure Vessels
 - Division 1
 - Division 2 — Alternative Rules
 - Division 3 — Alternative Rules for Construction of High Pressure Vessels
- IX Welding, Brazing, and Fusing Qualifications
- X Fiber-Reinforced Plastic Pressure Vessels
- XI Rules for Inservice Inspection of Nuclear Power Plant Components
 - 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 Power Plants
- XII Rules for Construction and Continued Service of Transport Tanks
- XIII Rules for Overpressure Protection

* In the 2021 Edition, Subsections NC and ND have been incorporated into one publication, Subsection NCD (BPVC.III.1.NCD), Class 2 and Class 3 Components.

INTERPRETATIONS

Interpretations are issued in real time in ASME's Interpretations Database at <http://go.asme.org/Interpretations>. Historical BPVC interpretations may also be found in the Database.

CODE CASES

The Boiler and Pressure Vessel Code committees meet regularly to consider proposed additions and revisions to the Code and to formulate Cases to clarify the intent of existing requirements or provide, when the need is urgent, rules for materials or constructions not covered by existing Code rules. Those Cases that have been adopted will appear in the appropriate 2021 Code Cases book: "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 up to the publication of the 2023 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. Code Case users can check the current status of any Code Case at <http://go.asme.org/BPVCCDatabase>. Code Case users can also view an index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases at <http://go.asme.org/BPVCC>.

FOREWORD*

(21)

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.

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

1 INTRODUCTION

(a) The following information provides guidance to Code users for submitting technical inquiries to the applicable Boiler and Pressure Vessel (BPV) Standards Committee (hereinafter referred to as the Committee). See the guidelines on approval of new materials under the ASME Boiler and Pressure Vessel Code in Section II, Part D for requirements for requests that involve adding new materials to the Code. See the guidelines on approval of new welding and brazing materials in Section II, Part C for requirements for requests that involve adding new welding and brazing materials (“consumables”) to the Code.

Technical inquiries can include requests for revisions or additions to the Code requirements, requests for Code Cases, or requests for Code Interpretations, as described below:

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

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

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

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

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

(3) *Code Interpretations*

(-a) Code Interpretations provide clarification of the meaning of existing requirements in the Code and are presented in Inquiry and Reply format. Interpretations do not introduce new requirements.

(-b) Interpretations will be issued only if existing Code text is ambiguous or conveys conflicting requirements. If a revision of the requirements is required to support the Interpretation, an Intent Interpretation will be issued in parallel with a revision to the Code.

(b) Code requirements, Code Cases, and Code Interpretations established by the Committee 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 requirements.

(c) Inquiries that do not comply with the following guidance or that do not provide sufficient information for the Committee’s full understanding may result in the request being returned to the Inquirer with no action.

2 INQUIRY FORMAT

Submittals to the Committee should include the following information:

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

(1) request for revision of present Code requirements

(2) request for new or additional Code requirements

(3) request for Code Case

(4) request for Code Interpretation

(b) *Background.* The Inquirer should provide the information needed for the Committee’s understanding of the Inquiry, being sure to include reference to the applicable Code Section, Division, Edition, Addenda (if applicable), paragraphs, figures, and tables. This information should include a statement indicating why the included paragraphs, figures, or tables are ambiguous or convey conflicting requirements. Preferably, the Inquirer should provide a copy of, or relevant extracts from, the specific referenced portions of the Code.