

**ASME RTP-1-2007**  
(Revision of ASME RTP-1-2005)

# **Reinforced Thermoset Plastic Corrosion-Resistant Equipment**

**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

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Date of Issuance: April 9, 2008

The next edition of this Standard is scheduled for publication in 2009. There will be no addenda issued to this edition.

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# CONTENTS

Foreword .....	x
Statements of Policy .....	xi
Committee Roster .....	xii
Summary of Changes .....	xv
<b>Introduction</b> .....	<b>1</b>
<b>Part 1      General Requirements</b> .....	<b>2</b>
1-100      Introduction .....	2
1-200      User's Basic Requirements Specification .....	2
1-300      Fabricator's Design Report .....	8
1-400      Inspection .....	8
1-500      Fabricator's Quality Control Program .....	9
<b>Part 2      Materials</b> .....	<b>14</b>
2-100      Scope .....	14
2-200      Laminate Compositions .....	14
2-300      Materials .....	14
Subpart 2A   Requirements for Representative Flat Laminates .....	15
2A-100      Introduction .....	15
2A-200      Laminate Requirements .....	15
2A-300      Requirements for Physical and Mechanical Properties .....	15
2A-400      Test Methods .....	18
2A-500      Records .....	18
2A-600      Additional Standard Laminate Compositions for Subpart 2A .....	18
Subpart 2B   Requirements for Laminates Developed Using the Lamination Analysis Method .....	19
2B-100      Laminate Composition .....	19
2B-200      Requirements for Physical and Mechanical Properties .....	19
2B-300      Test Methods .....	19
2B-400      Records .....	19
Subpart 2C   Permissible Tolerances for Laminate Thickness Variation .....	19
2C-100      Tolerance for Average Spot Thickness .....	20
2C-200      Tolerance for Average Thickness of a Major Part .....	20
2C-300      Exceptions .....	20
<b>Part 3      Design</b> .....	<b>21</b>
3-100      Scope .....	21
3-200      General .....	21
3-300      Definitions .....	21
Subpart 3A   Design by Rules .....	22
3A-100      Loadings .....	22
3A-200      Design for Total Internal Pressure .....	23
3A-300      Design for External Pressure .....	26
3A-400      Seismic, Wind, and Snow Loadings .....	29
3A-500      Large Diameter RTP Equipment Body Flanges .....	29
3A-600      Vessels Supported by Shell Attachments .....	29
3A-700      Reinforcement of Circular Openings .....	30
3A-800      Secondary Bond Shear Stress .....	30
Subpart 3B   Design by Stress Analysis .....	30
3B-100      Introduction .....	30
3B-200      Design Acceptability .....	31



3B-300	Loading .....	32
3B-400	Design .....	32
3B-500	Stress Criteria .....	32
3B-600	External Pressure .....	33
3B-700	Attachments .....	33
<b>Part 4</b>	<b>Fabrication .....</b>	<b>34</b>
4-100	Scope .....	34
4-200	Large Diameter Body Flanges .....	34
4-300	Shell Joints .....	34
4-400	Flanged Nozzles .....	35
4-500	Manways .....	35
4-600	Reinforcement of Cutouts .....	35
4-700	Tolerances .....	35
4-800	Balsa Wood Cored Plates .....	36
<b>Part 5</b>	<b>Overpressure Protection .....</b>	<b>53</b>
5-100	Basis for Design .....	53
5-200	Protection Against Overpressure .....	53
5-300	Type of Overpressure Protection .....	53
5-400	Location of Overpressure Protection Devices .....	53
5-500	Installation Practices .....	53
5-600	Overpressure Device Set Pressure .....	53
5-700	Relief Device Sizing .....	53
5-800	Discharge Lines From Pressure Relief Devices .....	53
5-900	Responsibility for Design and Selection .....	54
<b>Part 6</b>	<b>Inspection and Tests .....</b>	<b>55</b>
6-100	Scope .....	55
6-200	Inspector .....	55
6-300	Inspection and Responsibility .....	55
6-400	Conditions for Inspection .....	55
6-500	Equipment Design .....	56
6-600	Materials .....	56
6-700	Fabrication .....	56
6-800	Fabricator's Quality Assurance Program .....	56
6-900	Final Inspection .....	56
<b>Part 7</b>	<b>Shop Qualification .....</b>	<b>65</b>
7-100	Scope .....	65
7-200	General .....	65
7-300	Fabricator's Facilities and Equipment .....	65
7-400	Personnel .....	65
7-500	Quality Control Program, Document Handling, and Record System .....	65
7-600	Demonstration of Capability .....	65
7-700	Minimum Test Values From Demonstration Laminates .....	67
7-800	Demonstration Vessel .....	68
7-900	Identifying Demonstration Laminates .....	68
7-1000	Laboratory Test and Test Report Requirements for Demonstration Laminates .....	69



<b>Part 8</b>	<b>Certification</b> .....	71
8-100	Scope .....	71
8-200	General .....	71
8-300	Certification for ASME RTP-1 Fabricators .....	71
8-400	ASME RTP-1 Certificate of Authorization for Vessel Fabricators .....	72
<b>Figures</b>		
1-1	Official ASME RTP-1 Symbol .....	13
3-1	Toriconical Head Dimensions .....	25
4-1	Torispherical Heads .....	37
4-2	Flat-Bottom Tank Knuckle Detail .....	38
4-3	Joint Arrangement .....	41
4-4	Flush Nozzle Installation .....	41
4-5	Penetrating Nozzle Installation .....	42
4-6	Bottom Drain Detail .....	44
4-7	Stiffener Detail .....	45
4-8	Support Skirt Attachment Detail .....	46
4-9	Fabrication Tolerances .....	47
4-10	Nozzle Flange Dimensions for Class 150 Bolting .....	48
4-11	Flanged Nozzle Lay-Up Method .....	49
4-12	Nozzle Installation and Cutout Reinforcement Location .....	50
4-13	Nozzle Gussets .....	51
4-14	Flange Tolerances .....	52
4-15	Flat Cored Bottom Knuckle Detail .....	52
7-1	Dimensions for Tensile Test Specimen .....	69
<b>Tables</b>		
1-1	User's Basic Requirements Specification (URS) .....	4
1-2	Fabricator's Data Report .....	10
1-3	Fabricator's Partial Data Report .....	12
2A-1	Standard Laminate Composition Type I .....	16
2A-2	Standard Laminate Composition Type II .....	17
2A-3	Minimum Values of Flat Laminates .....	18
4-1	Flange Flatness Tolerance .....	34
4-2	Typical Dimensions of Manways .....	36
4-3	Shear Bond Length .....	43
6-1	RTP Visual Inspection Acceptance Criteria .....	60
7-1	Required Resin and Acceptable Fabrication Processes for Demonstration Laminates .....	66
7-2	Dimensional Requirements for Hand Lay-Up and Spray-Up Demonstration Laminates .....	67
7-3	Reinforcement Requirements for Hand Lay-Up and Spray-Up Demonstration Laminates .....	68
<b>Mandatory Appendices</b>		
M-1	Reinforcement Materials Receiving Procedures .....	73
M-2	Matrix Materials Receiving Procedures .....	82
M-3	Calculation of Physical and Mechanical Properties Using Lamination Analysis Method .....	91
M-4	Quality Control Program .....	113
M-5	Qualification of Laminators and Secondary Bonders .....	115
M-6	Demonstration Vessel .....	121
M-7	Repair Procedures .....	129
M-8	Acoustic Emission Examination .....	134
M-9	Glossary .....	136
M-10	Reference Documents .....	140
M-11	Submittal of Technical Inquiries to the Reinforced Thermoset Plastic Corrosion Resistant Equipment Committee .....	142



M-12	Dual Laminate Vessels .....	144
M-13	Balsa Wood Receiving and Inspection Procedures .....	183
<b>Figures</b>		
M3-1	Glass Fiber Volume Percent Versus Tensile Modulus .....	93
M3-2	Glass Fiber Volume Percent Versus Shear Modulus .....	94
M3-3	Oriented Glass Fiber at 30 Vol. % Versus Tensile Modulus .....	95
M3-4	Oriented Glass Fiber at 30 Vol. % Versus In-Plane Shear Modulus .....	96
M3-5	Oriented Glass Fiber at 40 Vol. % Versus Tensile Modulus .....	97
M3-6	Oriented Glass Fiber at 40 Vol. % Versus In-Plane Shear Modulus .....	98
M3-7	Oriented Glass Fiber at 50 Vol. % Versus Tensile Modulus .....	99
M3-8	Oriented Glass Fiber at 50 Vol. % Versus In-Plane Shear Modulus .....	100
M3-9	Oriented Glass Fiber at 60 Vol. % Versus Tensile Modulus .....	101
M3-10	Oriented Glass Fiber at 60 Vol. % Versus In-Plane Shear Modulus .....	102
M3-11	Oriented Glass Fiber at 70 Vol. % Versus Tensile Modulus .....	103
M3-12	Oriented Glass Fiber at 70 Vol. % Versus In-Plane Shear Modulus .....	104
M3-13	Poisson's Ratios — 10 to 70 Vol. % .....	105
M3-14	Moment Resultants .....	107
M3-15	In-Plane Force Resultants .....	107
M3-16	Geometry of an <i>n</i> -Layered Laminate .....	108
M3-17	Coordinate Systems .....	109
M5-1	Pipe Test Piece .....	118
M5-2	Secondary Bond Test Assembly .....	119
M5-3	Secondary Bond Test Specimen .....	120
M6-1	ASME RTP-1 Demonstration Vessel .....	126
M6-2	Post-Test Sectioning of Vessel for Final Inspection and Display .....	127
M6-3	Witness of Hydrotest of ASME RTP-1 Demonstration Vessel .....	128
M12C-1	Support Ledges Showing Recommended Weld Locations Away From Thermoformed Bends .....	158
M12D-1	Maximum Offset Allowed for Joints Between Sheets With Different Thicknesses .....	160
M12D-2	Visual Features of Hot Gas Welds .....	162
M12D-3	Illustrations of Flow Lines .....	162
M12D-4	Heat Affected Zone Patterns .....	163
M12D-5	Butt Fusion Welds Showing Melt Flow Lines .....	164
M12D-6	Nozzle Construction for Penetrating Nozzle .....	165
M12D-7	Nozzle and Manway Constructions .....	166
M12D-8	Bottom Nozzle Constructions .....	167
M12G-1	Dual Laminate Demonstration Vessel .....	172
M12G-2	Post-Test Sectioning of Dual Laminate Demonstration Vessel for Final Inspection and Display .....	177
<b>Tables</b>		
M1A-1	Veil and Mat Reinforcement Log Sheet .....	74
M1B-1	Roofing Reinforcement Log Sheet .....	76
M1C-1	Fabric Reinforcement Log Sheet .....	78
M1D-1	Milled Fiber Reinforcement Log Sheet .....	81
M2C-1	Recommended Numerical Standards for Comparator Viscosity Tubes .....	84
M2E-1	Resin Log Sheet .....	87
M2E-2	Curing Agents Log Sheet .....	88
M2G-1	Common Additives Log Sheet .....	90
M3-1	Glass Volume Fraction and Density .....	106
M3-2	Layer Properties .....	106
M3-3	Products of Layer Properties .....	106
M3-4	Summary Table of Laminate Properties .....	107
M5-1	Laminator Qualification Report .....	116
M5-2	Secondary Bonder Qualification Report .....	117
M6-1	User's Basic Requirements Specification (UBRS) .....	122



M8-1	Acceptance Criteria .....	135
M12B-1	ASTM Specifications for Thermoplastic Materials .....	145
M12B-2	Typical Thermoplastic Properties .....	146
M12B-3	Thermoplastic Sheet or Roll Receiving Log .....	148
M12B-4	Thermoplastic Sheet Visual Inspection Acceptance Criteria .....	149
M12B-5	Welding Material Receiving Log .....	151
M12B-6	Bonding Resin Receiving Log .....	152
M12B-7	Conductive Material Receiving Log .....	154
M12B-8	Thermoplastic Shape Receiving Log .....	156
M12D-1	Visual Weld Defects .....	161
M12E-1	Lining Visual Inspection Acceptance Criteria .....	170
M12G-1	User's Basic Requirements Specification (UBRS) .....	173
M12H-1	Welder Qualification Report .....	177
M12H-2	Weld Strength Requirements .....	181
M13-1	Balsa Wood Core Inspection Sheet .....	184
<b>Nonmandatory Appendices</b>		
NM-1	Design Examples .....	185
NM-2	Design of Integral Body Flanges .....	204
NM-3	Seismic, Wind, and Snow Loadings .....	220
NM-4	Hold-Down Lug Design .....	227
NM-5	Ring Support of Vessels .....	237
NM-6	Example of a Fabricator's Quality Control Program .....	250
NM-7	Acceptance Inspection by User's Inspector .....	264
NM-8	Handling and Shipping .....	271
NM-9	Installation of RTP Vessels .....	273
NM-10	Requirements and Responsibilities of User (or User's Agent), Fabricator, Inspector, and Certified Individual .....	276
NM-11	Design for 250 lb Concentrated Load on a Torispherical Head .....	280
NM-12	FRP Flange Design .....	282
NM-13	Stress Analysis Methods .....	286
NM-14	ISO 9001 Quality Control System .....	306
NM-15	Flat Cored Plate Design .....	312
NM-16	External Pressure Design Example for Cylindrical Shells .....	315
<b>Figures</b>		
NM1-1	Torispherical Head .....	186
NM1-2	Stress Intensity in a Torispherical Head .....	188
NM1-3	Horizontal Tank .....	190
NM1-4	Pressure Distribution .....	191
NM1-5	Saddle Reaction .....	192
NM1-6	Stress Along Top Meridian, Initial Try .....	193
NM1-7	Stress Along 45 deg Meridian, Initial Try .....	194
NM1-8	Stress Along 90 deg Meridian, Initial Try .....	195
NM1-9	Stress Along 135 deg Meridian, Initial Try .....	196
NM1-10	Stress Along Bottom Meridian, Initial Try .....	197
NM1-11	Stress Along Top Meridian, Final Try .....	199
NM1-12	Stress Along 45 deg Meridian, Final Try .....	200
NM1-13	Stress Along 90 deg Meridian, Final Try .....	201
NM1-14	Stress Along 135 deg Meridian, Final Try .....	202
NM1-15	Stress Along Bottom Meridian, Final Try .....	203
NM2-1	Design of Flat-Face Integral Body Flanges With Full-Face Gaskets .....	208
NM2-2	Values of $F$ (Integral Flange Factors) .....	209
NM2-3	Values of $f$ (Hub Stress Correction Factors) .....	210
NM2-4	Values of $T$ , $U$ , $Y$ , and $Z$ (Terms Involving $K$ ) .....	211
NM2-5	Values of $V$ (Integral Flange Factors) .....	213
NM2-6	Design of Flat-Face Integral Body Flanges With Full-Face Gaskets (Example Calculation — 72 in. Flange at 30 psi) .....	214



NM4-1	Wound-On Hold-Down Lug .....	228
NM4-2A	Secondary Bonded Hold-Down Lug, Type A .....	229
NM4-2B	Secondary Bonded Hold-Down Lug, Type B .....	230
NM4-3	Moment Coefficient, $M_L$ .....	231
NM4-4	Uplift Coefficient, $P_G$ .....	231
NM4-5	Recommended Hold-Down Clip .....	233
NM5-1	Lugs on Band .....	238
NM5-2	Moment Coefficient, $M_L$ .....	239
NM5-3	Split-Ring Flange .....	240
NM5-4	Ring Support of Vessels .....	241
NM5-5	Geometric Quantities .....	243
NM5-6	Ring Design Chart for Three Lugs .....	244
NM5-7	Ring Design Chart for Four Lugs .....	245
NM5-8	Ring Design Chart for Eight Lugs .....	246
NM5-9	Example Cross Section .....	247
NM5-10	Lug .....	248
NM6-1	Organization Chart .....	252
NM7-1	Recommended Fabrication Tolerances .....	269
NM8-1	Lifting Vessel With Spreader Bar .....	271
NM8-2	Strongback for Lifting .....	271
NM8-3	Use of Strongbacks .....	272
NM9-1	Flat-Face Valve Flange to Flat-Face RTP Nozzle Flange and Full-Face Gasket .....	273
NM9-2	Raised-Face Valve Flange to Flat-Face RTP Nozzle Flange With Filler Ring and Full-Face Gasket .....	274
NM9-3	Flange Bolt Tightening .....	275
NM10-1	RTP-1 Flowchart .....	279
NM11-1	Stress Function .....	281
NM12-1	Flange Dimensioning Details .....	282
NM12-2	Flange Loading Conditions .....	283
NM13A-1	Sign Conventions for Cylindrical Segments .....	303
NM13B-1	Sign Conventions for Spherical Segments .....	303
NM13C-1	Sign Conventions for Flat Plates .....	304
NM13C-2	Simply Supported Flat Plate .....	304
NM13C-3	Edge Loads on Flat Plate .....	304
NM13C-4	Flat Plate Vessel Head .....	304
NM13C-5	Flat Plate to Cylindrical Joint .....	304
NM13D-1	Example Pressure Vessel .....	304
NM13D-2	Forces and Moments in Pressure Vessel Example .....	305
NM13D-3	Hemispherical Head .....	305
NM13D-4	Cylindrical Shell .....	305
NM13D-5	Flat Plate Head .....	305
NM15-1	Equivalent Solid and Cored Plates .....	313
<b>Tables</b>		
NM1-1	Example 1, Vessel With a Toriconical Lower Head .....	189
NM1-2	Wall Thickness in a Horizontal Tank .....	198
NM2-1	Typical Body Flange Dimensions and Recommended Bolt Torque Values for RTP Body Flanges .....	205
NM2-2	Body Flange Design Using Full-Face Gaskets, Maximum Stress Less Than 3,000 psi — Type II Laminates .....	206
NM2-3	Body Flange Design Using Full-Face Gaskets, Maximum Stress Less Than 1,800 psi — Type I Laminates .....	207
NM2-4	Values of $T$ , $Z$ , $Y$ , and $U$ (Factors Involving $K$ ) .....	216
NM6-1	Mixing Data Sheet .....	256
NM6-2	Component Data Sheet .....	257
NM6-3	Document Control Sheet .....	258



NM6-4	Document Distribution List .....	259
NM6-5	Document Preparation and Distribution Responsibility .....	260
NM6-6	Nonconformity Correction Report .....	261
NM6-7	QC Manual Master Revision List .....	263
NM7-1	RTP Equipment Inspection Requirements .....	265
NM7-2	Inspection Checklist for RTP Equipment .....	266
NM13C-1	Multiplying Factors .....	303
<b>SI Units</b>	.....	318
<b>Index</b>	.....	321

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# FOREWORD

The function of the Reinforced Thermoset Plastic (RTP) Corrosion Resistant Equipment Committee is to establish rules of safety governing the design, fabrication, and inspection during construction of such equipment, and to interpret these rules when questions arise regarding their intent. In formulating the rules, the Committee considers the needs of users, material manufacturers, fabricators, and inspectors of this equipment. The objective of the rules is to afford protection of life and property, and to provide a margin for deterioration in service so as to give a reasonably long safe period of usefulness. Advancements in design and material, and the evidence of experience, are recognized.

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 Fabricator's freedom to choose any method of design or any form of construction that conforms to the rules of this Standard.

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

The Committee meets regularly to consider requests for interpretations and revisions of the rules, and to develop new rules as dictated by technological development. Inquiries must be addressed to the Secretary in writing and must give full particulars in order to receive consideration and a written interpretation. Proposed revisions to this Standard resulting from inquiries will be presented to the Main Committee for appropriate action.

Proposed revisions to this Standard approved by the Committee are submitted to the American National Standards Institute and published in *Mechanical Engineering* to invite comments from all interested persons. After the allotted time for public review and final approval by ASME, revisions are published in Addenda to this Standard. They may be used beginning with the date of issuance shown on the Addenda. Revisions become mandatory as requirements 6 months after such date of issuance.

The first edition of this Standard was issued on December 31, 1989. The 2007 edition of this Standard contains revisions to the 2005 edition.

Requests for interpretations or suggestions for revision should be sent to the Secretary, RTP Committee. The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.



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Certified by \_\_\_\_\_  
(Manufacturer)



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(The following is the roster of the Committee at the time of approval of this Standard.)

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# ASME RTP-1–2007 SUMMARY OF CHANGES

Following approval by the RTP Committee and ASME, and after public review, ASME RTP-1–2007 was approved by the American National Standards Institute on October 31, 2007.

ASME RTP-1–2007 includes the following changes identified by a margin note, (07).

<i>Page</i>	<i>Location</i>	<i>Change</i>
xi	Second Statement of Policy	Last two paragraphs revised
7	Table 1-1	(1) Items 6.1, 6.1.1, and 6.1.2 redesignated as 7, 7.1, and 7.2, respectively (2) Item 7 revised
9	1-520	(1) Title revised (2) Subparagraph (a) revised
21, 22	3-100	Subparagraph (d) deleted
	3-300	Added
	3A-110	Added
23	3A-120	Added
	3A-130	Added
	3A-140	Added
	3A-150	Added
26	3A-261	Added
28	3A-345	Added
29	3A-461	Title added
	3A-462	Added
38, 39	Fig. 4-2	(1) Title revised (2) General Note added
53	5-100	Paragraphs 5-110 and 5-120 redesignated as 5-120 and 5-130, respectively, and new para. 5-110 added
	5-600	Revised
55	6-100	Second paragraph revised
	6-300(a)	Revised
56	6-400(d)	Added
59, 64	6-950(d)	Revised
65	7-210	Revised
66	Table 7-1	General Note (b) added
71	Part 8	(1) Title revised



<i>Page</i>	<i>Location</i>	<i>Change</i>
		(2) Accreditation and accredited replaced by certification and certified throughout
126	Fig. M6-1	In lower drawing, callout beginning with A revised
134	M8-100	Revised
135	M8-400	Revised
	M8-500	Revised
206	Table NM2-2	Table NM2-3 redesignated as Table NM2-2 and corresponding cross-references revised
207	Table NM2-3	Table NM2-4 redesignated as Table NM2-3 and corresponding cross-references revised
209	Fig. NM2-2	Fig. NM2-3 redesignated as Fig. NM2-2 and corresponding cross-references revised
210	Fig. NM2-3	Fig. NM2-5 redesignated as Fig. NM2-3 and corresponding cross-references revised
211	Fig. NM2-4	Fig. NM2-2 redesignated as Fig. NM2-4 and corresponding cross-references revised
213	Fig. NM2-5	Fig. NM2-4 redesignated as Fig. NM2-5 and corresponding cross-references revised
216–219	Table NM2-4	Table NM2-2 redesignated as Table NM2-4 and corresponding cross-references revised
224–226	NM3-326	Revised
	NM3-327	Revised
	NM3-328	Revised
	NM3-329	Revised
	NM3-330	Revised
	NM3-331	Revised
228	Fig. NM4-1	Fig. NM4-3 redesignated as Fig. NM4-1 and corresponding cross-references revised
229	Fig. NM4-2A	Fig. NM4-4A redesignated as Fig. NM4-2A and corresponding cross-references revised
230	Fig. NM4-2B	Fig. NM4-4B redesignated as Fig. NM4-2B and corresponding cross-references revised



<i>Page</i>	<i>Location</i>	<i>Change</i>
231	Fig. NM4-3	Fig. NM4-1 redesignated as Fig. NM4-3 and corresponding cross-references revised
	Fig. NM4-4	Fig. NM4-2 redesignated as Fig. NM4-4 and corresponding cross-references revised
238	Fig. NM5-1	Fig. NM5-2 redesignated as Fig. NM5-1 and corresponding cross-references revised
239	Fig. NM5-2	Fig. NM5-4 redesignated as Fig. NM5-2 and corresponding cross-references revised
240	Fig. NM5-3	Fig. NM5-7 redesignated as Fig. NM5-3 and corresponding cross-references revised
241	Fig. NM5-4	Fig. NM5-3 redesignated as Fig. NM5-4 and corresponding cross-references revised
244	Fig. NM5-6	Fig. NM5-8 redesignated as Fig. NM5-6 and corresponding cross-references revised
245	Fig. NM5-7	Fig. NM5-9 redesignated as Fig. NM5-7 and corresponding cross-references revised
246	Fig. NM5-8	Fig. NM5-10 redesignated as Fig. NM5-8 and corresponding cross-references revised
247	Fig. NM5-9	Fig. NM5-6 redesignated as Fig. NM5-9 and corresponding cross-references revised
248	Fig. NM5-10	Fig. NM5-1 redesignated as Fig. NM5-10 and corresponding cross-references revised
264	Nonmandatory Appendix NM-7	(1) NM7-100, NM7-300, and NM7-400(d) revised (2) NM7-700 deleted
321	Index	Revised



# Introduction

## GENERAL

The use of reinforced thermoset plastic (RTP) vessels, operating at pressures not exceeding 15 psig external and/or 15 psig internal above any hydrostatic head, that contain corrosive and otherwise hazardous materials, dictates the need for rules and/or stress analysis concerning materials of construction, design, fabrication, quality control, and inspection of such equipment. In developing rules for RTP, the Committee has adapted the principles of rules included in Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code, wherever they are applicable.

Adaption of standard rules to RTP requires recognition of differences that exist between metallic materials and RTP. These differences are addressed in the remainder of this Introduction.

## MATERIALS AND ASSEMBLY

In the absence of ASTM standards, RTP laminate specifications (Part 2) have been developed for use with this ASME Standard. These specifications include laminate composition and properties. Laminates (composites) manufactured by contact molding and by filament winding are covered.

These materials of construction are not available in commerce as mill shapes such as sheet and plate for forming and joining by the Fabricator. They are produced in situ on a mandrel or mold by the Fabricator during fabrication of RTP equipment components. Each Fabricator, as part of his or her shop qualification to this Standard, must demonstrate capability to produce laminates meeting the requirements of the laminate specifications.

Assembly of components such as shells, heads, and nozzles requires joining by secondary bonding. This operation involves fit-up, surface preparation, and overwrapping with a laminate of composition equivalent to the laminates being joined. Secondary Bonders must be qualified individually by the procedures detailed in Appendix M-5.

## DESIGN

Design by formulas and by stress analysis are both included in this Standard. Consideration is given both to ultimate strength and to limiting strain. Time and temperature dependence of RTP laminate properties is recognized.

The ultimate stress consideration is required to assure safety against catastrophic failure over a reasonably long term. The design factors of Subparts 3A and 3B include consideration of variability of quality in the labor-intensive fabricating operation. The strain considerations are required to assure long-term operation under cyclic stress (fatigue) without cracking the resin matrix of the composite laminate, thus maintaining maximum corrosion resistance. More than 20 years of successful experience, together with test data, have shown these considerations to be valid.

## INSPECTION

Reliance is placed on careful auditing of the Fabricator's Quality Control Program and close visual inspection of equipment during fabrication and of finished equipment.

# Part 1

## General Requirements

### 1-100 INTRODUCTION

Part 1 of this Standard defines the requirements that are applicable to all reinforced thermoset plastic corrosion resistant vessels fabricated to this Standard and shall be used in conjunction with the specific requirements in other parts and mandatory appendices of this Standard.

### 1-110 Scope

(a) This Standard applies to stationary vessels used for the storage, accumulation, or processing of corrosive or other substances at pressures not exceeding 15 psig external and/or 15 psig internal above any hydrostatic head.

(b) In relation to the geometry of vessels, the scope of this Standard shall include the following:

(1) where external piping is to be connected to the vessel

(a) the first threaded joint for screwed connections

(b) the face of the first flange for bolted connections

(c) the vessel side sealing surface for proprietary connections or fittings

(2) the vessel attachment joint when an attachment is made to either the external or internal surface of the vessel

(3) covers for vessel openings, such as manhole and handhole covers

(4) the vessel side sealing surface for proprietary fittings attached to vessels for which rules are not provided by this Standard, such as gages and instruments

### 1-120 Exclusions

The following types of reinforced thermoset plastic equipment are excluded from the rules of this Standard:

(a) vessels with internal operating pressure in excess of 15 psig

(b) hoods, ducts, and stacks

(c) fans and blowers

(d) vessel internals such as entrainment separators, chevron blades, packing support plates, and liquid distribution plates

(e) pumps

(f) pipe or piping (see ASME B31.3)

(g) fully buried underground closed vessels

### 1-130 Application Limitations

Vessels specified, designed, fabricated, and certified by the Fabricator as conforming to this Standard shall be limited to the following pressure and temperature limits:

(a) *Maximum Internal Pressure*<sup>1</sup>

(1) *With Proof Test of As-Constructed Laminate.* The internal operating pressure, measured at the top of the vessel, shall not be greater than 15 psig.

(2) *Without Proof Test of As-Constructed Laminate.* The internal operating pressure, measured at the top of the vessel, shall not be greater than 2 psig.

(b) *Maximum External Pressure*<sup>1</sup>

(1) *With Proof Test of As-Constructed Laminate.* The limit on external operating pressure is 15 psig.

(2) *Without Proof Test of As-Constructed Laminate.* The limit on external operating pressure is 2 psig.

(c) *Temperature Limits.* The operating temperature shall be limited to a value for which mechanical properties have been determined by the procedures in paras. 2A-300(b) and 2B-200(a), and the chemical resistance has been established by the material selection process identified in Table 1-1, item 3.

In general, operating temperatures to 180°F maximum are commonly encountered and a large body of mechanical property and chemical resistance data exists to facilitate design. Applications above 180°F require that the designer recognizes and accounts for possible reduced mechanical properties at the elevated temperature and possibly decreasing mechanical properties with time as a consequence of thermal and chemical exposure. Such elevated temperature applications require special design attention, and consultation with the resin manufacturer is essential.

### 1-200 USER'S BASIC REQUIREMENTS SPECIFICATION

It is the responsibility of the User, or an Agent acting on his/her behalf, who intends that a vessel be designed, constructed, inspected, tested, and certified to be in compliance with this Standard, to provide or cause to be provided for such vessel a User's Basic Requirements Specification (UBRS). The UBRS shall set forth the intended operating conditions of the vessel to provide

<sup>1</sup> Refer to para. 6-930(d) for Proof Test requirements.

