ASME RTP-1–2015
(Revision of ASME RTP-1–2013)

Reinforced Thermoset Plastic Corrosion-Resistant Equipment

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

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The next edition of this Standard is scheduled for publication in 2017. This Standard will become effective 6 months after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME RTP Committee may be published as Cases. Cases and interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org/ as they are issued.

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The American Society of Mechanical Engineers
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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 Standards Committee for appropriate action.

Proposed revisions to this Standard approved by the Committee are submitted to the American National Standards Institute and published at *http://cstools.asme.org/csconnect/PublicReviewPage.cfm* to invite comments from all interested persons. After the allotted time for public review and final approval by ASME, revisions are published in updates to this Standard. They may be used beginning with the date of issuance. 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 2015 edition of this Standard contains revisions to the 2013 edition and was approved by the American National Standards Institute on July 27, 2015.

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

STATEMENT OF POLICY ON THE USE OF CERTIFICATION MARKS 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 Codes and Standards. 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 Codes and Standards may state this capability in its advertising literature.

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The Certification Mark shall be used only for stamping and nameplates as specifically provided in the Code or Standard. 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 a Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the Certification Mark. General usage is permitted only when all of a manufacturer's items are constructed under the rules of the applicable Code or Standard.

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The ASME Codes and Standards provide rules for the construction of various items. These include requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of ASME are identified with the official Certification Mark described in the governing Code or Standard.

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Certified by _____.
(Manufacturer)

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Reinforced Thermoset Plastic Corrosion-Resistant Equipment

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

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INTRODUCTION

GENERAL

The use of reinforced thermoset plastic (RTP) vessels, with maximum allowable working pressure (MAWP) and maximum allowable external working pressure (MAEWP) 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 Mandatory 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 are recognized.

The ultimate stress consideration is required to ensure 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 ensure 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.

ASME RTP-1–2015
SUMMARY OF CHANGES

Following approval by the RTP Committee and ASME, and after public review, ASME RTP-1–2015 was approved by the American National Standards Institute on July 27, 2015.

ASME RTP-1–2015 includes the following changes identified by a margin note, **(15)**.

Page	*Location*	*Change*
xiv	Introduction	First sentence revised
1	1-120	Subparagraph (a) revised
	1-130	Revised in its entirety
2	1-210	Subparagraph (c)(1) revised
	1-220	Subparagraph (a)(1) revised
3, 4	Table 1-1	Item 5 revised
7	1-300	First paragraph revised
12	1-550	Subparagraph (b)(3) revised
13	2-200	Second paragraph revised
	2-310	First paragraph revised
14	2A-210	Subparagraph (c) added
17	2A-300	(1) Subparagraphs (a)(2)(-a)(-7) through (a)(2)(-a)(-9) and (a)(2)(-b)(-3) added (2) Subparagraphs (a)(2)(-c), (b), and (c) revised
18	2A-600	Subparagraph (b) revised
	Subpart 2B	(1) Title revised (2) First paragraph added
19	2B-200	Subparagraphs (a) and (d) revised
	2C-300	Revised in its entirety
20	3-100	First paragraph revised
21	3A-100	Subparagraph (b) revised
	3A-110	Subparagraph (d) revised
22	3A-122	Revised
	3A-130	Revised in its entirety
23	3A-221	Subparagraphs (b) and (c) revised
	3A-222	Subparagraphs (b) and (c) revised
25	3A-260	Subparagraph (d) revised

Page	*Location*	*Change*
26, 27	3A-310	Note (1) revised
	3A-320	First nomenclature term and definition revised
	3A-330	(1) First and last paragraphs and definitions for E_h and I_s revised (2) Nomenclature for I_e added (3) Nomenclature for t deleted
28	3A-430	Subparagraphs (a) through (c) revised
29	3A-710	Example revised
30, 31	3B-220	Subparagraphs (e), (h), (i), and (q) revised
32	3B-400	First paragraph revised
	3B-500	Third paragraph in subpara. (d) revised
33	4-120	Revised
34, 35	4-430	Subparagraphs (d) through (g) added
44	Figure 4-7	Revised in its entirety
52	5-200	First paragraph revised
	5-710	Revised
	5-720	Revised
54	6-300	Subparagraphs (b) and (f) revised
55, 56	6-900	Subparagraphs (b) and (f) revised
	6-910	Subparagraphs (b)(3), (b)(4), and (c) revised
57, 58, 63	6-930	Subparagraphs (d), (d)(1)(-b), (d)(2), and (d)(5)(-d) revised
	6-950	Subparagraphs (a) through (d) revised
59, 60	Table 6-1	"Notes" column revised
64	7-600	Subparagraph (a) revised
65, 67	7-610	Subparagraphs (a), (b), and (d) revised
	7-620	Subparagraph (a) revised
68	7-900	Subparagraphs (a), (b)(4), and (b)(5) revised
	7-1000	Subparagraph (b)(2) revised
82, 85, 86	M2-100	Revised in its entirety
	M2A-200	Subparagraphs (a)(4), (a)(5), (b)(5), and (b)(6) revised
	M2B-500	Revised
	Article C	Previous Article C deleted; former Articles D through G redesignated as Articles C through F, and cross-references updated

Page	*Location*	*Change*
	M2C-100	Revised
	M2C-200	Subparagraphs (c) and (e) revised
	M2C-300	Subparagraphs (b) and (c) revised
	M2C-400	Subparagraph (a) revised
	M2D-200	Subparagraphs (a) through (c) and (f) revised
	M2D-300	Subparagraph (a) revised
89–111	Mandatory Appendix M-3	Revised in its entirety
121	M6-200	First paragraph revised
	M6-300	First paragraph revised
122	Figure M6-1	General Note revised
125–128	Table M6-1	Items 2, 4, and 6 revised
129	M7-200	Revised
	M7-210	Subparagraphs (a) through (d) revised
	M7-220	Revised
130	M7-611	Revised
	M7-621	Revised
131	M7-631	Revised
	M7-641	Revised
132	M7-651	Revised
134	M8-100	Revised
	M8-200	Subparagraph (b) revised
	Table M8-1	General Note revised
136, 138, 139	M-9	(1) Definition of *contact molding* revised (2) Definitions of *laminate structure (Type X)* and *Type I, Type II, and Type X laminates* added
140–142	M-10	Revised in its entirety
145, 146, 148	M12A-200	Revised
	M12B-100	Revised
	M12B-200	First paragraph and subparas. (a), (a)(2), and (c) revised
	M12B-300	Subparagraph (b) revised
	M12B-400	Revised in its entirety
	M12B-500	Revised in its entirety
	M12B-600	Subparagraphs (b) and (d) revised

Page	*Location*	*Change*
	M12B-612	Revised in its entirety
	M12B-613.2	Subparagraphs (b) and (c) revised
	M12B-613.4	Subparagraph (b) revised
150	M12B-614.4	Former subpara. (d)(2) deleted, and remaining subparagraph redesignated
151	M12B-632	Subparagraph (d) deleted
156	M12B-651	Title revised
158	M12C-200	Subparagraphs (a) and (b)(2) revised
164	M12D-424	Subparagraph (a) revised
165	M12D-510	Subparagraph (a) revised
166	Figure M12D-6	Revised
172, 179	M12G-400	First paragraph revised
	M12G-510	First paragraph revised
	M12G-520	Revised
	M12G-530	Subparagraphs (a) and (b) revised
	M12G-531	Revised in its entirety
	M12G-540	First sentence revised
	M12G-550	First paragraph revised
173	Figure M12G-1	General Note (b) revised
174–177	Table M12G-1	Items 1, 4, and 6 revised
221, 222	NM3-100	(1) First two paragraphs revised (2) Note added
	NM3-300	Subparagraphs (a)(3) and (a)(4) revised
	NM3-310	Last sentence of subpara. (a) revised
	NM3-320	Title revised
224	NM3-323	Title revised
245	NM5-430	Footnote 2 revised
258	Table NM6-1	"Gel time" line revised
260	Table NM6-3	Former item 6 deleted, and remaining items redesignated
261	Table NM6-4	Former item 6 deleted, and remaining items redesignated
262	Table NM6-5	Former item 6 deleted, and remaining items redesignated

Page	*Location*	*Change*
279	NM10-400	"Requirements and Responsibilities" entry for para. 6-930 revised
281	Figure NM10-1	Note (1) revised
321–326	Nonmandatory Appendix NM-17	Added
330, 331	Index	Updated

SPECIAL NOTE:

The interpretations to ASME RTP-1 are provided in a separate section for the user's convenience.

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REINFORCED THERMOSET PLASTIC CORROSION-RESISTANT 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, such as gages and instruments, for which rules are not provided by this Standard

(15) 1-120 Exclusions

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

(a) vessels with MAWP or MAEWP 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 (15)

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[1]

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

(2) Without Proof Test of As-Constructed Laminate. The MAWP shall not be greater than 2 psig.

(b) Maximum External Pressure[1]

(1) With Proof Test of As-Constructed Laminate. The MAEWP shall not be greater than 15 psig.

(2) Without Proof Test of As-Constructed Laminate. The MAEWP shall not be greater than 2 psig.

(c) Temperature Limits. The design 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] Refer to para. 6-930(d) for Proof Test requirements.