

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

Reinforced Thermoset Plastic Corrosion-Resistant Equipment

AN AMERICAN NATIONAL STANDARD



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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 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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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*¹

(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*¹

(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

¹ Refer to para. 6-930(d) for Proof Test requirements.

