ASME RTP-1–2011
(Revision of ASME RTP-1–2007)

Reinforced Thermoset Plastic Corrosion-Resistant Equipment

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

INTENTIONALLY LEFT BLANK

ASME RTP-1–2011
(Revision of ASME RTP-1–2007)

Reinforced Thermoset Plastic Corrosion-Resistant Equipment

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers
Three Park Avenue • New York, NY • 10016 USA

Date of Issuance: May 31, 2011

The next edition of this Standard is scheduled for publication in 2013. There will be no addenda issued to this edition.

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.

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

CONTENTS

Figures

Tables

Mandatory Appendices

Figures

Tables

Nonmandatory Appendices

Figures

Tables

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 2011 edition of this Standard contains revisions to the 2007 edition and was approved by the American National Standards Institute on April 8, 2011.

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.

STATEMENT OF POLICY ON THE USE OF CERTIFICATION MARKS AND CODE AUTHORIZATION IN ADVERTISING (11)

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.

Organizations that are authorized to use Certification Marks for making items or constructions that have been constructed and inspected in compliance with ASME Codes and Standards are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the Certification Marks for the benefit of the users, the enforcement jurisdictions, and the holders of the Certification Marks who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the Certification Marks, Certificates of Authorization, and references to Codes or Standards 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 a 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 applicable ASME Code or Standard." An ASME corporate logo shall not be used by any organization other than ASME.

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.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS (11)

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.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the 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.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME that tend to imply that all 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.

ASME's certification related to products means that the capability by the supplier to fulfill requirements in the applicable standard has been reviewed and accepted by ASME. The supplier is responsible for ensuring that products meet, and if applicable continue to meet, the requirements on which the certification is based. This shall be made clear on stampings, labels, or nameplate markings by inclusion of the words:

Certified by _____.
(Manufacturer)

(11)

ASME RTP COMMITTEE
Reinforced Thermoset Plastic Corrosion Resistant Equipment

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

STANDARDS COMMITTEE OFFICERS

L. J. Craigie, *Chair*
D. L. Keeler, *Vice Chair*
P. D. Stumpf, *Secretary*

STANDARDS COMMITTEE PERSONNEL

M. W. Arthur, An-Cor Industrial Plastics, Inc.
F. L. Brown, NBBI
J. L. Bustillos, Bustillos & Associates, LLC
B. R. Colley, Ashland Composite Polymers
L. J. Craigie, Composites Resource
R. A. Crawford, L & M Fiberglass, Inc.
R. B. Davis, Ershigs, Inc.
C. R. Green, Fluor, Inc.
B. Hebb, RPS Composites, Inc.
D. H. Hodgkinson, Consultant
W. F. Holtzclaw, Holtec, LLC
D. L. Keeler, Dow Chemical Co.
R. J. Lewandowski, Corrosion Resistant Composite Consultant
S. R. Linnemann, RL Industries, Inc.
H. N. Marsh, Jr., Consultant
B. F. Shelley, DuPont Engineering Co.
K. J. Spoo, Owens Corning
P. D. Stumpf, The American Society of Mechanical Engineers
J. E. Vacek, Dow Chemical Co.
G. A. Van Beek, Southern Co. Services
F. W. Van Name, Consultant
H. T. Wells, Albemarle Corp.
O. W. Siebert, *Honorary Member,* Siebert Materials Engineering, Inc.

SUBCOMMITTEE ON CERTIFICATION

F. L. Brown, *Chair,* NBBI
D. L. Keeler, *Vice Chair,* Dow Chemical Co.
J. P. Millman, *Secretary,* The American Society of Mechanical Engineers
M. W. Arthur, AN-COR Industrial Plastics, Inc.
J. L. Bustillos, Bustillos & Associates, LLC
B. R. Colley, Ashland Composite Polymers
L. J. Craigie, Composites Resource
C. R. Green, Fluor, Inc.
W. F. Holtzclaw, Holtec, LLC
F. Z. Krmpotich, Belding Tank Technologies
S. R. Linnemann, RL Industries, Inc.
H. N. Marsh, Jr., Consultant
B. F. Shelley, DuPont Engineering Co.
H. T. Wells, Albemarle Corp.
S. F. Harrison, *Contributing Member,* Consultant
T. W. Cowley, *Alternate,* DuPont Engineering Co.
R. A. Crawford, *Alternate,* L & M Fiberglass, Inc.
R. B. Davis, *Alternate,* Ershigs, Inc.
J. D. Eisenman, *Alternate,* Maverick Applied Science, Inc.
R. L. Lewandowski, *Alternate,* Corrosion Resistant Composite Consultant
R. W. Newbold, *Alternate,* RL Industries, Inc.
R. D. Schueler, *Alternate,* NBBI
J. E. Vacek, *Alternate,* Dow Chemical Co.
R. J. Vatovec, *Alternate,* Southern Co. Services
S. Zittrer, *Alternate,* Lubrizol Advanced Materials

SUBCOMMITTEE ON DESIGN AND FABRICATION

D. L. Keeler, *Chair,* Dow Chemical Co.
M. W. Arthur, An-Cor Industrial Plastics, Inc.
J. L. Bustillos, Bustillos & Associates, LLC
J. K. Covey, Plas-Tanks Industries, Inc.
J. Criner, Strand, LLC
W. Daugherty, Beetle Plastics, LLC
J. D. Eisenman, Maverick Applied Science, Inc.
M. Galasso, Norwest Design Associates
G. P. Gentry, Belco Manufacturing Co.
C. R. Green, Fluor, Inc.
B. Hebb, Reinforced Plastic Systems
D. H. Hodgkinson, Consultant
G. V. Jones, Southern Co. Services
F. Z. Krmpotich, Belding Tank Technologies
A. L. Newberry, Femech Engineering
R. W. Newbold, RL Industries, Inc.
D. S. Preston, Belco Manufacturing
J. M. Puthoff, Plas-Tanks Industries, Inc.
K. V. Rathman, Ershigs, Inc.
B. E. Riseborough, Replacom Engineering
J. A. Rolston, Rolston & Associates
B. F. Shelley, DuPont Engineering Co.
Z. Siveski, Bechtel Power
A. Springer, Ershigs, Inc.
T. G. Toth, Midwest Towers, Inc.
F. W. Van Name, Consultant
R. J. Vatovec, Southern Co. Services
S. L. Wagner, Nonus
Y. L. Yin, Fluor Daniel, Inc.

SUBCOMMITTEE ON DUAL LAMINATES

G. P. Gentry, *Chair,* Energy Solutions
S. Zittrer, *Vice Chair,* Lubrizol Advanced Materials
J. K. Argasinski, Solvay Solexis
D. Chandler, Engiplast, Inc.
P. Habib, CPF Dualam, Inc.
L. T. Hutton, Arkema, Inc.
S. R. Linnemann, RL Industries, Inc.
G. McCuaiag, CPF Dualam, Inc.
T. C. Schoessel, Tri-Clor, Inc.
J. E. Vacek, Dow Chemical Co.

SUBCOMMITTEE ON EDITORIAL

R. B. Davis, Ershigs, Inc.
D. H. Hodgkinson, Consultant

SUBCOMMITTEE ON MATERIAL QUALITY ASSURANCE

B. M. Linnemann, *Chair,* RL Industries, Inc.
F. L. Brown, NBBI
B. R. Colley, Ashland Composite Polymers
T. W. Cowley, DuPont Engineering Co.
L. J. Craigie, Composites Resource
R. A. Crawford, L & M Fiberglass, Inc.
R. B. Davis, Ershigs, Inc.
M. E. Guenat, Belco Manufacturing
R. W. Gulley, RL Industries, Inc.
T. Haber, Christen & Laudon LP
W. F. Holtzclaw, Holtec, LLC
R. J. Lewandowski, Corrosion Resistant Composite Consultant
H. N. Marsh, Jr., Consultant
G. L. Nicholson, Tri-Clor, Inc.
J. R. Richter, Tankinetics, Inc.
K. J. Spoo, Owens Corning
R. J. Stadelman, Reichhold, Inc.
F. E. Templeton, Augusta Fiberglass
G. A. Van Beek, Southern Co. Services
G. Ward, AOC, LLC
H. T. Wells, Albemarle Corp.

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 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 is 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-1–2011
SUMMARY OF CHANGES

Following approval by the RTP Committee and ASME, and after public review, ASME RTP-1–2011 was approved by the American National Standards Institute on April 8, 2011.

ASME RTP-1–2011 includes the following changes identified by a margin note, **(11)**.

Page	*Location*	*Change*
xi	Statement of Policy on the Use of Certification Marks and Code Authorization in Advertising	Revised
	Statement of Policy on the Use of ASME Marking to Identify Manufactured Items	Revised
xii, xiii	Personnel	Updated
8, 12	1-520	Subparagraph (a) revised
	1-531	Subparagraphs (a) through (c)(1) revised
	Fig. 1-1	Revised in its entirety
	1-540	Subparagraphs (a)(2), (a)(9), (a)(10), and (a)(12) revised
	1-550	Subparagraphs (a)(3) and (b)(3) revised
9	Table 1-2	Items 8 through 10 revised
14, 17	2A-300	(1) Subparagraph (c) revised (2) Note deleted
	2A-400	Subparagraph (e) revised
22, 23	3A-210	Subparagraph (b) revised
33	4-320	Title revised
34	4-330	Added
52	5-300	Subparagraph (e) deleted
54	6-300	Subparagraph (i) revised
57	6-930	Subparagraph (d)(2) revised
67	Table 7-3	General Note (a) deleted, and remaining General Notes redesignated
70	8-220	Subparagraphs (a), (a)(1), (c), and (e) revised
71	8-450	Revised
	8-460	Revised
134	M8-100	Revised

Page	*Location*	*Change*
135	M8-400	Revised
	M8-500	Revised
136, 138	M-9	(1) Definition of *certify* revised (2) Definition of *minor repairs* added
140	M-10	ASTM D 2393 and ASTM D 4166 references deleted
256	Table NM6-1	Reference to ASTM D 2393 deleted

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