



## Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment<sup>1</sup>

This standard is issued under the fixed designation C 582; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers composition, thickness, fabricating procedures, and physical property requirements for glass fiber reinforced thermoset polyester, vinyl ester, or other qualified thermosetting resin laminates comprising the materials of construction for RTP corrosion-resistant tanks, piping, and equipment. This specification is limited to fabrication by contact molding.

NOTE 1—The laminates covered by this specification are manufactured during fabrication of contact-molded RTP tanks, piping, and other equipment.

NOTE 2—There is no similar or equivalent ISO standard.

1.2 The following safety hazards caveat pertains only to the test method portion, Section 8, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- C 581 Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures Intended for Liquid Service<sup>2</sup>
- D 638 Test Method for Tensile Properties of Plastics<sup>3</sup>
- D 695 Test Method for Compressive Properties of Rigid Plastics<sup>3</sup>
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials<sup>3</sup>
- D 883 Terminology Relating to Plastics<sup>3</sup>
- D 2583 Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor<sup>4</sup>
- D 2584 Test Method for Ignition Loss of Cured Reinforced Resins<sup>4</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.23 on Reinforced Plastic Piping Systems and Chemical Equipment.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 08.04.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 08.02.

D 3681 Test Method for Chemical Resistance of “Fiber-glass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition<sup>2</sup>

E 84 Test Method for Surface Burning Characteristics of Building Materials<sup>5</sup>

### 3. Definitions

3.1 Definitions used in this specification are in accordance with Terminology D 883 unless otherwise indicated. The abbreviation for reinforced thermoset plastic is RTP.

3.2 *polyester*—resins produced by the polycondensation of dihydroxyderivatives and dibasic organic acids or anhydrides, wherein at least one component contributes ethylenic unsaturation yielding resins that can be compounded with styryl monomers and reacted to give highly crosslinked thermoset copolymers.

3.3 *vinyl ester*—resins characterized by reactive unsaturation located predominately in terminal positions that can be compounded with styryl monomers and reacted to give highly crosslinked thermoset copolymers.

NOTE 3—These resins are handled in the same way as polyesters in fabrication of RTP components.

3.4 *contact molding*—a method of fabrication wherein the glass-fiber reinforcement is applied to the mold, in the form of chopped strand mat or woven roving, by hand or from a reel, or in the form of chopped strands of continuous-filament glass from a chopper-spray gun. The resin matrix is applied by various methods, including brush, roller, or spray gun. Consolidation of the composite laminate is by rolling.

### 4. Classification

4.1 Laminates shall be classified according to type, class, and grade.

4.1.1 *Type*—In Roman numerals, shall designate the reinforcement structure comprised of specific plies of glass fiber in specific sequences.

4.1.1.1 *Type I*—A standard all-mat or chopped-roving construction, or both, as shown in Table 1.

4.1.1.2 *Type II*—A standard mat or chopped-roving and woven-roving construction, or combination thereof, as shown in Table 2.

<sup>5</sup> Annual Book of ASTM Standards, Vol 04.07.

**TABLE 1 Standard Laminate Composition Type I<sup>A</sup>**

Calculated Thickness <sup>B,C</sup>		Corrosion Barrier <sup>D</sup>			Structural Plies <sup>E</sup> Number and Sequence of Plies														Drafting Symbols	
in.	(mm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
0.18	(4.6)	V	M	M	M	M														V, 4M
0.23	(5.8)	V	M	M	M	M	M													V, 5M
0.27	(6.9)	V	M	M	M	M	M	M												V, 6M
0.31	(7.9)	V	M	M	M	M	M	M	M											V, 7M
0.35	(8.9)	V	M	M	M	M	M	M	M	M										V, 8M
0.40	(10.2)	V	M	M	M	M	M	M	M	M	M									V, 9M
0.44	(11.2)	V	M	M	M	M	M	M	M	M	M	M								V, 10M
0.48	(12.2)	V	M	M	M	M	M	M	M	M	M	M	M							V, 11M
0.53	(13.5)	V	M	M	M	M	M	M	M	M	M	M	M	M						V, 12M
0.57	(14.5)	V	M	M	M	M	M	M	M	M	M	M	M	M	M					V, 13M
0.61	(15.5)	V	M	M	M	M	M	M	M	M	M	M	M	M	M	M				V, 14M
0.66	(16.8)	V	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M			V, 15M
0.70	(17.8)	V	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M		V, 16M
0.74	(18.8)	V	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	V, 17M

<sup>A</sup> Glass content, weight, % = 25 to 30, all thickness.

<sup>B</sup> Calculated thickness for design purposes is determined as follows:

V = Surfacing mat – 0.010 in./ply (0.25 mm/ply) when saturated with resin.

M = 1 ½ oz/ft<sup>2</sup> (459 g/m<sup>2</sup>) mat – 0.043 in./ply (1.1 mm/ply) when saturated with resin.

<sup>C</sup> The thickness shall be not less than 90 % of the calculated thickness shown.

<sup>D</sup> Corrosion barrier (Plies 1, 2, and 3) shall gel before structural plies are added.

<sup>E</sup> Structural lay-up may be interrupted at intervals long enough to exotherm if required by the laminate manufacturing procedure and 6.3.1.

**TABLE 2 Standard Laminate Composition Type II**

Calculated Thickness <sup>A,B</sup>		Glass Content (weight, %)	Corrosion Barrier <sup>C</sup>			Structural Plies <sup>D</sup> Number and Sequence of Plies																Drafting Symbols			
in.	(mm)	(%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
0.22	(5.6)	28 to 33	V	M	M	M	R	M																	V, 2M, MRM
0.29	(7.4)	30 to 35	V	M	M	M	R	M	R	M															V, 2M, 2(MR)M
0.37	(9.4)	30 to 35	V	M	M	M	R	M	R	M	R	M													V, 2M, 3(MR)M
0.41	(10.4)	30 to 35	V	M	M	M	R	M	R	M	R	M	M												V, 2M, 3(MR)M, M
0.49	(12.5)	34 to 38	V	M	M	M	R	M	R	M	R	M	M	R	M										V, 2M, 3(MR)M, MRM
0.57	(14.5)	34 to 38	V	M	M	M	R	M	R	M	R	M	M	R	M	R	M								V, 2M, 3(MR)M, 2(MR)M
0.64	(16.3)	37 to 41	V	M	M	M	R	M	R	M	R	M	M	R	M	R	M	R	M						V, 2M, 3(MR)M, 3(MR)M
0.69	(17.5)	37 to 41	V	M	M	M	R	M	R	M	R	M	M	R	M	R	M	R	M	M					V, 2M, 3(MR)M, 3(MR)M, M
0.76	(19.3)	37 to 41	V	M	M	M	R	M	R	M	R	M	M	R	M	R	M	R	M	M	R	M			V, 2M, 3(MR)M, 3(MR)M, MRM

<sup>A</sup> Calculated thickness for design purposes is determined as follows:

V = Surfacing mat – 0.010 in./ply (0.25 mm/ply) when saturated with resin.

M = 1 ½ oz/ft<sup>2</sup> (459 g/m<sup>2</sup>) mat = 0.043 in./ply (1.1 mm/ply) when saturated with resin.

R = 24 ½ oz/yd<sup>2</sup> (832 g/m<sup>2</sup>) 5 × 4 woven roving = 0.033 in./ply (0.84 mm/ply) when saturated with resin.

<sup>B</sup> The thickness shall be not less than 90 % of the calculated thickness shown.

<sup>C</sup> Corrosion barrier (Plies 1, 2, and 3) shall gel before structural plies are added.

<sup>D</sup> Structural lay-up may be interrupted long enough to exotherm following an “M” ply, if required by the laminate manufacturing procedure. Location of exotherm plies may be shifted within the laminate body. No plies may be omitted. Refer to 6.3.1.

4.1.1.3 Other types, such as standard mat or chopped roving with alternating layers of nonwoven biaxial or unidirectional reinforcement in the structured plies, may be qualified in accordance with Appendix X2.

4.1.2 *Class*—In capital letters, shall designate the generic resin: “P” for polyester and “V” for vinyl ester. The letters “FS” followed by parenthesis, “FS( ),” shall designate fire retardancy, if specified, with maximum flame spread in the parentheses in accordance with Test Method E 84.

NOTE 4—Fire retardancy by Test Method E 84 is determined for 0.125-in. (3.175-mm) thick, flat laminates with all-mat glass content of 25 to 30 %.

NOTE 5—Maximum flame spread designation by Test Method E 84 relates to measurement and description of the properties of materials, products, or systems in response to heat and flame under controlled laboratory conditions and should not be considered or used for the description or appraisal of the fire hazard of materials, products, or systems under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment that takes into account all the factors that are pertinent to an assessment of the fire hazard or a particular end use.

4.1.3 *Grade*—In Arabic numerals, shall designate the minimum physical property levels of a laminate at 73.4 ± 3.6°F (23 ± 2°C).