



Designation: D1998 – 21

Standard Specification for Polyethylene Upright Storage Tanks¹

This standard is issued under the fixed designation D1998; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers flat-bottom, upright, cylindrical tanks molded in one-piece seamless construction by rotational molding. The tanks are molded from polyethylene for above ground, vertical installation and are capable of containing aggressive chemicals at atmospheric pressure. Included are requirements for materials, properties, design, construction, dimensions, tolerances, workmanship and appearance. Tank capacities are from 1900 L (500 gal) up.

1.2 This specification covers the design of stationery vessels for use at atmospheric pressure intended for use with liquids heated below their flash points and continuous service temperatures below 66°C (150°F) for Type I tanks and below 60°C (140°F) for Type II tanks.

1.2.1 NFPA Standards 30 and NFPA 31 shall be consulted for installations that are subject to the requirements of these standards.

1.3 For service requirements beyond the scope of this specification (1.2), such as externally imposed mechanical forces, internal pressure or vacuum, higher temperature service, etc., other relevant sources of standards, for example, local and state building codes, NFPA, ASME, ARM, etc., shall be consulted.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

NOTE 1—ISO 13341:2005+A1:2011 and ISO 13575:2012 are similar, but not equivalent to this standard.

1.5 The following precautionary caveat pertains only to the test methods portion, Section 11, 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.19 on Film, Sheeting, and Molded Products (Section D20.15.01).

Current edition approved July 15, 2021. Published August 2021. Originally approved in 1991. Last previous edition approved in 2015 as D1998 - 15. DOI: 10.1520/D1998-21.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

D618 Practice for Conditioning Plastics for Testing

D883 Terminology Relating to Plastics

D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics

D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

D3892 Practice for Packaging/Packing of Plastics

D4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F412 Terminology Relating to Plastic Piping Systems

2.2 OSHA Standard:

29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids³

2.3 ANSI Standard:

B-16.5 Pipe Flanges and Flanged Fittings⁴

2.4 NFPA Standards:

30 Flammable and Combustible Liquid Code⁵

31 Installation of Oil Burning Equipment⁵

2.5 ISO Standards:⁶

ISO 13341:2005+A1:2011 Static Thermoplastic Tanks for the Above Ground Storage of Chemicals – Blow Moulded

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

⁶ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

*A Summary of Changes section appears at the end of this standard

or Rotationally Moulded Polyethylene Tanks – Requirements and Test Methods

ISO 13575:2012 Static Thermoplastic Tanks for Above Ground Storage of Domestic Heating Oils, Kerosene and Diesel Fuels – Blow Moulded and Rotationally Moulded Polyethylene Tanks and Rotationally Moulded Tanks Made of Anionically Polymerized Polyamide 6 – Requirements and Test Methods

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification and associated with plastics issues, refer to the terminology contained in Terminologies D883 and F412 and the Association of Rotational Molders (ARM) Glossary of Terms,⁷ unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bottom knuckle radius, n*—the outside corner radius.

3.2.2 *impact failure, n*—any crack in the test specimen resulting from the impact and visible in normal room lighting to a person with normal eyesight.

3.2.3 *rotational molding, n*—a three-stage commercial process consisting of loading the mold with powdered resin, fusing the resin by heating while rotating the mold about more than one axis, and cooling and removing the molded article.

3.2.4 *service factor, n*—a number less than 1.0 (that takes into consideration all the variables and degrees of safety involved in a polyethylene storage tank installation) that is multiplied by the hydrostatic design basis to give the design hoop stress.

4. Classification

4.1 Tanks meeting this specification are classified according to type as follows, and it is the responsibility of the purchaser to specify Type I or Type II:

4.1.1 Type I—Tanks molded from cross-linkable polyethylene.

4.1.2 Type II—Tanks molded from non-cross-linkable polyethylene.

5. Materials

5.1 This specification is based upon the use of 100 % virgin polyethylene intended for the rotational molding process. Any use of regrind, recycled or reprocessed materials, or combinations of such materials, shall not rely upon the performance data of their original constituents, but must meet the requirements of this specification in its own right.

5.1.1 The polyethylene shall have a stress-cracking resistance of 500 h minimum F50 in accordance with Test Method D1693, Condition A, full-strength stress-cracking agent. The test specimens shall be compression molded or rotational molded. If compression molded, Procedure C of Annex A1 of Practice D4703 shall be followed for both types of polyethylene with a minimum platen temperature of 177°C (350°F) for Type II materials. The temperature for Type I (cross-linkable)

polyethylene shall be 197°C (390°F) and the platen shall be kept closed under full pressure for five minutes at the specified temperature in order to bring about the crosslinking reaction. If the test specimens are rotational molded, the conditions for rotational molding shall be similar to the conditions used for molding a tank from this polyethylene.

NOTE 2—The stress-cracking test is not used as an indicator of general chemical resistance of a polyethylene. Refer to the polyethylene supplier's or molder's chemical-resistance chart for information on the resistance of the polyethylene to specific chemicals or products, or test specific products or chemicals prior to use.

5.2 All tanks used for outdoor installation shall contain an ultraviolet stabilizer at a level adequate to give protection for the intended service life of the tanks. This stabilizer shall be compounded into the polyethylene.

5.3 Any pigments added must be compatible with the polyethylene and shall not exceed 0.5 % dry blended, and 2 % compounded in, of the total weight.

NOTE 3—The use of dry-blended pigments can have an effect on physical properties, that is, impact strength.

5.4 Each resin used in designing tanks covered by this specification shall have hydrostatic-hoop-stress data available.

6. Design Requirements for Both Type I and Type II Tanks

6.1 *Cylinder Shell (Unsupported Portion of Tanks)*—The minimum required wall thickness of the cylindrical shell at any fluid level (F) shall be determined by the following equations, but shall not be less than 4.7 mm (0.187 in.) thick. The tolerance indicated in 9.1.2 applies to these dimensions.

$$HL = HM - F \quad (1)$$

where:

HL = head at level F, m (ft),

HM = maximum fluid head, m (ft), and

F = any fluid level, m (ft).

For illustration, see Fig. 1.

$$T = P \times OD/2 \ SD \quad (2)$$

where:

T = wall thickness, mm (in.),

P = pressure, MPa (0.0098 MPa/m-H₂O × SG × HL (m)), or psi (0.433 psi/ft-H₂O × SG × HL (ft)),

SG = specific gravity of fluid,

HL = head at level F, m (ft),

OD = outside diameter of tank, mm (in.), and

SD = hydrostatic design stress, MPa (psi).

6.1.1 The hydrostatic design stress that is used to determine the minimum wall thickness at any fluid level must be based on hoop stress data for the resin. The hoop stress data, obtained in accordance with the procedures of Test Method D2837, provide a hydrostatic-design-basis for the resin. The hydrostatic-design-basis must be reduced by a service factor to determine the actual hydrostatic design stress. The maximum service factor shall be 0.5 for wall thicknesses less than 9.5 mm (0.375 in.). For thicknesses equal to or greater than 9.5 mm (0.375 in.), the maximum service factor shall be 0.475. For example,

⁷ Available from Association of Rotational Molders, 800 Roosevelt Road, C-312, Glen Ellyn, IL 60137, tel: 630-942-6589.