



Designation: **D7792/D7792M – 15** **D7792/D7792M – 23**

Standard Practice for Freeze/Thaw Conditioning of Pultruded Fiber Reinforced Polymer (FRP) Composites Used in Structural Designs¹

This standard is issued under the fixed designation D7792/D7792M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope-Scope*

1.1 In general, it is feasible that the mechanical properties of FRP composites will be affected by environmental conditions such as freeze/thaw cycling. In order to make reliable comparisons between different materials under freeze/thaw environmental conditions, it is necessary to standardize the freeze/thaw conditions to which specimens of these materials are subjected prior to and during testing. This practice defines procedures for freeze/thaw conditioning of pultruded FRP composites intended for use in structural design applications.

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system ~~may not be~~ not necessarily exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems ~~may have the potential to result in nonconformance with the standard.~~

1.3 *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.*

1.4 *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](#)

[D3918 Terminology Relating to Reinforced Plastic Pultruded Products \(Withdrawn 2020\)](#)³

[D6641/D6641M Test Method for Compressive Properties of Polymer Matrix Composite Materials Using a Combined Loading Compression \(CLC\) Test Fixture](#)

[D7290 Practice for Evaluating Material Property Characteristic Values for Polymeric Composites for Civil Engineering Structural Applications](#)

[D7745 Practice for Testing Pultruded Composites](#)

3. Terminology

3.1 Definitions:

¹ This test method is under the jurisdiction of ASTM Committee [D20](#) on Plastics and is the direct responsibility of Subcommittee [D20.18](#) on Reinforced Thermosetting Plastics.

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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 The last approved version of this historical standard is referenced on [www.astm.org](#).

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

3.1.1 *standard laboratory temperature*—a temperature of $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$].

3.1.2 *standard laboratory atmosphere*—an atmosphere having a temperature of $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$] and a relative humidity of $50 \pm 10\%$.

3.1.3 *freeze/thaw resistance*—the ability of a thermoset pultruded composite to withstand repeated water exposure and subsequent freeze cycling for 100 freeze/thaw cycles. This ability will be quantified in terms of the % retention of the mechanical property of interest as compared to samples exposed to water for a comparable time without subsequent freeze/thaw cycling.

3.2 Terminology relating to pultruded composites is found in Terminology **D3918**.

4. Significance and Use

4.1 The freeze/thaw conditioning procedures prescribed in this practice are designed to provide a standard procedure to be used to evaluate and compare the effect of 100 freeze/thaw cycles under controlled laboratory conditions on pultruded FRP composites to be used in structural design applications. The conditioning procedures prescribed in this practice are designed to obtain reproducible results to compare and evaluate these materials but are not intended to produce equilibrium conditions or actual service conditions for these materials.

5. Sampling

5.1 Sampling shall be in accordance with the locations from which test specimens shall be taken from the reinforced pultruded composites as defined in Practice **D7745**.

5.2 Sampling shall be in accordance with the ASTM test methods for the specific mechanical properties to be determined.⁴

6. Test Specimens

6.1 The numbers and types of test specimens shall be in accordance with the ASTM test methods for the specific mechanical properties to be determined. If Practice **D7290** is to be used to determine characteristic values, at least ten samples are needed for the control and ten samples are needed for the freeze/thaw exposure for a total of at least 20 samples.

6.2 Test specimens shall be machined or otherwise fabricated to the test coupon geometry specified by the ASTM test method for the properties to be determined prior to their exposure to the environmental conditioning.

6.3 The thickness of the test specimens shall be the original product thickness without any machining of the surface. The specimen thickness needs to be compatible with the thickness requirements of the mechanical property test method that will be used to evaluate the samples.

6.4 All test specimens shall be conditioned in the standard laboratory atmosphere in accordance with Practice **D618**, Procedure A, prior to initiating the freeze/thaw conditioning procedures described here.

6.5 Use test specimens up to 25 mm [1.0 in.] in thickness with this freeze/thaw standard practice. Experimental data has shown that for pultruded composite samples up to 25 mm [1.0 in.] the interior center of the test specimen is freezing and thawing as desired during the cycle time and temperatures described in this practice. If the interior center is not freezing and thawing during this cycle for the specimen, property data obtained from samples exposed to conditioning as described in this freeze/thaw practice shall not be reported as being obtained using this freeze/thaw standard practice.

7. Apparatus

7.1 *Cold Chamber*—Capable of maintaining a constant temperature of $-20 \pm 2^\circ\text{C}$ [$-4 \pm 3.6^\circ\text{F}$].

⁴To evaluate the effect of freeze/thaw cycling on the matrix and fiber/matrix interface of a pultruded composite material, the use of Test Method **D6641/D6641M** for mechanical property determination is suggested. If other property effects are to be examined, appropriate test methods for the desired property should be selected.