

# COOLING TECHNOLOGY INSTITUTE

## Fiberglass-Reinforced Plastic Panels



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This guideline document summarizes the best current state of knowledge regarding the specific subject. This document represents a consensus of those individual members who have reviewed this document, its scope and provisions. It is intended to aid all users or potential users of cooling towers.

**Approved by the CTI Executive Board**



This document has been reviewed and approved as part of CTI's Five Year Review Cycle. This Document is again subject to review in 2007.

Approved by the  
CTI Executive Board

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# Fiberglass-Reinforced Plastic Panels

## 1.0 SCOPE

- 1.1 This specification covers the classification, material of construction, workmanship, physical properties, and methods of testing glass-fiber reinforced plastic panels in various profiles intended for use as casing, louvers, and similar applications on cooling towers. FRP panels as covered by this specification may also be suitable for other uses in cooling towers. Consult manufacturers, regarding the suitability of FRP for other applications.
- 1.2 Supplementary information on glass-fiber reinforced plastic (FRP) panels may be obtained from ASTM D-3841 Standard Specification for Glass Fiber-Reinforced Polyester Plastic Panels or directly from the manufacturers.
- 1.3 Laboratory flammability tests (E84/UL-723) applicable to this standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire risk of materials, products, or assemblies under actual fire conditions.

## 2.0 APPLICABLE DOCUMENTS

- 2.1 ASTM D-3841 - Standard Specifications for Glass Fiber Reinforced Polyester Plastic Panels.  
(Current Revision)
- 2.2 ASTM D-618 - Conditioning Plastics and Electrical Insulation Materials for Testing.
- 2.3 ASTM D-790 - Test Method for Flexural Properties of Reinforced Plastics.
- 2.4 ASTM D-638 - Test method for Tensile Properties of Plastics
- 2.5 ASTM D-1494 - Test Method for diffuse light Transmission Factor of Reinforced Plastic Panels.
- 2.6 ASTM E-84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- 2.7 ASTM E-72 - Conducting Strength Tests on Building Materials

## 3.0 MATERIALS

- 3.1 The polyester resin used in the panels shall be a thermosetting styrenated and/or acrylated light-stabilized resin composed of polymeric esters in which the recurring ester groups are an integral part of the main polymer chain. The resin shall be reinforced with glass fibers. Glass fiber reinforcement may be either chopped strand roving, continuous strand roving, woven roving or any combination thereof. Glass veils, polyester veils or any combination thereof may be used.

The polyester resin may contain additives for various purposes such as additives to provide low smoke density, or high flame retardancy, catalyst residues, stabilizers, pigments, dyes, opacifying fillers, and reinforcing fiber or filament.

## 4.0 WORKMANSHIP

The panels will conform to the specific dimensions of the profile being produced and shall be fully cured. Panels shall not contain major visual cracks, pinholes, foreign inclusions, or surface wrinkles that would impair the proper resting of the panels, alter the specific dimensions of the panels, or otherwise affect their serviceability.

## 5.0 PHYSICAL REQUIREMENTS

- 5.1 SIZE (Length and Width) - Tolerances or nominal length and width specified by the purchaser shall be  $\pm$  inch (6 mm) measured in accordance with 6.2.
- 5.2 SQUARENESS - Panels shall be within 1/8 inch (3.2 mm) of square when measured in accordance with 6.3.
- 5.3 WEIGHT - Tolerance on the specified weight of all panels shall be  $\pm$  10% when determined in accordance with 6.4 except for the following: Minimum panel weight produced shall not be less than 8 ounces/square foot. The following is a table of the panel weights typically specified and their associated manufacturing tolerances.

Specified Panel Weight	Minimum Weight	Maximum Weight
8 oz/sf	8.0	8.8
10 oz/sf	9.0	11.0

12oz/sf	10.8	13.2
16 oz/sf	14.4	17.6

5.4 PROFILE - the pitch and depth of the profile shall have the following tolerances; pitch  $\pm$  1/16 inch per foot of panel width measured in accordance with 6.5 and depth  $\pm$  1/16 inch measured in accordance with 6.6.

5.5 COLOR - Panel color shall be agreed upon with the purchaser and uniform throughout the panel. Minor differences in color intensity due to the disbursement of glass fibers shall not be cause for rejection.

5.6 LIGHT TRANSMISSION - The nominal light transmission factor of opaque cooling tower panels shall be 5% or less (or as agreed upon with the purchaser) when tested in accordance with ASTM D-1494. A light transmission value of 5% or less is not possible in all colors. Consult the manufacturer for specific light transmission values of various available colors.

5.7 FLAME SPREAD CLASSIFICATION - The flame spread classifications shall be determined in accordance with ASTM E-84 (UL-723). The numerical flame spread number is used by building code bodies to assess the fire hazard of an installation. All of the major building code bodies use three classifications that are also applicable for cooling tower applications. These classifications are as follows:

Flame Spread Rating	Building Code Category
0 thru 25	1, I or A
26 thru 75	2, II or B
76 thru 200	3, III or C

Products specified with a flame spread rating of 25 or less shall be identified by the manufacturer with an Underwriter Laboratories, Inc. label, Factory Mutual label or approved testing agency.

Note: Flame spread ratings are not an indication of how a material will perform in an actual fire situation. They may be used as elements of a fire risk assessment, which takes into account all of the factors that are pertinent to an assessment of the fire hazard of a particular end use. All fire relative to FRP panels regardless of their rating will continue to burn when continuously fed by an outside flame source.

5.8 MECHANICAL PROPERTIES  
MECHANICAL MINIMUM ASTM

PROPERTY	VALUE	TEST
Flexural Strength	14,000 psi	D-790
Flexural Modulus	$0.9 \times 10^{-6}$ psi	D-790
Tensile Strength	7,000 psi	D-638

Note: the above values reflect manufacturer minimum. Panel load/span performance should not be solely based on physical properties since they cannot be used to predict the full scale performance of a panel. In-place performance is affected by other factors such as local instability, geometric configuration of the profile, and fastening requirements. In order to determine proper loads, deflection data or maximum spans recommended, consult the panel manufacturer regarding performance of the material and fastening recommendations for the intended applications use.

5.9 LOAD DEFLECTION/FASTENER PULLOVER - The load-deflection and fastener pullover performance of the profiled FRP panel will be established by the manufacturer using the method described in Section 6.7 and 6.8. Panels shall be fastened to structural supports using #14 fasteners with 5/8" diameter (minimum) steel backed neoprene washer to resist fastener pullover and enhance watertightness. Spacing of the fasteners and use of larger diameter washers shall be per manufacturer recommendations to achieve desired load/span performance. Type and spacing of the fastener shall reflect fastening conditions used in testing and shall be identified on any manufacturer published load/span performance tables.

## 6.0 TEST METHODS

(6.1-6.6 unchanged remainder of section revised)

6.1 CONDITIONING - Condition the test specimens in accordance with procedure A of ASTM D-618 where conditioning is required.

6.2 LENGTH AND WIDTH - Lay the panel on flat, smooth surface and measure with a steel tape. Measure the length on the two sides and the center to the nearest 1/32 inch (0.8 mm) and average the three measurements. Measure the width or the projected width at each end and in the center to the nearest 1/32 inch (0.8 mm) and average the three measurements.

- 6.3 **SQUARENESS** - Any type of jig that has two rails perpendicular to one another, each of length at least equal to the length of the panel in contact with the rail, may be used to determine squareness. Place the panel in the jig so that the longest edge of the panel touches the horizontal rail along its entire length, and the vertical (shorter edge) touches the rail at some point along its entire length. Measure the area between the vertical rail and the short edge of the panel at the corner opposite the one touching the rail to the nearest 1/32 inch (0.8 mm). Rotate the panel 180 degrees and repeat the test.
- 6.4 **WEIGHT** - Weigh the panel on a scale accurate to  $\pm 1\%$ . Calculate the area on the basis of length and width measurements in accordance with 6.2. Calculate the weight in ounces per square foot (or kilograms per square meter).
- 6.5 **PITCH** - The pitch of a panel's profile is the average distance from the crest of one corrugation to the crest of an adjacent corrugation, or in the case of ribbed panels, the distance from the center of one rib to the center of an adjacent rib. Determine the crests of the corrugation or ribs by placing a metal straight edge crosswise on the panel so that it touches the crests. Measure to within  $\pm 1/16$  inch per foot of panel width, then divide by the number of pitches to obtain an average pitch value.
- 6.6 **DEPTH** - the depth of a corrugation is the vertical distance between the plane of the crests and the upper side of the sheet at the bottom of a valley. Make ten depth measurements, five at each end, to the nearest 1/32 inch (0.8 mm) on each specimen and average the results.
- 6.7 **LOAD-DEFLECTION PROPERTIES** - Determine these properties through full scale panel testing simulating actual project design conditions.
- 6.7.1 **METHOD OF TESTING** - Vacuum Chamber Method recommended for uniform load testing shall be per ASTM E-72 Standard Methods of Conducting Tests of Panels for Building Construction (chamber method) to determine these properties.

6.7.2 **INSTALLATION** - Install panels on the test frame exactly as recommended by the manufacturer for appropriate application. Separate panel tests are required to determine values for maximum positive and negative loads. Note: Panels shall be inverted for negative load testing

6.7.3 **TEST RESULTS** - Report type of testing conducted (positive or negative loading), panel profile tested, panel weight in ounces per square foot, panel span length, fastener type (including washer size) and fastener spacing. Record the panel deflection (inches per pound per square foot of load), the load at failure (pounds per square foot) and describe the type of failure and extent of damage visible.

6.7.4 **RETEST AND REJECTION** - If any premature failure occurs, the reasons shall be noted in the report and steps shall be taken to correct the problem. Retest the specified panel conditions as previously described.

6.8 **PANEL PERFORMANCE AND CERTIFICATION** - Manufacturer shall supply certification of compliance to ASTM D-3841 and provide load/span performance data based on the results of the panel testing. Allowable load and span limits shall be based on the lesser of the following performance criteria: panel bending stress (buckling), panel deflection, or fastener pullover.

6.8.1 **DESIGN PARAMETERS** - Load/span tables shall be generated from the test data using the following industry accepted design parameters:

Safety Factors:

2.50 for snow and/or live loads

1.88 for positive & negative wind loads

Deflection Limits:

Maximum deflection -  $L / 40$

Where L is the panel span (inches) between supports

6.8.2 **DESIGN CONDITIONS** - Panels shall be tested and results generated based on ambient design conditions. For applications where more severe design conditions exist (such as high temperatures, humidity, creep due to extended long term loads, etc.) contact manufacturer for supporting design information or conduct additional panel testing (if feasible) to include the effects of the actual in-place conditions.