



ICBO Evaluation Service, Inc.

A subsidiary corporation of the International Conference of Building Officials

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ACCEPTANCE CRITERIA FOR ANTENNA ENCLOSURE SYSTEMS (Proprietary)

AC141

September 1998

PREFACE

Evaluation reports issued by the ICBO Evaluation Service, Inc. (ICBO ES), are based upon performance features of the *Uniform Building Code*[™], *ICBO Uniform Mechanical Code*[™] and related codes. Section 104.2.8 of the *Uniform Building Code* is the primary charging section upon which evaluation reports are issued. Section 104.2.8 reads as follows:

The provisions of this code are not intended to prevent the use of any material, alternate design or method of construction not specifically prescribed by this code, provided any alternate has been approved and its use authorized by the building official.

The building official may approve any such alternate, provided the building official finds that the proposed design is satisfactory and complies with the provisions of this code and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in suitability, strength, effectiveness, fire resistance, durability, safety and sanitation.

The building official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use. The details of any action granting approval of an alternate shall be recorded and entered in the files of the code enforcement agency.

The attached acceptance criteria for the general code sections noted has been issued to provide all interested parties with guidelines on implementing performance features of the codes. The attached acceptance criteria was developed and adopted following public hearings conducted by the Evaluation Committee and is effective on the date shown above. All reports issued or reissued on or after this date must comply with this criteria. If the criteria is an updated version from a previous edition, solid vertical lines (■) in the outer margin within the criteria indicate a technical change or addition from the previous edition. Deletion indicators (◆) are provided in the outer margins where a paragraph or item has been deleted if the deletion resulted from a technical change. This criteria may be revised from time to time as the need dictates.

ICBO ES may consider alternate criteria, provided the proponent submits valid data demonstrating that the alternate criteria are at least equivalent to the attached criteria and otherwise meet the applicable performance requirements of the codes. Notwithstanding that a material, type or method of construction, or equipment, meets the attached acceptance criteria, or that it can be demonstrated that valid alternate criteria are equivalent and otherwise meet the applicable performance requirements of the codes, if the material, product, system or equipment is such that either unusual care in its installation or use must be exercised for satisfactory performance, or malfunctioning is apt to cause unreasonable property damage or personal injury or sickness relative to the benefits to be achieved by the use thereof, ICBO ES retains the right to refuse to issue or renew an evaluation report.

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1.0 INTRODUCTION

1.1 Purpose: The purpose of this criteria is to establish requirements for recognition of antenna enclosure systems in ICBO Evaluation Service, Inc. (ICBO ES), evaluation reports, under the 1997 *Uniform Building Code*[™], hereafter identified as “the code.”

1.2 Scope: The antenna enclosure systems have nonmetallic components, which permit transmission of radio frequency signals and shield the antenna components from wind forces. The antenna enclosure systems shall not be used to form an enclosed structure, such as a penthouse. The enclosure system is composed of nonbearing sandwich wall panels and fiber-reinforced plastic (FRP) structural components, including framing members and bolts. The sandwich panels are composed of acrylonitrile butadiene styrene (ABS) plastic skins bonded by adhesive to extruded polystyrene foam cores.

The sandwich panels may be coated or painted to match the exterior surface conditions of the existing building.

The antenna enclosure system is nonrated combustible construction and must be installed in accordance with Sections 1511 and 1512 of the code.

2.0 REFERENCE DOCUMENTS

1. ICBO ES Acceptance Criteria for Test Reports and Product Sampling (AC85).
2. ICBO ES Acceptance Criteria for Quality Control Manuals (AC10).
3. ICBO ES Acceptance Criteria for Sandwich Panels (AC04).
4. ICBO ES Acceptance Criteria for Sandwich Panel Adhesives (AC05).
5. ICBO ES Acceptance Criteria for Foam Plastic Insulation (AC12).
6. ICBO ES Acceptance Criteria for Laboratory Accreditation (AC89).
7. 1997 *Uniform Building Code* (UBC).
8. UBC Standard 26-6: Ignition Properties of Plastics.
9. UBC Standard 26-7: Method of Test for Determining Classification of Approved Light-transmitting Plastics.
10. ASTM D 198: Method of Static Tests of Timbers in Structural Sizes.
11. ASTM B 117: Standard Practice for Operating Salt Spray (Fog) Apparatus.
12. ASTM D 570: Standard Test Method for Water Absorption of Plastics.
13. ASTM D 618: Standard Practice for Conditioning Plastics and Electrical Insulating Materials for Testing.
14. ASTM D 638: Standard Test Method for Tensile Properties of Plastic.
15. ASTM D 695: Standard Test Method for Compressive Properties of Rigid Plastic.
16. ASTM D 696: Standard Test Method for Coefficient of Live or Thermal Expansion of Plastics Between -30°C and 30°C .
17. ASTM D 790: Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
18. ASTM D 792: Standard Test Method for Density and Specific Gravity of Plastic by Displacement.
19. ASTM D 953: Test Method for Bearing Strength of Plastics.
20. ASTM D 2344: Standard Test Method for Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short-seam Method.

21. ASTM D 2990: Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.

22. ASTM E 84: Test Method for Surface Burning Characteristics of Building Materials.

23. ASTM E 529: Guide for Conducting Flexural Tests on Beams and Girders for Building Construction.

24. ASTM E 330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Difference.

25. ASTM G 26: Practice for Operating Light-exposure Apparatus (xenon-arc type) with/without Water for Exposure of Non-metallic Materials.

3.0 DEFINITIONS

3.1 Antenna Enclosure: Wall system used as a screen for rooftop-mounted antenna or equipment.

3.2 Pultrusion: A process for producing reinforced-plastic profiles in continuous lengths by pulling the raw materials through forming, shaping and curing operations. Principal material used is fiberglass reinforcement, saturated with fire-retardant thermosetting resins such as polyesters and vinylesters.

3.3 Fiber-reinforced Plastic (FRP): A plastic shape produced by the pultrusion process. The FRP consists of fiberglass reinforcement and fire-retardant polyester resin.

3.4 Sandwich Panel: A panel constructed by laminating two sheets of special plastic facings to either side of extruded polystyrene foam plastic.

3.5 Extruded Polystyrene Foam Plastic (XEPS): XEPS that complies with AC12.

4.0 BASIC INFORMATION

Required Items:

4.1 Product Description: Complete information, as applicable, concerning formulation, density, protective coatings and the manufacturing process, is required. For sandwich panels, the panel description shall comply with Section 2 of AC04, and the sandwich panel adhesive must comply with AC05 as a Type I, Class 2, adhesive.

4.2 Installation Instructions: Dimensioned scale drawings and installation details, noting installation limitations and all thicknesses, and size and location of fasteners, are required.

4.3 Packaging and Identification: A description of the method of packaging and identification of components are required. Identification shall include the evaluation report number, the name or logo of the quality control agency, and notice of any product installation limitations. A copy of the installation instructions that are packaged with the product shall be submitted.

4.4 Field Preparation: A description of the methods of field cutting, trimming or forming, and of the treatment of cut edges are required.

4.5 Testing Laboratories: Testing laboratories shall comply with the ICBO ES Acceptance Criteria for Laboratory Accreditation (AC89).

4.6 Test Reports and Product Sampling: Test reports and product sampling shall comply with the ICBO ES Acceptance Criteria for Test Reports and Product Sampling (AC85). The test report must be in sufficient detail to identify specimen properties that might affect performance. The testing agency must verify and report dimensions, weight, density, chemical formulation, treatment, moisture content and other relevant physical properties of the major components. The testing

agency must also verify and report the manner of installation, and provide a description of fastening elements.

5.0 REQUIRED DATA

5.1 Durability: Testing is required as follows:

5.1.1 Weatherometer tests as set forth in Section 6.1.

5.1.2 Freeze-thaw tests as set forth in Section 6.2.

5.1.3 Salt-spray resistance tests as set forth in Section 6.3.

5.2 Joints: The need for expansion and control joints must be determined and locations specified by the architect, designer, builder or manufacturer, in that order. All expansion and control-joint materials must be corrosion resistant. If used, expansion and control joints must be a part of the test specimens used in durability and structural tests.

5.3 Structural Considerations:

5.3.1 Sandwich Panels: The sandwich panel system is a nonbearing wall system. Structural tests in accordance with Section 6.4 for sandwich panels are required to determine allowable positive and negative wind pressures that may be imposed on the panel system. The test program must be in accordance with the following:

5.3.1.1 Test specimens must reflect the minimum conditions of installation. These conditions include such items as panel facings, insulation density and thickness, and connections. Sections 4.1 to 4.3 of AC04 apply to test requirements and derivation of allowable loads. Deflection limits in the code and AC04 are not used to determine allowable loads.

5.3.1.2 The deflection limit shall be imposed by the manufacturer.

5.3.2 Fasteners: Lateral resistance and tension capacity of mechanical fasteners must be determined. Mechanical properties, such as tensile yield and shear stress, of plastic bolts must be determined in accordance with Section 6.7. The connection design is calculated based on the mechanical properties.

5.3.3 Details:

5.3.3.1 General: Plans, details and specifications that concern proper installation of the enclosure system and that are applicable to the specific building under consideration must be part of the plans submitted to the building official for approval.

5.3.3.2 Specific Requirements: Recommended installation details of the enclosure system at typical areas of termination, such as parapets, intersections with other materials, expansion and control joints and roofing, are necessary. Details must be of camera-ready quality, for inclusion in evaluation reports, and must be consistent with recommended application instructions. Vertical joints between panels shall include a polystyrene foam plastic spline.

5.3.4 Pultruded Structural Components: The flexural and axial capacity and physical properties of the pultruded shapes shall be determined in accordance with Section 6.5. Applicable design values will be reported in the evaluation report.

5.3.5 Sandwich Panel Facings: Physical properties for the sandwich panel facings shall be determined in accordance with Section 6.6.

6.0 TEST PROCEDURES

6.1 Accelerated Weathering Test (Weatherometer):

1. Five specimens of each of the following components shall be prepared: the FRP pultrusion profiles, panel facings and plastic bolts.

2. ASTM G 26 applies. Model D or DH, with the operating schedule set forth under Method 1, Section 5, of ASTM G 26, must be used.

3. The test shall be for a minimum of 2,000 hours.

4. Failure is defined as surface changes, as revealed by minimum 5× magnification, such as cracking, checking, crazing, erosion or other characteristics, that might affect the performance of the product.

5. Tensile tests shall be conducted after weatherometer exposure and shall be compared to the control. At a 95 percent confidence level, mean tensile values shall be at least 90 percent of mean control values.

6.2 Freeze-thaw Tests:

1. Five samples of each of the following components shall be prepared: FRP pultrusion profiles, plastic panel facings, and plastic bolts. Profiles shall be at least 6 inches (152 mm) long and facings shall be at least 6 inches (152 mm) square.

2. Samples are subjected to 10 freeze-thaw cycles. Each cycle consists of air drying at 120°F (49°C) for a minimum of eight hours, and total immersion in water at 70°F to 80°F (21.1°C to 26.7°C) for eight hours, followed by exposure to -20°F (-28.8°C) chamber temperatures for 16 hours.

3. Failure is defined as surface changes, as revealed by minimum 5× magnification, such as cracking, checking, crazing, erosion or other characteristics, that might affect performance as an enclosure.

Delamination, or indication of same between components, is also defined as failure.

6.3 Salt-spray Resistance: Testing must be in accordance with ASTM B 117. Specimens are prepared as described in Section 6.2 for the freeze-thaw test specimens. Specimens must periodically be inspected, and results reported. The testing period is 300 hours. Condition of acceptance is that, at the end of the test, there are no deleterious effects from salt spray, such as any cracking, checking, crazing, erosion, delamination or other distress, that might affect performance.

6.4 Structural Performance Tests for Sandwich Panels: Transverse load testing shall be in accordance with Sections 4.1 through 4.3 of AC04, except the test method ASTM E 330 shall be used in lieu of ASTM E 72.

6.5 Pultrusion Structural Components:

6.5.1 The mechanical properties of the FRP pultruded structural components must comply with Table 1.

6.5.2 Axial load tests to determine column action are conducted on 4-foot, 6-foot and 8-foot (1219 mm, 1829 mm and 2438 mm) lengths of products. The test method is ASTM D 198. A minimum of three specimens per condition are required.

6.5.3 Flexural tests are conducted on 8-foot, 12-foot and 20-foot (2438 mm, 3658 mm and 6096 mm) lengths of beams. The test method is ASTM E 529. A minimum of three specimens per condition are required.

6.5.4 Structural Design: A minimum safety factor of five must be applied to the mechanical property results in Table 1. This safety factor may increase if the coefficient of variation of the test results exceeds 15 percent.

The resulting design values are compared to the full-scale flexural beam and full-scale axial compression tests. The design values are subject to further reduction based on this comparison.

6.6 ABS Plastic Skins for Sandwich Panels:

Mechanical properties for the ABS skins shall comply with Table 2.

6.7 Plastic Bolts:

The tension and shear capacity of the plastic bolts must be determined in accordance with Table 3. A safety factor of five is ap-

plied to the mean of structural property values, for design purposes. This safety factor may increase if the coefficient of variation of the test results exceeds 15 percent.

6.8 Fire Testing:

6.8.1 FRP pultrusion structural products must meet the requirements for CC1 classification when tested in accordance with UBC Standard 26-7.

6.8.2 ABS plastic facings for sandwich panels must meet the requirements for CC1 classification when tested in accordance with UBC Standard 26-7.

6.8.3 FRP pultrusion structural components must have a flame-spread rating of 50 or less when tested in accordance with ASTM E 84.

6.8.4 ABS plastic facings for sandwich panels must have a flame-spread rating of 50 or less when tested in accordance with ASTM E 84. If the panel is coated with a fire-retardant paint or coating, additional samples must be exposed

to weathering on the laboratory rooftop for one year and thereafter must be tested.

6.8.5 FRP pultrusion structural products must have a self-ignition temperature of 650°F (343°C) or higher when tested in accordance with UBC Standard 26-6.

6.8.6 ABS plastic facings for sandwich panels must have a self-ignition temperature of 650°F (343°C) or higher when tested in accordance with UBC Standard 26-6.

7.0 QUALITY CONTROL

The products shall be produced under a quality control program administered by an inspection agency accredited by ICBO ES or recognized by the National Evaluation Service, Inc.

A quality control manual, developed in consultation with the recognized quality control agency responsible for follow-up inspections, must be submitted. Quality control manual requirements are noted in the ICBO ES Acceptance Criteria for Quality Control Manuals (AC10).

TABLE 1—MECHANICAL PROPERTIES FOR PULTRUDED STRUCTURAL COMPONENTS¹

PROPERTY	DIRECTION	TEST METHOD	NUMBER OF TEST SAMPLES	UNITS	MINIMUM VALUE ³
Tensile ¹	Lengthwise	ASTM D 638	5	psi (MPa)	30,000 (207)
	Crosswise		5		605 (45)
Tensile modulus	Lengthwise	ASTM D 638	5	psi (MPa)	2.3 × 10 ⁶ (15.8)
	Crosswise		5		0.8 × 10 ⁶ (5.5)
Flexural strength	Lengthwise	ASTM D 790	5	psi (MPa)	30,000 (207)
	Crosswise		5		10,000 (45)
Flexural modulus	Lengthwise	ASTM D 790	5	psi (MPa)	1.5 × 10 ⁶ (10.3)
	Crosswise		5		0.7 × 10 ⁶ (4.8)
Compressive strength	Lengthwise	ASTM D 695	5	psi (MPa)	30,000 (207)
	Crosswise		5		10,000 (45)
Apparent horizontal shear	—	ASTM D 2344	5	psi (MPa)	3,000 (20.7)
Water absorption	—	ASTM D 570	5	% max.	0.7
Density	—	ASTM D 792	5	lb./in. ³ (g/cm ³)	0.06 – 0.068 (1.6 – 1.9)
Specific gravity	—	ASTM D 792	5	—	1.6 - 1.9
Coefficient of thermal expansion	—	ASTM D 696	5	in./in./°F (mm/mm/°C)	2.9 × 10 ⁻⁶ (5.2 × 10 ⁻⁶)
Flame spread	—	ASTM E 84	1	FSI	50 (maximum)
Self-ignition temperature	—	UBC Standard 26-6	1	°F (°C)	650 (343)
Classification	—	UBC Standard 26-7	10	—	CC1
Bolt bearing	Lengthwise	ASTM D 953	5	psi (MPa)	Report value
	Crosswise		5		
Bolt edge distance	Lengthwise	ASTM D 695	5	inch (mm)	Report value
	Crosswise		5		
Creep ²	Lengthwise	ASTM D 2990 Section 6.3	5	strain	Report value
	Crosswise		5		

¹Five samples are to be subjected to 2,000 hours of weatherometer exposure. Tensile strength tests are to be conducted after weatherometer exposure. Result after weatherometer exposure must be a minimum of 75 percent of control.

²Creep properties apply only when components support long-term loads other than self-weight.

³Except as otherwise stated in this column or the specific test method, minimum value applies to mean of individual results.

TABLE 2—MECHANICAL PROPERTIES OF SANDWICH PANEL FACINGS

PROPERTY	DIRECTION	TEST METHOD	NUMBER OF TEST SAMPLES	UNITS	MINIMUM VALUE
Tensile ¹	Lengthwise	ASTM D 638	5	psi (MPa)	Report value
	Crosswise		5		Report value
Classification	—	UBC Standard 26-7	10	—	CC1
Flame spread	—	ASTM E 84	1	FSI	50 (maximum)
Self-ignition temperature	—	UBC Standard 26-6	1	°F (°C)	650 (343)

¹Five samples are to be subjected to 2,000 hours of weatherometer exposure. Tensile strength tests are to be conducted after weatherometer exposure. Result after weatherometer exposure must be a minimum of 75 percent of control.

TABLE 3—MECHANICAL PROPERTIES OF PLASTIC BOLTS

PROPERTY	DIRECTION	TEST METHOD	NUMBER OF TEST SAMPLES	UNITS	MINIMUM VALUE
Tensile ^{1,2}	Tensile	ASTM D 638	5	psi (MPa)	Report value
	Elongation			inch (mm)	Report elongation at yield
Tensile modulus	Tensile	ASTM D 638	5	psi (MPa)	Report value
Shear	—	ASTM D 790	5	psi (MPa)	Report value
Bearing	Lengthwise	ASTM D 953	5	psi (MPa)	Report value
	Crosswise		5		Report value
Creep ³	Lengthwise	ASTM D 2990 Section 6.1	5	strain	Report value

¹Five samples are to be subjected to 2,000 hours of weatherometer exposure. Tensile and shear strength tests are to be conducted after weatherometer exposure. Result after weatherometer exposure must be a minimum of 75 percent of control.

²Five samples are tested by applying load through head and nut to body of bolt.

³Creep properties apply only when bolts support long-term loads other than self-weight.