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A subsidiary corporation of the International Conference of Building Officials

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ACCEPTANCE CRITERIA FOR COMPOSITE RUBBER HOSE AND FITTINGS FOR USE IN HYDRONIC HEATING SYSTEMS (PROPRIETARY)

AC111

April 1998

Previously Issued July 1995

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. 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.

Published by the

International Conference of Building Officials

5360 WORKMAN MILL ROAD • WHITTIER, CALIFORNIA 90601-2298

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1.0 INTRODUCTION

Scope: The purpose of this criteria is to establish requirements for ICBO Evaluation Service, Inc. (ICBO ES), recognition of composite rubber hydronic heating hose and proprietary fittings under Chapter 12 of the 1997 ICBO *Uniform Mechanical Code*™ and the 1996 *International Mechanical Code*™ and 1997 Supplement. This criteria covers composite rubber hose and proprietary fittings intended for use in hydronic panel heating systems with a maximum continuous use temperature of 180°F at a pressure of 100 psi.

2.0 DEFINITIONS

2.1 Failure is any continuous loss of pressure resulting from the transmission of the test liquid through the body of the specimen under test.

2.2 Ballooning is any abnormal localized expansion of a tubing specimen while under internal hydraulic pressure.

2.3 Bursting is failure by a break in the tubing with immediate loss of test liquid and continued loss at essentially no pressure.

2.4 Seepage or Weeping is failure that occurs through essentially microscopic breaks in the tubing wall, frequently only at or near the test pressure. At lower pressures, the tubing may carry liquids without evidence of loss of the liquids.

3.0 REFERENCES

3.1 ASTM F 876-96b, Crosslinked Polyethylene (PEX) Tubing.

3.2 ASTM F 877-97b, Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.

3.3 PPI Technical Report TR-3/92, Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials, published by the Plastics Pipe Institute, A Division of the Society of the Plastics Industry, Inc., The Wayne Interchange Plaza II, 155 Route 46, West Wayne, New Jersey 07470.

4.0 BASIC INFORMATION AND REPORTS OF TESTS

4.1 Product Description: Complete information, as applicable, concerning dimensions, tolerances, formulation, components, manufacturing process and installation procedures.

4.2 Packaging and Identification: Method of packaging and identification of components.

4.3 Testing: An ICBO ES or NES accredited independent testing agency shall sample test specimens, conduct tests and prepare test reports.

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

4.4 Test Reports: Test reports shall comply with the ICBO ES Acceptance Criteria for Test Reports and Product Sampling (AC85).

4.5 Test Conditioning: Condition test specimens at 73.4°F ± 3.6°F and 50 ± 5 percent relative humidity for not less than 40 hours prior to test, unless otherwise specified in these criteria.

4.6 Test Specimens: Not less than 50 percent of the test specimens required for any test shall have at least a part of the marking in their central sections. The central section is that portion of the hose that is at least one tubing diameter away from an end closure.

4.7 Testing: Tests must be performed using representative proprietary fittings assembled in accordance with manufacturer's recommended methods. Tests are performed on pipe sizes with maximum and minimum outside diameter to wall thickness ratios. Where the ratio is constant throughout the range of pipe sizes, one representative size is tested.

5.0 REQUIRED DATA

5.1 Dimensions: Outside diameter and wall thickness of hose and outside diameter of fittings shall be determined in accordance with ASTM D 2122 methods. Average outside diameter is the arithmetic average of the maximum and minimum diameter at any cross section.

5.2 Adhesion: Adhesion tests between layers of the hose shall be performed in accordance with ASTM D 413, ring test method. Values shall be included in the quality control manual and shall be used as a basis for on-going quality control.

5.3 Immersion Tests: Immersion tests shall be performed in accordance with the methods of ASTM D 471 for periods of 7, 28 and 56 days in the following fluids:

5.3.1 deionized water

5.3.2 50 percent ethylene glycol, 50 percent deionized water

5.3.3 50 percent propylene glycol, 50 percent deionized water

Change in volume and strength deterioration tests shall be conducted in accordance with ASTM D 380. Specimens shall not crack, craze or delaminate as a result of exposure.

5.4 Low Temperature Flexibility: Low temperature flexibility tests shall be conducted on hose in accordance with ASTM D 380 at a test temperature of -40°F. Conditions of Acceptance are that none of the specimens show crazing or cracking upon visual examination under 5× magnification in the bent condition.

5.5 Hydrostatic Burst Strength: Hose and fittings shall meet the minimum hydrostatic burst requirements when exposed to test pressures noted in Table 1 at test temperatures of 73.4°F (23°C), 180°F (82°C) and 200°F (93.3°C). Hose and fittings shall be assembled using the manufacturer's recommended procedure. Test a single specimen assembly, containing at least six joints prepared from hose and fittings. After assembly, fill the specimen assembly with water, and condition in water at the test temperature for two hours minimum or in air for 4 hours minimum. In the case of testing at 180°F and 200°F, the sample must be filled with water of at least 120°F temperature prior to conditioning. Tests shall be conducted in accordance with methods of ASTM D 1599. Increase the internal pressure at a constant rate so as to reach the maximum burst requirement in 60 to 70 seconds. Leakage or separation at any of the joints tested at less than the minimum hydrostatic burst requirements for either temperature specified shall constitute failure in this test.

5.6 Hydrostatic Sustained Pressure Strength: Six hose and fitting assemblies shall sustain the test pressures noted in Table 2 at test temperatures of 73.4°F (23°C), 180°F (82°C) and 200°F (93.3°C) for 1,000 hours. Tests shall be conducted in accordance with methods of ASTM D 1598 except for the following:

5.6.1 Hose and fittings shall be assembled following manufacturer's recommended procedure.

5.6.2 The external environment shall be air or water.

5.6.3 Fill the specimens with water at a temperature of at least 120°F.

5.6.4 Failure of any one of the six specimens constitutes failure in the test.

5.7 Thermocycling of Hose and Fittings: Rubber to metal transition fittings and compression-type fittings assembled using the manufacturer's recommended procedure shall not separate or leak when thermocycled 1,000 times between the temperatures of 60°F and 180°F. Pressurize hose and fittings with nitrogen or air to 100 ± 10 psi. Thermally cycle specimens alternately between 60°F ± 4°F and 180°F ± 4°F by means of immersion in water using the following test cycle:

Water immersion at 180°F	2 minutes (minimum)
Air immersion at ambient	2 minutes (maximum)
Water immersion at 60°F	2 minutes (minimum)
Air immersion at ambient	2 minutes (maximum)

Upon completion of 1,000 thermal cycles, immerse the specimen assembly again in 60°F ± 4°F water and check for any sign of leakage. Any evidence of leakage at the fitting or separation of the fitting from the hose in any one of six test specimens constitutes a failure.

5.8 Bent Hose Hydrostatic Sustained Pressure Strength: Hose bent with the minimum radius recommended by the manufacturer inducing not less than a 90-degree angle, shall sustain the test pressures noted in Table 3 at a test temperature of 180°F (82°C) for 1,000 hours. The bend length and bend angle is kept throughout the testing period by rigid supports immediately outside the bend.

5.9 Excessive Temperature—Pressure Capability:

5.9.1 General: In the event of a heating system malfunction, the hose shall have adequate strength to accommodate short-term conditions, 48 hours of 210°F, 150 psi until repairs can be made.

5.9.2 Hydrostatic Sustained Pressure Strength: Hose and fittings, when tested as assemblies shall not fail as defined in ASTM D 1598 in less than 1,000 hours when tested as follows:

- 5.9.2.1** Six specimen assemblies shall be tested.
- 5.9.2.2** Test temperature shall be 210°F ± 4°F.
- 5.9.2.3** The external test environment shall be air.
- 5.9.2.4** Fill the specimens with water and condition for two hours at a temperature of 210°F ± 4°F and a pressure of 30 ± 3 psi.
- 5.9.2.5** Pressurize test specimens to achieve the test pressures noted in Table 4, and maintain for 720 hours.

5.10 Hydrostatic Design Basis: The tube shall have a pressure design basis, *PDB*, established in accordance with the requirements of PPI Technical Report TR-3 at 180°F (82°C) following the method of ASTM D 2837, with the following exceptions: Test pressure versus time shall be plotted following the methods of ASTM D 2837 and extrapolated to 100,000 hours. The hydrostatic pressure design basis shall be the pressure corresponding to 100,000 hours on the straight-

line plot. The rated pressure of the tube shall be calculated as follows:

$$P = PDB (DF)$$

where:

- P* = Rated pressure, psi.
- PDB* = Pressure design basis, psi.
- DF* = Design factor = 0.50.

The hydrostatic pressure design basis must be established for all tube sizes for which recognition is sought. Alternate test proposals may be considered with written concurrence of ICBO ES. Condition of acceptance is that the hose shall be rated at 100 psi at a temperature of 180°F (82°C).

6.0 LIMITATIONS OF RECOGNITION

6.1 Systems using this hose are not connected to the potable water supply.

6.2 The hose is recognized for use only with fittings as determined by testing in this criteria.

7.0 QUALITY CONTROL

The rubber hydronic hose shall be produced under a quality control program administered by an inspection agency currently accredited by ICBO Evaluation Service, Inc., or the National Evaluation Service, Inc. A quality control manual developed in concert with the approved agency and complying with the ICBO ES Acceptance Criteria for Quality Control Manuals (AC10) must be submitted.

8.0 MARKING

8.1 Hose shall be marked at minimum intervals of 5 feet as follows:

- 8.1.1** Manufacturer's name or trademark.
- 8.1.2** Name or logo of quality control agency.
- 8.1.3** Pressure rating at 180°F.
- 8.1.4** Nominal size.
- 8.1.5** A code number identifying the materials and the date of manufacture.
- 8.1.6** Evaluation report number.

8.2 Fittings shall be identified with markings as noted in Sections 8.1.1 and 8.1.2 in addition to the designation 180°F.

8.3 Packaging for fittings shall be identified as follows:

- 8.3.1** Manufacturer's name or trademark.
- 8.3.2** Name or logo of quality control agency.
- 8.3.3** Pressure rating at 180°F.
- 8.3.4** Nominal size.
- 8.3.5** Evaluation report number.

8.4 Manufacturer shall provide adequate labeling and instruction on tube and fitting compatibility to prevent use of noncompatible components.

TABLE 1—BURST PRESSURE REQUIREMENTS FOR WATER AT DIFFERENT TEMPERATURES

NOMINAL TUBE SIZE (inch)	MINIMUM BURST PRESSURES (psi)		
	73.4°F	180°F	200°F
1/4	870	390	330
3/8	620	275	235
1/2	480	215	185
5/8 and larger	475	210	180

For **SI**: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, °F = $5/9$ °C + 32.

TABLE 2—SUSTAINED WATER PRESSURE TEST CONDITIONS AT DIFFERENT TEMPERATURES

NOMINAL TUBE SIZE (inch)	MINIMUM SUSTAINED PRESSURES (psi)		
	73.4°F	180°F	200°F
3/8	525	250	210
1/2	330	195	165
5/8 and larger	325	190	165

For **SI**: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, °F = $5/9$ °C + 32.

TABLE 3—BENT HOSE SUSTAINED PRESSURE TEST CONDITIONS

NOMINAL TUBE SIZE (inch)	MINIMUM SUSTAINED PRESSURE AT 180°F (psi)
3/8	250
1/2	195
5/8 and larger	190

For **SI**: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, °F = $5/9$ °C + 32.

TABLE 4—EXCESSIVE TEMPERATURE AND PRESSURE TEST CONDITIONS

NOMINAL TUBE SIZE (inch)	MINIMUM SUSTAINED PRESSURE AT 210°F (psi)
3/8	230
1/2	170
5/8 and larger	170

For **SI**: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, °F = $5/9$ °C + 32.