



ICBO Evaluation Service, Inc.

A subsidiary corporation of the International Conference of Building Officials

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ACCEPTANCE CRITERIA FOR FITTINGS FOR PEX TUBING (PROPRIETARY)

AC139

June 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

The purpose of this criteria is to establish requirements for recognition, in an ICBO ES evaluation report, of mechanical cold flare compression fittings with integral dished springs that are used with ICBO ES recognized cross-linked polyethylene (PEX) tubing, for use in hydronic heating systems under the 1997 ICBO *Uniform Mechanical Code*[™] and the 1998 *International Mechanical Code*[™] and for use in water distribution systems under the 1997 *International Plumbing Code*[™] and the 1994 *Uniform Plumbing Code*^{*}. The proprietary fittings are intended for use in systems with a maximum continuous-use temperature of 180°F (82°C) at a pressure of 100 psi (689 kPa), and are designed for use with special tools.

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 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 BASIC INFORMATION AND REPORTS OF TESTS

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

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

3.3 Testing: An ICBO ES accredited or NES recognized independent testing agency shall sample test specimens, conduct tests and prepare test reports. Testing laboratories shall comply with the ICBO ES Acceptance Criteria for Testing Laboratories (AC89).

3.4 Test Specimens: Tests must be performed using representative fittings assembled in accordance with the fitting manufacturer's recommended methods, and using PEX tubing complying with ASTM F 876-97a and the ICBO ES Acceptance Criteria for PEX, PB and PEX-AL-PEX Tube and Fittings Used in Hydronic Heating and Water Distribution Systems (AC122). Consideration must be given to performance of the fittings with PEX tubing at the minimum and maximum dimensions allowed by ASTM F 876. A minimum of six specimens shall be used for each test, unless otherwise noted in this acceptance criteria. All fittings that will be subjected to secondary processes of mechanical marking that affect their dimensional tolerances shall be tested in their final, marked condition.

3.5 Test Reports: Test reports shall comply with the ICBO ES Acceptance Criteria for Test Reports and Product Sampling (AC85). The test report must document the equipment and methods used to install the fittings.

3.6 Test Conditioning: Test specimens shall be conditioned at 73.4°F ± 3.6°F (23°C ± 2°C) and 50 ± 5 percent relative humidity for not less than 40 hours prior to testing, unless otherwise specified in this acceptance criteria.

3.7 Limitations of Recognition: Use of the fittings must be specifically recognized in an evaluation report on PEX tubing.

4.0 REQUIRED DATA

4.1 Materials and Manufacture: Fitting components and dished springs shall be made from the following materials:

4.1.1 Machined Brass Fittings: Fitting components of machined brass shall be made from material meeting the requirements of ASTM B 16 copper alloy UNS C360.

4.1.2 Sand-cast Brass Fittings: Fitting components of sand-cast brass shall be made from material meeting the requirements of ASTM B 584 copper alloy UNS C84400.

4.1.3 Dished Springs: Dished springs shall be made from Type 301 stainless steel.

4.2 Workmanship, Finish and Appearance: The sealing, mating and threaded surfaces of the fittings shall be smooth and free of foreign material. The fitting walls shall be free of cracks, holes, blisters, voids, foreign inclusions, and other defects that are visible to the naked eye and that may affect the wall integrity.

4.3 Dimensions: Dimensions and tolerances of fittings and compression sleeves shall be as shown in Figure 1 and Table 1. The maximum angular variation of any opening shall not exceed 1/2 degree off the true centerline axis. Randomly selected fittings shall be used to determine dimensions. Measurements shall be made in accordance with the methods of ASTM D 2122. Fitting diameter is determined by making measurements at four points, spaced approximately 45 degrees apart, around the circumference. Inspection and gauging of solder joint ends shall be in accordance with ANSI B16.18 or ANSI B16.22. Fitting threads of tapered threaded ends shall be right-hand, conforming to ANSI/ASME B 1.20.1.

4.4 Hydrostatic Burst Strength: The minimum burst pressure shall be determined in accordance with ASTM D 1599, with at least six assemblies at each temperature in Table 2. After assembly, the specimen assemblies either are filled with water and are conditioned in water at the test temperature for a minimum of two hours, or are conditioned in air for a minimum of four hours. In the case of testing at 180°F (82°C), the sample, prior to conditioning, must be filled with water having a temperature of at least 120°F (50°C). Internal pressure must be increased at a constant rate so as to reach the maximum burst pressure requirement in 60 to 70 seconds.

Conditions of Acceptance: Assemblies shall meet the minimum hydrostatic burst requirements shown in Table 2. Leakage or separation at any of the tested joints, at less than the minimum hydrostatic burst requirement conditions, for either temperature specified, shall constitute test failure.

4.5 Hydrostatic Sustained Pressure Strength: Tests shall be conducted in accordance with methods of ASTM D 1598, at a test temperature of 180°F ± 4°F (82°C ± 2°C), and in an external environment of air or water. The specimens must be filled with water having a temperature of at least 120°F (50°C).

Conditions of Acceptance: Assemblies shall meet the minimum hydrostatic-sustained-pressure-strength requirements shown in Table 3. Failure of any one of the six specimens constitutes test failure.

4.6 Thermocycling of Hose and Fittings: Six test assemblies must be pressurized with nitrogen or air to 100 ± 10 psi (0.69 ± 0.069 MPa). The specimens are thermally cycled alternately between 60°F ± 4°F (16°C ± 2°C) and 180°F ± 4°F (82°C ± 2°C) by means of immersion in water, using the following test cycle:

* *Uniform Plumbing Code* is a copyrighted publication of the International Association of Plumbing and Mechanical Officials, 20001 Walnut Drive South, Walnut, California 91789-2825.

PROCEDURE	DURATION
Water immersion at 180°F (82°C)	2 minutes (minimum)
Air immersion at ambient	2 minutes (maximum)
Water immersion at 60°F (16°C)	2 minutes (minimum)
Air immersion at ambient	2 minutes (maximum)

Upon completion of 1,000 thermal cycles, the specimen assembly is immersed again in 60°F ± 4°F (16°C ± 2°C) water and checked for any sign of leakage.

Conditions of Acceptance: The test specimens shall not separate or leak when thermocycled 1,000 times between the temperatures of 60°F (16°C) and 180°F (82°C). Any evidence of leakage at the fitting, or separation of the fitting from the tubing, in any one of the six test specimens, shall constitute test failure.

4.7 Bent Tube Hydrostatic Sustained-pressure Strength: Tubing and fitting assemblies shall be tested with a bend radius of 2.5 times the outside diameter for hot-bent tubes, and with a bend radius of 6 times the outside diameter for cold-bent tubes, inducing not less than a 90-degree angle. The bend length and bend angle shall be maintained throughout the testing period by rigid supports immediately outside the bend. Tests shall be conducted in accordance with the methods of ASTM D 1598, at a test temperature of 180°F ± 4°F (82°C ± 2°C), and in an external environment of air or water. The specimens must be filled with water having a temperature of at least 120°F (50°C).

Conditions of Acceptance: The specimens shall meet the minimum hydrostatic-sustained-pressure-strength requirements shown in Table 3. Failure of any one of the six specimens constitutes test failure.

4.8 Excessive Temperature—Pressure Capability: Tests shall be conducted in accordance with the methods of ASTM D 1598, at a test temperature of 210°F ± 4°F (99°C ± 2°C), and in an external environment of air. The specimens must be filled with water and conditioned for at least 2 hours at a temperature of at least 210°F ± 4°F (99°C ± 2°C) and a pressure of 30 ± 3 psi (207 ± 21 kPa). Test specimens must be pressurized to the required pressure and maintained at that pressure for 720 hours.

Conditions of Acceptance: Tube and fitting assemblies shall not fail, as defined in ASTM D 1598, in less than 720 hours. Any evidence of leakage at the fitting, or separation of the fitting from the tube, in any one of the six test specimens, shall constitute test failure.

4.9 Potable Water Systems: Fittings for use in potable water distribution systems shall comply with the requirements of NSF 61-95.

5.0 MARKING

5.1 Fitting components shall be marked with the manufacturer's name or trademark, the name or logo of the quality control agency, and the designation "PEX."

5.2 Packaging shall be marked with the manufacturer's name, the fitting size, and the evaluation report number.

6.0 QUALITY CONTROL

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

TABLE 1—FITTING DIMENSIONS AND TOLERANCES (inches)

SIZE	A - Conical Stub I.D. ¹	B - Conical Stub O.D.	C - Union Nut I.D.	D - Union Nut O.D. ¹	E - Union Nut Length ¹	F - Grip Ring Length ¹	G - Grip Ring I.D. ¹
³ / ₈	0.330	0.617 - 0.623	0.617 - 0.623	0.828	0.495	0.438	0.446
¹ / ₂	0.472	0.803 - 0.807	0.803 - 0.807	1.043	0.610	0.552	0.594
⁵ / ₈	0.572	1.005 - 1.010	1.005 - 1.010	1.300	0.812	0.670	0.716
³ / ₄	0.660	1.097 - 1.103	1.097 - 1.103	1.408	0.895	0.800	0.837

For **SI**: 1 inch = 25.4 mm.

¹Tolerances on all dimensions are ± 0.005 inch.

TABLE 2—BURST PRESSURE REQUIREMENTS FOR WATER AT DIFFERENT TEMPERATURES

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

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

TABLE 3—SUSTAINED WATER PRESSURE TEST CONDITIONS AT DIFFERENT TEMPERATURES

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.

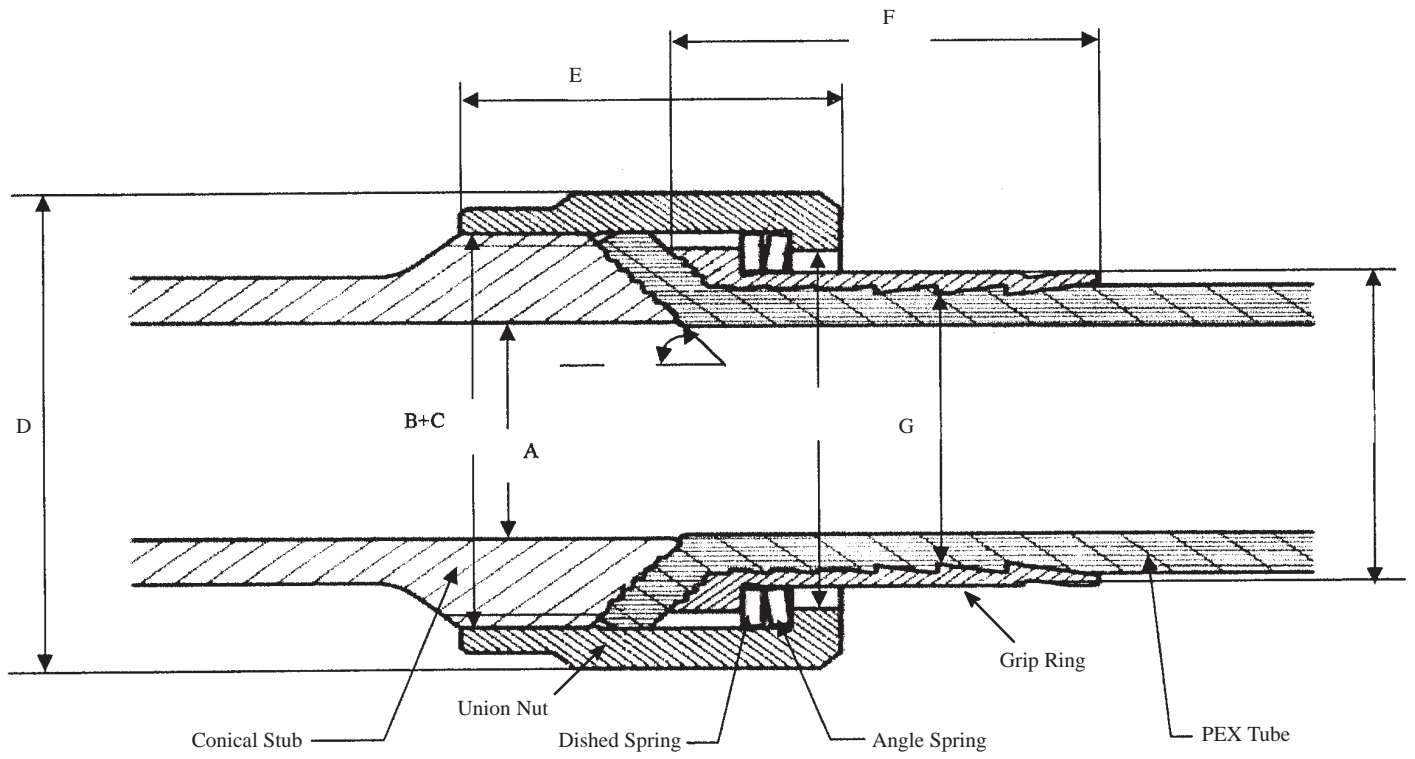


FIGURE 1—CONE UNION ASSEMBLY