

Designation: F3226/F3226M –  $16^{\varepsilon 1}$ 

# Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems<sup>1</sup>

This standard is issued under the fixed designation F3226/F3226M; 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 reapproval. A superscript epsilon ( $\varepsilon$ ) indicates an editorial change since the last revision or reapproval.

 $\epsilon^1$  NOTE—Editorial corrections were made throughout in April 2017.

## 1. Scope

1.1 This specification establishes the performance characteristics required for Metallic Press-Connect Fittings for use in piping and tubing systems with a maximum allowable working pressure of three-hundred pounds per square inch (300 psi). These fittings directly attach to pipe or tube by mechanical deformation of the pipe or tube or fitting, or a combination thereof, creating a seal and a restrained joint. The seal may be created via the mechanical deformation (of the pipe, tube or fitting) or created independently. Successful completion of the tests described herein constitutes completion of the technical portion of the qualification process.

1.2 The tests specified are applicable only to ascertain the performance characteristics. These tests are not intended for use in the evaluation of non-Press-Connect Fittings.

1.3 Refer to IACS UR P2.7.4, Table-7 for Metallic Press-Connect Fittings applications.

1.4 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 exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 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.

1.6 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:<sup>2</sup>
- A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- A135/A135M Specification for Electric-Resistance-Welded Steel Pipe
- A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

A269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

- A276 Specification for Stainless Steel Bars and Shapes
- A312/A312M Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- A795/A795M Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
- B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- B62 Specification for Composition Bronze or Ounce Metal Castings
- B75 Specification for Seamless Copper Tube
- **B88** Specification for Seamless Copper Water Tube
- B124/B124M Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes
- B140/B140M Specification for Copper-Zinc-Lead (Red Brass or Hardware Bronze) Rod, Bar, and Shapes
- **B283** Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)
- B371/B371M Specification for Copper-Zinc-Silicon Alloy Rod
- B466/B466M Specification for Seamless Copper-Nickel Pipe and Tube
- **B467** Specification for Welded Copper-Nickel Pipe
- **B584** Specification for Copper Alloy Sand Castings for General Applications
- **B858** Test Method for Ammonia Vapor Test for Determining

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<sup>&</sup>lt;sup>2</sup> 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.

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Susceptibility to Stress Corrosion Cracking in Copper Alloys

- **B967/B967M** Specification for Copper-Zinc-Tin-Bismuth Alloy Rod, Bar and Wire
- D2000 Classification System for Rubber Products in Automotive Applications
- 2.2 ASME Standards:<sup>3</sup>
- B1.20.1 Pipe Threads, General Purpose (Inch)
- B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings
- B36.10 Welded and Seamless Wrought Steel Pipe
- B46.1 Surface Texture (Surface Roughness, Waviness and Lay)
- 2.3 IACS Document:<sup>4</sup>
- UR P2.11 Type Approval of Mechanical Joints
- UR P2.7.4 Mechanical Joints
- 2.4 ISO Standards:<sup>5</sup>
- 19921 Ships and marine technology Fire resistance of metallic pipe components with resilient and elastomeric seals Test methods
- 19922 Ships and marine technology Fire resistance of metallic pipe components with resilient and elastomeric seals Requirements imposed on the test bench

2.5 AWS Standards:<sup>6</sup>

- ANSI/AWS A5.8M/A5.8 Specification for Filler Metals for Brazing and Braze Welding
- AWS B2.2/B2.2M Standard for Brazing Procedure and Performance Qualifications

# 3. Terminology

3.1 Definitions:

3.1.1 *class*, n—a group of fitting of a particular design with the dimensions proportional to pipe or tube outside diameters, made from the same material grade (or combination of grades), for the same rated pressure, or for a rated pressure inversely proportional to the diameter.

3.1.2 'FTG', n—indicates a pipe-end or tube-end of a Press-Connect fitting (that is, FTG × NPT). A fitting ends configuration that is dimensionally the same as a pipe or tube and intended to insert into a Press-Connect fitting.

3.1.3 *failure, n*—the condition of not achieving the desired performance, as evidenced by leakage or joint separation.

3.1.4 *fitting*, *n*—connecting device used to join multiple pipes or tubes or other fittings together to create a working system.

3.1.5 *joint, n*—interface between the fitting and pipe or tube where the seal is maintained and mechanical holding strength is applied or maintained.

3.1.6 *leakage*, n—the escape of fluid or gas from any hole in the pressure containment wall, sufficient to drip or flow from the point of formation or gas bubbles rising to the surface after the first minute of submersion.

3.1.7 'P' designation, n—indicates a Press-Connect fitting end (that is,  $P \times NPT$ ).

3.1.8 *permanent*, *n*—cannot be disassembled and reused after initial assembly.

3.1.9 *pipe*, *n*—hollow cylindrical shape used to transport liquids, gases, or oil. Pipe is specified by nominal outside diameter (OD) and schedule (wall thickness).

3.1.10 press connection, n—type of fitting joint that attaches directly to pipe or tube by mechanical deformation of the pipe, tube or fitting or combination creating a seal and restrained joint. The joint is created by use of an elastomeric seal or mechanical deformation, or both. Mechanical deformation is achieved by use of an electro-hydraulic pressing tool. Press-Connect ends may vary by design as found in Fig. 1.

3.1.11 *rated pressure*, *n*—the manufacturer's recommended maximum in-service pressure at a defined temperature.

3.1.12 *re-test*, *n*—performed when the original test specimen leaks or separates during testing as a result of any cause that is not related to the design of the fittings being qualified.

3.1.13 *specimen*, *n*—a prepared assembly consisting of fittings assembled onto a preselected pipe or tube. The specimen is placed into a controlled environment and tested to determine if the assembly meets the specified test requirements.

3.1.14 *test pressure*, *n*—selected pressure used during testing, based upon the rated pressure of the fitting, pipe or tube.

3.1.15 *tube*, n—hollow thin-walled cylindrical product that is usually specified with respect to inside diameter (ID) and wall thickness.

## 4. Classification

4.1 Press-Connect fittings shall be classified into the following categories:

- 4.1.1 Material (see 4.2).
- 4.1.2 Rated operating pressure (see 4.3).
- 4.1.3 Elastomeric Seals (see 4.4).

4.2 Fittings shall be made from one or more of the following material grades:

- 4.2.1 Grade A-Carbon steel.
- 4.2.2 Grade B-Stainless steel.
- 4.2.3 Grade C-Copper and Copper-Alloy.
- 4.2.4 Grade D-Copper-nickel.
- 4.2.5 *Grade E*—Brass.

4.3 The fittings rated pressure shall be one of the following classes:

- 4.3.1 Class 1-100 psi (0.69 MPa) maximum.
- 4.3.2 Class 2-200 psi (1.38 MPa) maximum.
- 4.3.3 Class 3-300 psi (2.07 MPa) maximum.

4.4 Elastomeric seals:

4.4.1 *Type 1*—Ethylene Propylene Diene Monomer (EPDM).

<sup>&</sup>lt;sup>3</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http:// www.asme.org.

<sup>&</sup>lt;sup>4</sup> Available from International Association of Classification Societies (IACS) Limited, Permanent Secretariat, 6th Floor, 36 Broadway, London SW1H 0BH, UK, http://www.iacs.org.uk.

<sup>&</sup>lt;sup>5</sup> Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

<sup>&</sup>lt;sup>6</sup> Available from American Welding Society (AWS), 8669 NW 36 St., #130, Miami, FL 33166-6672, http://www.aws.org.

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Fitting Body (typical)



FIG. 1 Metallic Press-Connect Fitting Joints (Typical, But Not Limited To)

4.4.2 *Type* 2—Hydrogenated Nitrile Butadiene Rubber (HNBR).

4.4.3 *Type 3*—Fluoro-Elastomer or Synthetic Fluorinated Rubber (FKM).

Note 1—When multiple components resulting in more than one material grade are specified within an assembly, the combination of grades used shall be galvanically compatible.

NOTE 2-Rated pressures may differ within the size range being qualified. Pressures indicated are at ambient temperature.

### 5. Ordering Information

5.1 Orders under this specification shall include the following:

5.1.1 ASTM designation, title, number, and year of issue;

5.1.2 Quantity of fittings;

5.1.3 Size;

5.1.3.1 Nominal pipe size (NPS) and wall thickness (schedule).

5.1.3.2 Tube size, outside diameter (OD) (actual or nominal) and wall thickness (dimension in decimal fraction of inches or type – K, L, M).

5.1.4 Material;

5.1.5 Class (operating pressure rating);

5.1.6 Configuration (elbow, cross, union, coupling, etc.);

5.1.7 Supplementary requirements, if any;

5.1.8 Other requirements agreed to between the purchaser and the manufacturer; and

5.1.9 Inspection and acceptance as agreed upon between the purchaser and the supplier.

5.2 Optional Ordering Requirements:

5.2.1 Certification (see Section 15).

## 6. Materials and Manufacture

6.1 *Material*—Material(s) shall conform to a nationally recognized standard or may be other materials as agreed to between the manufacturer and the purchaser.

6.1.1 Fittings may be manufactured from wrought bars, forgings, castings, pipe, or tube.

6.2 Carbon Steel Fittings:

6.2.1 Carbon steel fittings shall be made from material meeting the requirements of Specifications A53/A53M, Type E and S, A135/A135M, or A795/A795M.

6.3 Stainless Steel Fittings:

6.3.1 Stainless steel fittings shall be made from material meeting the requirements of Specifications A312/A312M, A269, or A276.

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## 6.4 Copper and Copper-Alloy Fittings:

6.4.1 Wrought copper fittings shall be made from material meeting the requirements of Specifications **B584** or **B88**.

6.4.2 Cast coppers alloy fittings shall be made from material meeting the requirements of Specifications **B584** or **B62**.

## 6.5 Copper-Nickel Fittings:

6.5.1 Copper-nickel fittings shall be made from material meeting the requirements of Specifications B466/B466M or B467.

## 6.6 Brass Fittings:

6.6.1 Machined brass fittings shall be made from material meeting the requirements of Specifications B140/B140M, B16/B16M, B124/B124M, B371/B371M, or B967/B967M.

6.6.2 Forged brass fittings shall be made from material meeting the requirements of Specification B283.

6.7 *Flow of Grain*—If machined from hot- or cold-drawn bars fittings shall have their longitudinal axis parallel to the longitudinal axis of the bar with at least the center one third of the bar removed during the manufacturing process unless testing shows the center material to be free of injurious defects.

6.8 *Material Quality*—Material shall be of such quality and purity that the finished product shall have the properties and characteristics to meet the performance requirements of this specification.

Note 3—The term "recovered materials" is interpreted as those materials that have been collected or recovered from solid waste and reprocessed to become a source of raw material, as opposed to extra virgin raw materials.

6.9 Seal Materials—Seals shall be as specified in 4.4.

6.9.1 Seal materials shall meet the minimum property and test requirements specified in Classifications D2000.

6.9.2 Only seal lubricants as specified by the manufacturer shall be used.

6.10 *Surface Applications and Coatings*—Surface applications and coatings if applicable, shall be applied and tested in accordance with a nationally recognized standard or may be other materials as agreed to between the manufacturer and the purchaser.

6.11 *Fabrication*—If fabricated from two or more parts, the components may be welded or brazed.

6.11.1 Welding procedure qualification and welding operator performance qualification shall be in accordance with ASME Section IX.

6.11.1.1 The welding procedure qualification test shall duplicate the joint configuration to be used in production.

6.11.2 Taper pipe threads shall conform to ASME B1.20.1. 6.11.3 Brazed copper connections shall conform to ANSI/ AWS A5.8M/A5.8 and AWS B2.2/B2.2M.

6.12 *Processing Stainless Steel Forgings*—Austenitic stainless steel components manufactured by hot forge or other sensitizing processes shall be solution annealed and certified free of intergranular precipitation. Practice A262 shall be used to evaluate carbide precipitation in stainless steels.

## 7. Performance Requirements

7.1 *Testing Requirements*—Fittings Shall be subjected to the standard performance tests specified in Section 13.

7.1.1 Specimens can be reused for other primary tests as long as all requirements herein are complied with for each test.

7.1.2 Tests shall be repeated any time changes are made in the design, material, or manufacturing process, which in the opinion of the purchaser, may degrade performance.

7.2 Intermixing of Subcomponents—The intermixing by the purchaser of subcomponents of the same design, but of different brands or trade names, is not permitted.

7.3 *Qualification Requirements*—Testing shall use specimens of the same type, grade (or combination of grades), and class. The pipe or tube selected for the technical qualification to this specification shall meet the requirement specified in 7.3.3. Technical qualification of the assemblies shall be based upon successful completion of all required testing. Each design is qualified for use with the pipe or tube material and the minimum to maximum wall thickness tested or extended by interpolation (see 7.3.1 and 7.3.2).

7.3.1 Through reasonable interpolations between the sizes tested, all other sizes within the same type, grade (or combination of grades), and class, will be considered acceptable if the specimens pass all of the testing requirements specified by the purchaser. Extrapolation is not acceptable.

7.3.2 Acceptance of tees, elbows, and other shapes within the same class, may be accomplished by parametric analysis (see 7.3.2.1) based on the acceptance of couplings, as agreed to between the manufacturer and the purchaser.

7.3.2.1 If tees, elbows, and other shapes are made from a different raw material form than the coupling (for example, tees and elbows manufactured from castings versus couplings manufactured from solid bar or round tube), this alternate material form shall undergo the same test regimen as the coupling. Once this is complete, parametric analysis may be used to qualify the remainder of the shapes as agreed to between the purchaser and the manufacturer.

7.3.3 Recommended pipe or tube for use with Press-Connect fittings shall be qualified throughout its wall thickness range.

7.3.4 Press-Connect fittings may incorporate other end configurations or features allowing for the transition when connecting to other piping and tube components (for example, bolted flanges, threaded, grooved, and others).

7.4 *Test Report*—Upon completion of testing, a test report shall be written and maintained on file during the life cycle of the design. A copy of this report shall be made available upon request from the purchaser.

7.4.1 Any failure during testing shall be analyzed and the failure analysis (see 11.3.1 and 11.3.2) and corrective action shall be included in the test report.

7.4.2 A retest as specified in Section 11 may be allowed when failure of the original assembly occurs during testing. When retesting the failure analysis and corrective action shall be included in the test report as specified in 7.4.1. ∰7 F3226/F3226M – 16<sup>ε1</sup>

7.5 *Test Equipment and Inspection Facilities*—The manufacturer shall ensure that test equipment and inspection facilities are of sufficient accuracy, quality, and quantity established and maintained to permit the performance of required inspections.

7.5.1 *Calibration System Requirements*—The manufacturer shall maintain a calibration system for all measuring and test equipment (M & TE).

7.5.1.1 Accuracy of the M & TE used to measure allowable variables during testing shall be within one third of the tolerances permitted (see 7.6).

7.6 *Test Conditions*—Unless otherwise specified in the testing procedures, the following tolerances shall be used to control conditions of the testing.

7.6.1 *Ambient Conditions*—When ambient is specified, standard ambient conditions shall be maintained at  $25 \pm 10^{\circ}$ C (77  $\pm 18^{\circ}$ F).

7.6.2 *Pressure*—Unless otherwise specified, the tolerance for the internal pressure applied to the test specimen during testing shall be maintained at  $\pm 5$  %.

7.6.3 *Test Fluids*—Water and other test fluids compatible with the sealing elastomer may be used without affecting the validity of the test.

7.6.4 *Temperature*—Unless otherwise specified, the allowable tolerance for temperature applied to the test specimen during testing shall be  $\pm 5^{\circ}$ C ( $\pm 10^{\circ}$ F).

7.7 *Pass or Fail Criteria*—Pass or fail criteria for each test shall be based upon meeting or exceeding the performance requirements specified in each test.

## 8. Dimensions

8.1 Dimensions:

8.1.1 Dimensions shall be as specified by the Table 1 or Table 2 and the manufacturer.

8.1.1.1 Dimensions specified in Table 1 shall be utilized for copper tube sized (CTS, Specification B88) Press-Connect fittings.

8.1.1.2 Dimensions specified in Table 2 shall be utilized for iron pipe sized (IPS, Specification A53/A53M) Press-Connect fittings.

## 9. Workmanship, Finish, and Appearance

9.1 *Machined Surfaces*—Machined surfaces shall be free from burrs, cracks, laps, or seams which would affect the suitability for the intended service.

TABL	.E 1	Tube
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Nominal Tube Size	Outside Diameter A		Internal Diameter O	
in.	in.	[mm]	in.	[mm]
1/2	0.625	[15.90]	0.627	[15.93]
5/8	0.75	[19.05]	0.752	[19.09]
3/4	0.875	[22.25]	0.877	[22.28]
1	1.125	[28.63]	1.279	[28.65]
<b>1</b> 1⁄4	1.375	[34.98]	1.378	[35.00]
11/2	1.6525	[41.33]	1.628	[41.35]
2	2.125	[54.03]	2.128	[54.05]
21/2	2.625	[66.73]	2.628	[66.75]
3	3.125	[79.43]	3.128	[79.45]
4	4.125	[104.83]	4.128	[104.85]

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Nominal Pipe Size	Outside Diameter A		Internal Diameter O						
in.	in.	mm	in.	mm					
1/2	0.84	[21.3]	0.87	[22.1]					
3/4	1.05	[26.7]	1.091	[27.7]					
1	1.35	[33.4]	1.343	[34.1]					
11/4	1.66	[42.2]	1.689	[42.9]					
11/2	1.9	[48.3]	1.927	[48.95]					
2	2.375	[60.3]	2.402	[61.00]					
21/2	2.875	[73.0]	2.902	[73.70]					
3	3.5	[88.9]	3.528	[89.60]					
4	4.5	[114.3]	4.528	[115.00]					
6	6.625	[168.3]	6.654	[169.00]					
8	8.625	[219.1]	8.654	[219.80]					

TABLE 2 Ding

9.1.1 All machined surfaces shall be 3.2-µm roughness, average (Ra) (125-µin. Ra) as specified in ASME B46.1 or duplicate of that qualified.

9.1.1.1 External surfaces that do not affect overall function shall be excluded from the requirement specified in 9.1.1.

9.2 Un-Machined Surfaces—Un-machined surfaces, such as forging or casting surfaces and bar stock flats, shall be free from scale, blisters, fins, folds, seams, laps, segregations, or cracks which may be injurious to personnel or equipment or affect performance.

9.3 Cadmium plating shall not be used if intended for use on U.S. Navy vessels.

### 10. Sampling for Testing

10.1 *Inspection Sampling of Raw Material*—Except when specified herein, the number of samples required for inspection of raw materials for conformance of products during manufacturing and processing shall be in accordance with established quality assurance procedures maintained by the manufacturer and approved by the purchaser.

10.2 *In-Process Inspection Sampling*—Inspection sampling plans shall be mutually agreed upon between the manufacturer and the purchaser. Level of inspection and acceptable quality level (AQL) shall be in accordance with the manufacturer's quality assurance procedures.

10.3 *Lot Acceptance*—Lot acceptance sampling plans shall be mutually agreed upon between the manufacturer and the purchaser.

### 11. Tests and Re-Tests

11.1 *Number of Test Specimens*—The number of specimens required for each test shall be as determined by the test laboratory and the manufacturer.

11.2 *Replacement of Test Specimens*—When untested specimens are rejected as a result of over-tightening, inferior workmanship or materials, or assembly, the specimens shall be dispositioned in accordance with the manufacturer's quality assurance procedures.

11.2.1 The original unique numbers assigned in accordance with 12.3.1 shall be recorded in the test report along with the reason for rejection.

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11.2.1.1 New test specimens of the same type, grade, and class, and pipe or tube of the same outside diameter and wall thickness shall be prepared in accordance with Section 12.

11.3 *Re-Testing*—In the event of a test failure, the manufacturer shall proceed with one of the following options:

11.3.1 If the failure is determined to be design related, the manufacturer shall redesign and start all tests from the beginning. The requirements in 11.3.2 shall not apply to redesigned products.

11.3.2 If the failure is determined to be unrelated to the design, the test specimen shall be retested. A replacement test specimen shall be prepared in accordance with the requirements in 11.2 and Section 12.

11.3.3 If the failure cannot be determined to be either design related or not design related, the manufacturer shall test three additional re-test specimens. The requirements specified in 11.3.2 shall apply.

11.4 *Re-Testing Specimen Preparation*—Penalty run specimens shall be prepared when the specimen has failed any of the specified tests.

11.4.1 The specimen used for retesting shall be of the same type, grade, and class as the failed specimen being replaced.

11.4.2 Pipe or tube used in re-tests shall be of the same material (including form and condition), outer diameter, and wall thicknesses as the pipe or tube being replaced.

11.4.3 Preparation of the re-test specimens shall be in accordance with Section 12.

11.4.4 Re-test specimens shall be identified in accordance with 12.3 and 11.4.5.

11.4.5 In addition to the part number and test specimen number, a designator shall be placed after the test specimen number which would allow the specimen to be identified as a re-test specimen. The method used to identify re-test specimens shall be at the manufacturer's option.

### 12. Specimen Preparation

12.1 Specimen preparation and installation on the appropriate testing apparatus shall be in accordance with the manufacturer's recommended procedures.

12.2 Assembly of Specimens—Fittings qualified under the requirements of this specification shall be tested and qualified as a completed assembly. The acceptance of similar, but different designs shall not permit the intermixing of their subcomponents such as sleeves, nuts, and ferrules.

12.2.1 Test specimens used in testing shall be assembled using a single class, type, grade and pipe or tube material.

12.2.2 The wall thickness and outer diameter size of the pipe or tube shall be selected in accordance with the sizes (see 7.3.3) being qualified.

12.3 *Identification of Test Specimens*—Each test specimen shall be identified with a unique number to provide traceability back to the test records.

12.3.1 Identification of test specimens shall be permanent. In those cases in which size or design does not permit permanent markings, tagging or bagging may be used. 12.3.2 When, as a result of testing, a test specimen is sectioned into two or more pieces, the identification method shall be as specified in 12.3.1.

## 13. General Testing Requirements and Testing Methods

13.1 Before the start of performance testing, the manufacturer and the purchaser shall agree to a test plan. The test plan shall include the following information:

13.1.1 A matrix showing the material grade(s) (or combination(s) of grades) (see 4.2) and operating pressure class(s) (see 4.3) and type(s) of elastomeric seals (see 4.4) to be qualified.

13.1.2 Sizes selected to qualify every size within its range. 13.1.3 Compatible pipe or tube materials to be used in

assemblies to be tested. 13.1.3.1 Pipe or tube wall thicknesses and sizes selected to

qualify the pipe or tube through the size range.

13.1.4 The manufacturer's recommended procedure covering the assembly onto pipe or tube.

13.1.5 Test fluids used for each test.

13.1.6 Test temperatures for each test.

13.2 *Testing*—All Press-Connect fittings, regardless of material grade, operating pressure class, or elastomeric seal type shall comply to the following test criteria. Testing shall be done at a location acceptable to the manufacturer and the purchaser. The test laboratory shall verify that specimens to be tested are as identified and certify results. Except as noted in 13.10.

13.2.1 Sizes selected to qualify every size within its range.

13.2.2 Test range of sizes, shall include the smallest and largest. Test one or more intermediate sizes if the ratio of the minimum to the maximum pipe or tube outside diameter to be tested is equal to or more than ten.

13.2.3 Compatible pipe or tube materials shall be used in assemblies to be tested.

13.2.4 Pipe or tube wall thicknesses and sizes selected to qualify the pipe or tube through the size range.

13.2.5 The pipe or tube used for testing shall not be changed from its original mechanical or chemical properties unless otherwise specified in the manufacturer's installation instructions.

13.2.6 Pipe or tube ends shall be deburred, but not reduced below the minimum wall thickness.

13.2.7 Combinations of materials, must be shown to be galvanically compatible.

13.2.8 End caps or adapters used to connect the test specimen assembly to the test apparatus, or plugs used to block off a specimen end, shall be an optional design designated by the manufacturer. The end caps or adapters shall be constructed as to prevent their failure during testing.

13.2.9 The test specimens shall be assembled in accordance with manufacturer's recommended procedure covering the assembly onto pipe or tube.

13.2.10 Test fluids used for each test shall be identified prior to the start of any testing.

13.2.11 Test temperatures shall be as specified within each individual test.

13.2.12 The total number of test assemblies shall each pass their designated tests successfully to meet the requirements of this performance specification. **H** F3226/F3226M − 16<sup>ε1</sup>

13.3 Hydrostatic Proof Testing:

13.3.1 *Scope:* 

13.3.1.1 This section covers hydrostatic proof testing of selected test specimens.

13.3.2 Significance and Use:

13.3.2.1 This test is performed by pressurizing the test specimens using test fluid or water. The initial pressure applied, 0.690 MPa (100 psi), tests the assembled specimen to determine if it can retain fluid without leakage at the pipe or tube and joint. If there is no leakage, the pressure is gradually increased to a second pressurization period of 150 % rated pressure of the pipe or tube or fitting, whichever is lower. This elevated pressure level tests the ability of the specimens to hold fluid without leakage.

13.3.2.2 If the specimen still shows no evidence of leakage after the second pressurization period, the specimens have passed the test. This test is useful in determining the integrity of the fitting joint to hold fluid at an elevated pressure without leakage. After successful completion of this test, the test specimens are ready for additional testing.

13.3.3 Procedure:

13.3.3.1 Fill the test specimens with fluid before installation onto the appropriate testing apparatus.

13.3.3.2 Place the test specimens in a burst chamber and secure into place in accordance with the manufacturer's recommended procedures. One end of the test specimen shall be free to move.

13.3.3.3 Equip the chamber with calibrated pressure gages to permit visual readings of actual pressure being applied.

13.3.3.4 Perform the hydrostatic proof test at ambient temperature.

13.3.3.5 Initially pressurize the test specimens to 0.690 MPa (100 psi)  $\pm$  5 % for a total period of 5 min. There shall be no evidence of leakage during this 5-min period. If leakage occurs, discontinue the test. The affected specimens have failed the test. Fill out the test report noting the reason for discontinuing the test.

13.3.3.6 If there is no evidence of leakage after the initial 5-min period, gradually increase the pressure at an average rate not to exceed 8.2 MPa/min (1 189 psig/min) to  $150 \pm 5 \%$  of the rated pressure of the pipe or tube or fitting, whichever is lower. Maintain this pressure for an additional period of 5 min. There shall be no evidence of leakage during this 5-min period. If leakage occurs, discontinue the test. The affected specimens have failed the test.

13.3.3.7 If there is no evidence of leakage within the fitting or fitting joint during both pressurized periods, the test specimens have passed the hydrostatic proof test.

13.4 Hydrostatic Burst Test:

13.4.1 *Scope:* 

13.4.1.1 This section covers the test requirements for burst testing.

13.4.2 Significance and Use:

13.4.2.1 This test verifies the integrity of the pipe or tube and joint to withstand, without leakage or burst, a minimum pressure equal to four times the rated pressure of the pipe or tube or fitting, whichever is lower. 13.4.3 Procedure:

13.4.3.1 Fill the test specimens with water or hydraulic fluid before installation onto the appropriate testing apparatus.

13.4.3.2 Place the test specimens into a burst chamber and secure them into place in accordance with the manufacturer's recommended procedures. One end must be free to move.

13.4.3.3 Equip the chamber with calibrated pressure gages to permit visual readings of actual pressure being applied.

13.4.3.4 Perform the hydrostatic burst test at ambient temperature.

13.4.3.5 Subject the test specimens to a gradual increase of pressure at an average rate not to exceed 8.2 MPa/min (1 189 psig/min) to four times the rated pressure of the specimen assembly and hold for a minimum of 1 min. If leakage or burst occurs below four times the rated pressure of the specimen assembly, discontinue the test. The affected test specimens have failed the test.

13.4.3.6 The test specimens have passed the hydrostatic burst test when four times the rated pressure of the specimen assembly has been attained.

13.5 Pull-Out Test:

13.5.1 *Scope:* 

13.5.1.1 This section covers the requirement for pull-out testing.

13.5.2 Significance and Use:

13.5.2.1 This test verifies the integrity of the pipe or tube and joint to withstand axial loading without leakage.

13.5.3 Procedure:

13.5.3.1 Fill the test specimens with water or hydraulic fluid.

13.5.3.2 The test specimen is to be pressurized to design pressure. When pressure is attained, an external axial load is to be imposed with a value calculated using the following formula:

$$\mathbf{L} = \pi/4 (\mathbf{D}^2)(\mathbf{p}) \tag{1}$$

where:

L = applied axial load.

D = pipe/tube OD.

p = design pressure.

13.5.3.3 The axial load and design pressure shall be maintained for a period of no less than five minutes.

13.5.3.4 The joint shall be monitored for movement between the assembled joint and the pipe/tube and any drop in pressure.

13.5.3.5 The test specimen have passed if there is no loss of internal pressure.

13.6 Vacuum Test:

13.6.1 Scope:

13.6.1.1 This section covers the test requirements for vacuum testing.

13.6.2 Significance and Use:

13.6.2.1 This test verifies the integrity of the pipe or tube and joint to withstand internal pressure below atmospheric.

13.6.3 Procedure:

13.6.3.1 Assemble the test specimens.

13.6.3.2 The test specimen shall be connected to a vacuum system, and the internal pressure shall be lowered to  $183 \pm 20$ , mbar absolute (5.4  $\pm$  0.5 inches of absolute Hg).

13.6.3.3 Test specimen's internal pressure shall be stabilized then isolated from the vacuum system.

13.6.3.4 The test specimen shall hold the internal pressure for a period not less than 5 minutes.

13.6.3.5 The test specimen have passed if there is not a loss of internal pressure.

13.7 Vibration Test:

13.7.1 Scope:

13.7.1.1 This section covers the test requirements for vibration testing.

13.7.2 Significance and Use:

13.7.2.1 This test verifies the integrity of the pipe/tube and joint to withstand vibration fatigue which may occur under operating conditions.

13.7.3 *Procedure:* 

13.7.3.1 Two lengths of pipe/tube shall be connected by a joint assembly.

13.7.3.2 Assemble the test specimen as stated within the manufacturer's instructions and fill with water or hydraulic fluid.

13.7.3.3 One end of the test specimen shall be securely fixed while the opposite end is attached to the vibration element on the test jig. Length of the test specimen connected to the fixed end of the jig shall not exceed 200 mm. The test specimen shall not be longitudinally restrained.

13.7.3.4 Test specimen shall be place in a cantilever type test assembly used for fatigue testing.

13.7.3.5 The initial deflection angle of the pipe axis shall be equal to the maximum deflection angle recommended by the manufacturer.

13.7.3.6 Amplitude shall be measured at a distance of 1 m from the center line of the test specimens assembled joint free end, as connected to the rotating section of the test jig.

13.7.3.7 Evaluation of 3 tests are required each test is performed at 3 000 000 cycles. Test parameters are listed below:

(1) 3 000 000 cycles at  $\pm 0.06$  mm at frequency of 100 Hz.

(2) 3 000 000 cycles at  $\pm 0.5$  mm at frequency of 45 Hz.

(3) 3 000 000 cycles at  $\pm 1.5$  mm at frequency of 10 Hz.

Feed Supply

13.8 Fire Test:

13.8.1 *Scope:* 

13.8.1.1 This section covers the requirements for fire testing.

13.8.2 Significance and Use:

13.8.2.1 This test verifies the integrity of the pipe/tube and joint under fire conditions.

13.8.3 Procedure:

13.8.3.1 Fire endurance tests shall be conducted as directed by the following test standards:

(1) ISO 19921.

(2) ISO 19922.

13.8.3.2 Alternate tests considered to be equivalent shall be accepted by agreement.

13.9 Impulse Pressure Test:

13.9.1 Scope:

13.9.1.1 This section covers the testing requirements for pressure pulse testing.

13.9.2 Significance and Use:

13.9.2.1 This test verifies the assembled joint to withstand rapid changes in pressure that may occur during normal operations.

13.9.3 Procedure:

13.9.3.1 The test specimen is to be filled with test fluid, de-aerated and pressurized to the design pressure of the joint.

13.9.3.2 The pressure source shall be capable of generating pressure pulses of 150 % of the design pressure within 10 % of the testing duration.

13.9.3.3 Internal pressure of the test specimen is to be raised from 0 to 1.5 times the design pressure of the joint with a frequency equal to 30-100 cycles per minute.

13.9.3.4 The number of cycles shall be not less than 500 000.

13.9.3.5 The test specimen shall be examined for leakage and damage. The test specimen has passed if there is no loss of internal pressure.

13.10 Ammonia Vapor Test, for Copper Alloys Containing 15 % Zinc or Greater:

13.10.1 *Scope*:

13.10.1.1 This section covers vapor testing requirements for copper alloys containing 15 % zinc or greater.

Pressure Gauge Pressure Pressure Pressure Pressure Pressure

FIG. 2 Vibration Test Arrangement

## 13.10.2 Significance and Use:

13.10.2.1 This test is to determine the susceptibility to stress-corrosion cracking of fittings made from wrought copper alloy.

13.10.3 Procedure:

13.10.3.1 Two fittings from each size and shape made from the same material lot of either copper zinc alloys containing more than 15 % zinc or copper-aluminum alloys shall be tested. 13.10.3.2 Assemble the test specimens onto pipe or tube.

13.10.3.3 Subject the test specimens onto pipe of tabe. 13.10.3.3 Subject the test specimens to the Ammonia Vapor Test in accordance with Specification B584 using a solution of risk level High (pH-value between 10 and 10.5) as described in Specification B584, Annex A1.

13.10.3.4 After completion of Ammonia Vapor Test, rinse and dry the specimens before immediate examination. There shall be no cracks.

13.10.3.5 Fittings successfully pass this test when no cracks are observed during the examination.

13.10.4 Precision and Bias:

13.10.4.1 The precision of this test is the solution and the material tested. There may be bias if the solution is not properly mixed in accordance with Test Method B858.

13.11 *Certification of Test Results*—If certified test results are required, a certification shall be provided to the purchaser as specified in the contract or purchase order.

13.12 Failure of any test specimen which is related to separation or leakage at the joint of the end cap or adapter and pipe or tube shall be recorded in the test report but shall not be considered a failure of the specimen being tested. Replacement test specimens shall be prepared in accordance with Section 12.

## 14. Inspection

14.1 *Terms of Inspection*—Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection requirements (examination and tests) specified herein.

14.2 *Raw Material Inspection*—Each lot of raw material used for production in accordance with this specification shall be inspected for conformance to the applicable material specification. A lot of raw material shall consist of bars, pipe, tube, forgings, or castings of the same heat, produced at essentially the same time and submitted for inspection at the same time.

14.3 *Quality Conformance Inspection*—Shall be visually and dimensionally examined to verify compliance with the

appropriate drawings. Quality conformance inspection shall be performed on each lot produced under this specification.

14.3.1 The inspections shall include size and shape manufactured under essentially the same conditions from the same lot of material and submitted for inspection at one time.

14.4 *Process Control Inspection*—Shall be inspected throughout the entire manufacturing and processing cycle. Methods of inspection shall be in compliance with the manufacturer's quality assurance procedures.

14.5 *Inspection Records*—Inspection records shall be maintained by the manufacturer. The length of time on file shall be in accordance with the manufacturer's quality assurance procedures.

14.6 *Performance Testing Records*—The manufacturer shall maintain a record of all performance tests throughout the life of the Press-Connect design.

## 15. Certification

15.1 *Certification of Testing or Inspection*—When requested by the purchaser, the manufacturer shall supply written certifications that testing has been qualified in accordance with this specification.

15.2 *Certification of Raw Material*—A certificate of compliance or mill certificate shall be obtained from the material supplier. This certificate shall state that all applicable requirements of the raw material are met. As a minimum, the material specification shall specify the chemical and mechanical requirements of the material.

### 16. Product Marking

16.1 *Product Marking*—Shall be marked with the manufacturer's name or trademark and size.

16.2 *Product Marking*—Shall conform to Manufacturers Standardization Society (MSS) SP-25 Standard Marking System for Valves, Fittings, Flanges and Unions.

16.2.1 *Additional Markings*—When specified in the contract or purchaser order, additional markings other than those specified shall be applied.

## 17. Keywords

17.1 brass; carbon steel; copper; copper alloy; coppernickel; elastomeric seal; fitting; FTG; operating pressure; pipe; press connect; stainless steel; tube

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