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6 Markings
Preface


This Standard was developed by the IAPMO Standards Review Committee (SRC) in accordance with the policies and procedures regulating IAPMO industry standards development, Policy S-001, Standards Development Process. This Standard was approved as an IAPMO Industry Standard on Month DD, YYYY.

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(4) During its development, this Standard was made available for public review, thus providing an opportunity for additional input from stakeholders from industry, academia, regulatory agencies, and the public at large. Upon closing of public review, all comments received were duly considered and resolved by the IAPMO Standards Review Committee.
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(b) relevant section, table, or figure number, as applicable;
(c) wording of the proposed change, tracking the changes between the original and the proposed wording; and
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(b) the definition of the problem, making reference to the specific section and, when appropriate, an illustrative sketch explaining the question;
(c) an explanation of circumstances surrounding the actual field conditions; and
(d) the request for interpretation phrased in such a way that a “yes” or “no” answer will address the issue.
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(12) Proposals for amendments to this Standard will be processed in accordance with the standards-writing procedures of IAPMO industry standards development, Policy S-001, Standards Development Process.
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<th>Name</th>
<th>Position</th>
<th>City, Country</th>
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<tbody>
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</tr>
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<td>Topeka, Kansas, USA</td>
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</tr>
<tr>
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<tr>
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<td>Ontario, California, USA</td>
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<td>G. Istefan</td>
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<td>IAPMO</td>
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</tbody>
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IAPMO PS 53-2019a2020
Grooved Mechanical Pipe Couplings and Grooved Fittings

1  Scope

1.1  Scope
This Standard covers grooved mechanical pipe couplings and grooved fittings and gaskets for pressure applications intended for use with copper, ductile iron, cast iron, PVC, CPVC, steel, and stainless steel pipe and specifies requirements for materials, physical characteristics, performance testing, and markings.

1.2  Alternative Materials
The requirements of this Standard are not intended to prevent the use of alternative materials or methods of construction provided such alternatives meet the intent and requirements of this Standard.

1.3  Terminology
In this Standard,
(a) “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;
(b) “should” is used to express a recommendation, but not a requirement;
(c) “may” is used to express an option or something permissible within the scope of the Standard; and
(d) “can” is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.4  Units of Measurement
SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application, but each unit system is to be used independently. All references to gallons are to U.S. gallons.

1.5  Amendments
Proposals for amendments to this Standard will be processed in accordance with the standards writing procedures of IAPMO.
2 Reference Publications
This Standard refers to the following publications, and where such reference is made, it shall be to the current edition of those publications, including all amendments published thereto.

ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.13M Metric Screw Threads: M Profile
ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A183 Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A351/A351M Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A563/A563M Standard Specification for Carbon and Alloy Steel Nuts
ASTM A536 Standard Specification for Ductile Iron Castings
ASTM B88 Standard Specification for Seamless Copper Water Tube
ASTM B633 Standard Specification for Electrodepositied Coatings of Zinc on Iron and Steel
ASTM B766 Standard Specification for Electrodepositied Coatings of Cadmium
ASTM D395 Standard Test Methods for Rubber Property - Compression Set
ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM D471 Standard Test Method for Rubber Property—Effect of Liquids
ASTM D573 Standard Test Method for Rubber —Deterioration in an Air Oven
ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness

NSF 61 Drinking Water System Components – Health Effects

SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners
3 Definitions and Abbreviations

3.1 Definitions
The following definition shall apply in this Standard:

**Housing** — the structural element of a pipe coupling that mechanically connects to the pipe ends and encapsulates the gasket.

**Pipe Coupling** — A device for connecting grooved pipe, fittings, or other components.

**Transition Coupling** — A pipe coupling which mechanically connects pipe, fittings, or other components of two different materials. For example, a coupling which joins metallic pipe to non-metallic pipe.

3.2 Abbreviations
The following abbreviations apply in this Standard:

- **CPVC** — chlorinated polyvinyl chloride
- **CTS** — copper tube size
- **EPDM** — ethylene-propylene-diene-monomer
- **FKM** — fluoroelastomer (fluorine rubber)
- **IPS** — iron pipe size
- **NBR** — nitrile rubber
- **NPS** — nominal pipe size
- **OD** — outside diameter
- **PVC** — polyvinylchloride
- **UNS** — Unified Numbering System

4 General Requirements

4.1 Compatibility with Pipe
Grooved mechanical pipe couplings and grooved fittings shall be compatible with
(a) Schedule 5 or thicker wall steel or stainless steel IPS pipe;
(b) Class 53, Class 53 equivalent, or thicker wall ductile iron pipe;
(c) cast iron pipe having minimum wall thicknesses as follows:
   (i) Class 22 for pipe NPS 12 and smaller; and
   (ii) Class 23 for pipe larger than NPS 12;
(d) DWV or thicker wall copper water tube;
(e) Schedule 40 or thicker wall PVC pipe; or
(f) Schedule 80 or thicker wall CPVC pipe.
4.2 Materials

4.2.1 Gaskets
Gaskets shall
(a) be made of EPDM, FKM, NBR, or other synthetic elastomers suitable for the intended applications; and
(b) comply with the requirements specified in Table 1.

4.2.2 Coupling Housings
Coupling housings shall be made of
(a) ductile iron complying with the properties specified in ASTM A536 for Grade 65-45-12;
(b) malleable iron complying with the properties specified in ASTM A47 for Grade 32510;
(c) stainless steel complying with or exceeding the properties specified in ASTM A351 or ASTM A743 for Grades CF8 or CF8M; or
(d) other materials suitable for the intended applications and complying with nationally recognized standards.

4.2.3 Fabricated and Formed Fittings
Fabricated fittings shall be made of
(a) Type 304/304L or Type 316/316L stainless steel alloys;
(b) steel pipe complying with the requirements of ASTM A53, ASTM A135, or ASTM A795;
(c) copper tube made of C12200 alloy; or
(d) other materials suitable for the intended applications and complying with nationally recognized standards.
(e) CPVC material that:
   (i) meets the minimum cell classification of 23447 referenced in ASTM D1784; or
   (ii) clean reworked material from the same manufacturer that meets the yields properties equivalent to the minimum cell classification specification.

4.2.4 Cast Fittings
Cast fittings shall be made of
(a) ductile iron complying with the properties specified in ASTM A536 for Grade 65-45-12;
(b) malleable iron complying with the properties specified in ASTM A47 for Grade 32510;
(c) stainless steel complying with or exceeding the properties specified in ASTM A351, ASTM A743, or ASTM A744 for Grades CF8 or CF8M;
(d) copper alloys with UNS designations C89833, C89836, or C90500; or
(e) other materials suitable for the intended applications and complying with nationally recognized standards.

4.3 Dimensions

4.3.1 Housings
Housings shall be sized to accommodate the pipe with which they are intended to be connected.

4.3.2 Grooved Fittings other than CTS Fittings
Dimensions for grooved fittings, other than CTS groove dimensions, shall be as specified by the fitting manufacturer.
4.3.3 CTS Groove Dimensions
CTS groove dimensions shall be as specified in Table 2 (see Figure 1).

4.3.4 Alternative Connections
Dimensions of alternative connections shall
(a) comply with the dimensional requirements of applicable standards; or
(b) if there are no applicable standards, be capable of accommodating the connecting piping system.

4.4 Coatings
Zinc (hot-dipped galvanized) coatings shall comply with the applicable requirements of ASTM A153.

4.5 Bolts and Nuts

4.5.1 Threads shall comply with ASME B1.1 or ASME B1.13M.

4.5.2 Bolts shall allow tightening of nuts from one side with a single tool.

4.5.3 Bolts shall be made of materials that comply with ASTM A183, ASTM A193, or SAE J429, as applicable, or other materials suitable for the intended applications.

4.5.4 Nuts shall be made of materials that comply with ASTM A194, ASTM A563/A563M, or SAE J995, as applicable, or other materials suitable for the intended applications.

4.5.5 Carbon steel bolts and nuts shall be
(a) zinc-plated in accordance with ASTM B633; or
(b) cadmium-plated in accordance with ASTM B766.

4.6 Toxicity

4.6.1 Materials and components, in contact with potable water, intended to convey or dispense water for human consumption through drinking or cooking shall comply with the applicable requirements of NSF 61 and the applicable low-lead requirements.

Note: “Low-lead” requirements are also known as “lead-free” and “reduction of lead” requirements. Such requirements are found in federal, state, or local laws and also in standards.

4.6.2 Solders and fluxes in contact with potable water shall not exceed, by mass, 0.2% lead content.

4.6.3 Metal alloys in contact with potable water shall not exceed 8% lead content.

4.7 Illustration
A typical coupling joint assembly is illustrated in Figure 2.
5 Testing Requirements

5.1 Testing Pipe

5.1.1 Steel and Stainless Steel IPS Pipe
For testing purposes,
(a) standard wall steel and stainless steel IPS pipe may be cut- or roll-grooved;
(b) steel and stainless steel IPS pipe of wall thickness less than standard wall shall be roll-grooved; and
(c) steel and stainless steel IPS pipe of wall thickness greater than standard wall shall be cut-grooved.

Note: Standard wall thickness is equivalent to Schedule 40 for sizes NPS-10 and smaller. For sizes larger than NPS-10, standard wall thickness is 9.53 mm (0.375 in).

5.1.2 Cast Iron Pipe
Ductile iron and cast iron pipe used for testing shall be cut-grooved.

5.1.3 Copper Tube
Copper tube used for testing shall be roll-grooved.

5.1.4 PVC Pipe
PVC pipe used for testing may be cut or roll-grooved.

5.1.5 CPVC Pipe
CPVC pipe used for testing shall be cut-grooved.

5.1.6 Pipe Preparation
For testing purposes, pipe shall be prepared (i.e., cut and deburred) in accordance with the manufacturer’s installation instructions.

5.2 Hydrostatic Pressure Test for Rigid Joints

5.2.1 Test Procedure
The hydrostatic pressure test for rigid joints shall be conducted as follows:
(a) Install the test specimen in accordance with the manufacturer’s installation instructions.
(b) Apply a hydrostatic pressure of 3,620 kPa (525 psi) or three times the manufacturer’s rated working pressure, whichever is greater.
(c) Hold the pressure for 5 min.

5.2.2 Performance Requirement
There shall be no leakage.
5.3 Hydrostatic Pressure Test for Flexible Joints

5.3.1 Test Procedure
The hydrostatic pressure test for flexible joints shall be conducted as follows:
(a) Assemble the test assembly shown in Figure 3, using
   (i) two pieces of pipe, each at least 600 mm (2 ft) long, one having maximum outside
t      diameter (OD) and the other one having minimum OD; and
   (ii) a pipe coupling of nominal dimensions in the center.
   Note: Pipe may be machined to attain minimum OD.
(b) Fill the test assembly with water and ensure that all air is expelled.
(c) Deflect the test assembly to the maximum possible angle without inducing strain at the
joint.
(d) Secure the test assembly in the maximum deflection position against the tendency to
straighten when the internal pressure is applied.
(e) Gradually increase the pressure to twice the maximum rated working pressure of the pipe
coupling; and
(f) Maintain the test pressure for 5 min.
(g) Check for leaks, permanent distortion, or separation of the joint.
(h) Continue to gradually increase the test pressure until leakage or joint separation occurs.
(i) Record the maximum pressure achieved.

5.3.2 Performance Requirement
There shall be no leakage or permanent distortion of the joint at twice the maximum rated
working pressure of the pipe coupling.

5.4 Hydrostatic Pressure Test for PVC/CPVC Fittings, Transition Couplings, and Pipe Couplings
Intended to Join PVC/CPVC

5.4.1 Test Specimen

5.4.1.1 The test specimen for PVC and CPVC Fittings shall consist of assemblies of PVC/CPVC fittings,
grooved pipe couplings, and at least two of each fitting. The specimens used for each test shall
contain the same configuration.

5.4.1.2 The test specimen for transition couplings and pipe couplings intended to join PVC/CPVC, shall
consist of couplings assembled onto sections of the intended pipes. Each test specimen of a
particular size, style, and/or type, shall exhibit the same general construction/configuration.

5.4.1.3 For fittings that include an elastomeric seal, condition the specimen for 1 h at 50 % of
the test pressure prior to the 1 h and the 1000 h tests.
5.4.2 Test Procedure
The hydrostatic pressure test for PVC/CPVC fittings, transition couplings, and pipe couplings intended to join PVC/CPVC, shall be conducted at a temperature of 82°C ± 2°C (180°F ± 3.6°F) in accordance with Section 9, Procedure in ASTM D1599 and as follows:
(a) Assemble the specimen in accordance with the manufacturer’s instructions and Section 5.4.1.1.
   (i) Apply a pressure of 3.2 x P*.
   (ii) Hold the pressure for 60 s.
(b) Assemble a new specimen in accordance with the manufacturer’s instructions and Section 5.4.1.1.
   (i) Apply a pressure of 2.5 x P*.
   (ii) Hold the pressure for 1 h.
(c) Assemble a new specimen in accordance with the manufacturer’s instructions and Section 5.4.1.1.
   (i) Apply a pressure of 2.1 x P*.
   (ii) Hold the pressure for 1000 h.
Note: P* is the pressure recommended by the manufacturer at 82°C (180°F).

5.4.3 Performance Requirements
There shall be no leakage, permanent deformation or slippage of the joint for all tests applied.

6 Markings

6.1 Couplings and fittings complying with this Standard shall be marked with the
(a) manufacturer's name or trademark;
(b) nominal size; and
(c) model number.

6.2 Markings on couplings and fittings shall be permanent, legible, and visible after installation.

6.3 Gaskets complying with this Standard shall be marked with:
(a) marked with the
   (i) manufacturer’s name or trademark; and
   (ii) nominal size; and
(b) color-coded or otherwise marked to identify the material; and,
(c) service (e.g. “drinking-water”, “NSF 61”, “potable”, “P”, or “PW”), when intended for use in potable water systems.
   (a) Manufacturer’s name or trademark; and
   (b) Nominal Size; and
   (c) Material Identification Marking (for example, color code); and
   (d) Service Type (e.g. “Drinking Water”, “NSF 61”, “Potable”, “P”, or “PW”) when intended for use in potable water systems.

6.4 Markings on gaskets shall be permanent and legible.

6.5 Acceptable ways of marking couplings, fittings and gaskets shall be to cast or stamp the marking on the gasket, coupling housing, or fitting exterior.
Table 1  
Material Properties for Elastomers  
(See Section 4.2.1)

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Method</th>
<th>Conditions</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in volume</td>
<td>D471</td>
<td>After 70 h in water at 100°C (212°F)</td>
<td>15% maximum change in volume</td>
</tr>
<tr>
<td>(Water absorption)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compression set</td>
<td>D395 Method B</td>
<td>After 70 h at 100°C (212°F)</td>
<td>30% maximum</td>
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<tr>
<td>Elongation</td>
<td>D412</td>
<td>Unaged</td>
<td>250% minimum</td>
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<td>D573</td>
<td>After aging in an oven for 70 h at 100°C (212°F) or 96 h at 70°C (158°F)</td>
<td>35% maximum change</td>
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<td>Hardness</td>
<td>D2240</td>
<td>Unaged</td>
<td>50 to 75 Shore A durometer</td>
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<td>After aging in an oven for 70 h at 100°C (212°F)</td>
<td>15% maximum change</td>
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<tr>
<td>Tensile Strength</td>
<td>D412</td>
<td>Unaged</td>
<td>10,350 kPa (1,500 psi)</td>
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<tr>
<td></td>
<td>D573</td>
<td>After aging in an oven for 70 h at 100°C (212°F)</td>
<td>30% maximum change</td>
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### Table 2

**CTS Groove Dimensions**

(See Section 4.3.3 and Figure 1)

<table>
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<tr>
<th>Nominal Size</th>
<th>Actual Outside Diameter (OD)</th>
<th>A, Gasket Seat</th>
<th>B, Groove Width</th>
<th>C, Groove Diameter</th>
<th>D, Groove Depth</th>
<th>Flare Diameter</th>
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<tr>
<td></td>
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<td>Maximum mm (in)</td>
<td>Minimum mm (in)</td>
<td>Maximum mm (in)</td>
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<td>155.19 (6.110)</td>
<td>155.96 (6.140)</td>
<td>154.91 (6.151)</td>
<td>14.73 (0.580)</td>
<td>16.26 (0.640)</td>
</tr>
<tr>
<td>8</td>
<td>206.38 (8.125)</td>
<td>205.99 (8.110)</td>
<td>206.76 (8.140)</td>
<td>205.56 (8.159)</td>
<td>14.73 (0.580)</td>
<td>16.26 (0.640)</td>
</tr>
</tbody>
</table>

**Notes:**

1. Refer to Figure 1 for dimensions A, B, C, D, and flare diameter.
2. The nominal size is the nominal tube size, in accordance with ASTM B88.
3. The gasket seat (Dimension A) shall be free from scores, roll marks, indentations, grease, and dirt which can interfere with gasket sealing.
4. The groove width (Dimension B) shall be free from chips, dirt, and other substances or defects which can interfere with proper coupling assembly.
5. The groove depth (Dimension D) shall be uniform for the entire circumference of the grooved end and is provided as a reference dimension.
6. The flare diameter is the outside diameter measured at the most extreme end diameter.
Figure 1
Illustration of CTS Groove Dimensions
(See Section 4.3.3 and Table 2)
Figure 2
Illustration of Typical Coupling Joint Assembly
(See Section 4.7)

Figure 3
Hydrostatic Test for Flexible Joints
(See Section 5.3.1)

(See Section ------)