

IAPMO IGC 233-2019

Corrugated Stainless Steel Hot- and Cold- Water Distribution Systems



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Preface

This is the fifth edition of IAPMO IGC 233, Corrugated Stainless Steel Hot- and Cold-Water Distribution Systems. This Standard supersedes IAPMO IGC 233-2009, Corrugated Stainless Steel Hot- and Cold-Water Distribution Systems. The previous editions of this standard are: July 2009, May 2008, September 2007, July 2006

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 September 09, 2019.

Notes:

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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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 - (a) *standard designation (number);*
 - (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*
 - (d) *rationale for the change.*
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 - (a) *the edition of the standard for which the interpretation is being requested;*
 - (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*
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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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IAPMO IGC 233-2019

Corrugated Stainless Steel Hot- and Cold-Water Distribution Systems

1 Scope

1.1 General

1.1.1 This Standard covers corrugated stainless steel hot- and cold- water distribution systems intended for use in 1012.8 kPa (147 psi) water service up to and including a maximum working temperature of 100°C (212°F) and specifies requirements for materials, physical characteristics, performance testing, and markings.

1.1.2 Components within this system comprise of corrugated stainless steel pipe and metallic fittings made in one standard dimension ratio.

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.

2 Referenced 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.

ASSE International

ASSE 1061

Performance Requirements for Push-Fit Fittings

ASME International (The American Society of Mechanical Engineers)

ASME B1.20.1

Pipe Threads, General Purpose (Inch)

ASTM International

ASTM A240/A240M

Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A312/A312M

Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

ASTM D4101

Standard Classification System and Basis for Specification for Propylene Plastic Injection and Extrusion Material

ASTM D3350

Standard Specification for Polyethylene Plastics Pipe and Fittings

CSA Group (Canadian Standards Association)

CSA B137

Thermoplastic Pressure Piping Compendium

NSF International

NSF/ANSI/CAN 61

Drinking Water System Components - Health Effects

IAPMO

IAPMO PS 66

Dielectric Fittings

3 Definitions and Abbreviations

This section is reserved for later use.

4 General Requirements

4.1 Materials

Stainless steel material shall be a minimum type 304 complying with the requirements of ASTM A240/A240M or ASTM A312/A312M. Copper alloys material shall contain at least 58% copper and maximum 8% lead content.

4.2 Toxicity

All materials that come in contact with potable water shall be non-toxic and shall show compliance with NSF/ANSI/CAN 61.

4.3 Piping

Corrugated piping dimensions and tolerances shall comply with Figure 1 and Table 1.

4.4 Fittings

Dielectric fittings shall comply with the requirements in IAPMO PS 66. Threaded ends shall comply with ASME B1.20.1. Fittings and manifolds shall be compatible with the piping made to the requirements in Table 1. Push fit end connection shall comply with the applicable requirements in ASSE 1061.

4.5 Plastic Coating

Polypropylene material shall comply with the requirements in ASTM D4101 or CSA B137 and Polyethylene material shall comply with the requirements in ASTM D3350 or CSA B137.

4.6 Sizing

Water systems using the stainless steel piping shall be determined in accordance with Table 2.

5 Testing Requirements

5.1 Sampling

A sufficient quantity of tubing or fittings shall be selected and tested to determine conformance with this standard.

5.2 Hydrostatic Test

5.2.1 Test Procedure

The hydrostatic test shall be conducted as follows:

- (a) Prepare a test specimen at least 500 mm (20 in) in length, from randomly selected specimens assembled per the manufacturer's instructions; and
- (b) Fill the test specimen with water and increase the internal pressure to 1516 ± 48 kPa (220 ± 7 psi) or 1.5 times the manufacturer's rated pressure, whichever is greater, at a temperature of $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($68^{\circ}\text{F} \pm 5^{\circ}\text{F}$) for a period of 5 min.

5.2.2 Performance Requirements

No signs of leakage shall occur.

5.3 Hydrostatic Burst Test at 20°C (68°F)

5.3.1 Test Procedure

The hydrostatic burst test shall be conducted as follows:

- (a) Prepare a test specimen at least 500 mm (20 in) in length, randomly selected specimens assembled per the manufacturer's instructions; and
- (b) Fill the test specimen with water at a temperature of $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($68^{\circ}\text{F} \pm 5^{\circ}\text{F}$);
- (c) Increase the hydrostatic pressure to 4054 ± 48 kPa (588 ± 7 psi) or 4 times the manufacturer's rated working pressure, whichever is greater; and
- (d) Hold the hydrostatic pressure for a period of 5 min.

5.3.2 Performance Requirements

No signs of cracking or leakage shall occur.

5.4 Bending Test

5.4.1 Test Procedure

The bending test shall be conducted as follows:

- (a) Prepare a test specimen at least 610 mm (24 in) in length, from randomly selected specimens assembled per the manufacturer's instructions;
- (b) Securely attach one end of the sample assembly to a fixed pipe to which an air supply system and manometer is connected;
- (c) Cap the other end to form an air tight seal;
- (d) Apply a pressure equivalent to 20.3 kPa (2.95 psi);
- (e) Place two mandrels whose radius is 3 times the nominal tube diameter, one at each side of the fixed end of the sample, in contact with the sample fitting and with center lines opposite the inner end of the internal or external retention skirt;
- (f) Bend the sample into the starting position, as in Figure 2;
- (g) Bend the unattached end by hand from the position indicated by "B" along the path shown by the dotted circle to position "C";
- (h) Bend the sample back to the starting position;
- (i) Each bending (as from "B" to "C" or from "C" to "B") is constituted as one cycle; and
- (j) Repeat this process until 10 cycles have been completed, the bending motion being applied uniformly at the rate of 5 – 6 cycles per minute.

5.4.2 Performance Requirements

No signs of leakage shall occur.

5.5 Hydraulic Shock (Water Hammer) Test

5.5.1 Test Procedure

The hydraulic shock test shall be conducted as follows:

- (a) Prepare a specimen at least 610 mm (2 ft) in length containing a fitting joint.
- (b) Mount the specimen in a system with water at atmospheric pressure.
- (c) Subject the specimen to a hydraulic shock for 2,000 cycles at $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($68^{\circ}\text{F} \pm 5^{\circ}\text{F}$).
- (d) The hydraulic shock shall consist of a sudden increase in pressure from 345 kPa (50 psi) to 1958 kPa (284 psi) lasting 1 s.

5.5.2 Performance Requirements

No signs of leakage shall occur.

5.6 Vibration Test**5.6.1 Test Procedure**

The vibration test shall be conducted as follows:

- (a) Prepare two specimens at least 610 mm (2 ft) in length ;
- (b) Each sample is to be fitted with pipe plugs, filled with water in such a manner as to exclude all air, and connected to a hydrostatic source;
- (c) subject the specimen to a hydrostatic pressure of 101.3 kPa (14.7 psi);
- (d) Extend the samples to their intermediate position and insure they are locked, filled with water, and mounted in the pendant position on a test fixture attached to the table of a vibration machine; and
- (e) The amplitude of the vibration is to be 5 mm (0.2 in), and the frequency is to be 25 Hz for 3 h.

5.6.2 Performance Requirements

No signs of leakage shall occur.

5.7 Flattening Test**5.7.1 Test Procedure**

The flattening test shall be conducted as follows:

- (a) Prepare a specimen of piping at least 610 mm (2 ft);
- (b) Securely attach one end of the sample assembly to a fixture to which a pressure equivalent to 20.3 kPa (2.95 psi) is obtained and manometer is connected;
- (c) Plug the other end of the specimen closed;
- (d) Insert the specimen into two flat plates with the welded end set to 90 degrees opposite of the pressing direction (See Figure 3); and
- (e) The tube shall be pressed to 2/3 D height of the outer diameter until the tube is flat.

5.7.2 Performance Requirements

No signs of cracks or leakage shall be found.

5.8 Steel Ball Impact Test**5.8.1 Test Procedure**

The steel ball impact test shall be conducted as follows:

- (a) Prepare a specimen at least 305 mm (1 ft) in length, from randomly selected specimens assembled per the manufacturer's instructions;
- (b) Securely attach one end of a sample assembly to a fixture to which a pressure equivalent to 20.3 kPa (2.95 psi) is obtained and manometer is connected;
- (c) Plug the other end of the specimen closed;
- (d) Secure the specimen on a concrete cement plate; and
- (e) Drop a 2 kg (4.4 lb) steel ball onto the center of specimen from 1 m (3.28 ft) height (See Figure 4).

5.8.2 Performance Requirements

No sign of leakage shall occur.

5.9 Impact Test**5.9.1 Test Procedure**

The impact test shall be conducted as follows:

- (a) A specimen is fabricated from randomly selected specimen assembled per the manufacturer's instructions;
- (b) Securely attach one end of a sample assembly to a fixture to which a pressure equivalent to 20.3 kPa (2.95 psi) is obtained and manometer is connected;
- (c) Plug the other end of the specimen closed; and
- (d) Apply an impact force in accordance with Table 3 to the fitting using a hammer as shown in Figure 5.

5.9.2 Performance Requirements

No signs of cracks or leakage shall occur.

6 Markings and Accompanying Literature**6.1 Markings**

Corrugated stainless steel hot-and cold- water distribution systems complying with this Standard shall be marked with the:

- (a) Manufacturer's name or trademark;
- (b) Nominal Size;
- (c) Pressure Rating at 212°F (100°C); and
- (d) Manufacturing Date.

6.2 Spacing

Markings shall be spaced at intervals of not more than 1 m (3 ft).