

Maximum Performance (MaP) Testing Toilet Fixture Performance Testing Protocol¹ Version 7 – January 2018

1.0 Purpose and Scope of MaP Testing

- 1.1 The purpose of this specification is to measure the maximum bulk waste removal flush performance of all types of toilet (water closet) models.
- 1.2 The scope of Maximum Performance (MaP) Testing is presented in Sections 2.0 and 3.0.
- 1.3 Reference Standards and Specifications

The following documents form a part of this specification to the extent specified herein (the latest approved version shall apply):

- ASME A112.19.2/CSA B45.1 – Ceramic Plumbing Fixtures
- ASME A112.19.14 - Six-Liter Water Closets Equipped with a Dual Flushing Device
- ASME A112.19.5/CSA B45.15 - Flush valves and spuds for water closets, urinals, and tanks
- U.S. EPA WaterSense® Program - Specification v.1.2 for Tank-Type Toilets
- U.S. EPA WaterSense® Program – WaterSense® Specification v.1.0 for Flushometer-Valve Water Closets

2.0 General Requirements for Toilet Models that are **NOT** WaterSense®-Certified

Note: Compliance with the U.S. EPA WaterSense Program “WaterSense Specification for Tank-Type Toilets” v.1.2 or “WaterSense Specification v.1.0 for Flushometer Valve Water Closets shall fully satisfy the requirements of Section 2.0.

- 2.1 All toilet models and combinations must conform to the latest ANSI-approved version of *ASME A112.19.2/CSA B45.1*
- 2.2 All dual-flush toilet models must conform to the latest ANSI-approved version of *ASME A112.19.14*.
- 2.3 All flush valves and flappers in tank-type gravity toilets must conform to the latest ANSI-approved version of *ASME A112.19.5/CSA B45.15*.

3.0 MaP Testing Protocol

3.1 Performance Requirements

- 3.1.1 Toilet model maximum performance (MaP) level is identified as the maximum media loading (in discrete increments expressed in grams) at which a toilet model successfully clears all test media from fixture in at least four of five attempts when **cased** media is used and in at least two of three attempts when **uncased** (raw) media is used.
- 3.1.2 Tests where toilet model clogs, plugs, or fails to restore a minimum of a 2-inch (50mm) trap seal after each test will be deemed a failed test.

3.2 Test Media

¹ For further information on or clarification of this test protocol, contact the following individuals:
Bill Gauley, P.Eng., Gauley Associates, Ltd. bill@gauley.ca
John Koeller, P.E., Koeller and Company jkoeller@map-testing.com

3.2.1 MaP test media is comprised of either of the following:

3.2.1.1 **Cased** Media: One or more $50 \pm 4\text{g}$ test specimens (“test specimen”) consisting of soybean paste contained in latex casing, tied at each end forming a ‘sausage’, and meeting the requirements of Section 5.2, and four loosely crumpled balls of toilet paper (“paper”), OR

3.2.1.2 **Uncased** (Raw) Media: One or more $50 \pm 4\text{g}$ test specimen (“test specimen”) consisting of extruded soybean paste meeting the requirements of Section 5.1 and four loosely crumpled balls of toilet paper (“paper”).

3.2.2 Each test specimen shall be $100 \pm 13\text{mm}$ in length and $25 \pm 6\text{mm}$ in diameter².

3.2.3 Unless otherwise specified, all MaP testing shall be completed using cased media; however, the client may choose, at their discretion, to have toilet model samples tested with uncased test media.

3.3 Toilet Model Sample Selection

3.3.1 A single randomly selected sample of each toilet model (“sample”) is required for testing.

3.3.2 Any toilet model not certified to the applicable plumbing standards as specified in Section 1.3 shall be identified as a “Prototype Model”.

3.4 Set-Up

3.4.1 Samples shall be assembled according to manufacturer’s written instructions as contained within the product packaging and placed on test apparatus (rig), ensuring tank (where applicable) and bowl are level.

3.4.2 For tank-type gravity toilet models, tank water level shall be adjusted to the level specified by manufacturer in the manufacturer’s instructions (e.g., set to waterline).

3.4.3 Static water supply pressure shall be set to 50 ± 3 PSIG.

3.4.4 Inlet water temperature shall be 18 to 27°C (65 to 80°F).

3.4.5 Samples shall be flushed minimum of three times prior to commencement of testing.

3.4.6 For tank-type gravity toilet models, re-adjust tank water level to proper level if required.

3.5 Flush Volume Measurement

3.5.1 Measure and record flush volume of sample in accordance with *ASME A112.19.2-2/CSA B45.1*, paragraphs 7.4.2 and 7.4.3.

3.5.2 Samples with measured flush volumes in excess of 0.10 gallons (0.4 litres) greater than their rated flush volume when adjusted to the indicated waterline shall be deemed to fail MaP testing requirements due to excessive flush volume.

3.5.3 Samples with measured flush volumes less than 0.10 gallons (0.4 litres) greater than their rated flush volume when adjusted to the indicated waterline shall be adjusted, if possible, to their rated flush volume prior to performance testing. The rated flush volume shall be recorded on the MaP test report.

3.5.4 Samples with measured flush volumes less than their rated flush volume shall be tested at their measured volume and this volume shall be recorded on the MaP test

² Approximately 4 ± 0.5 inches in length and 1 ± 0.25 inches in diameter

report.

3.6 Waste Extraction Test

- 3.6.1 Cased test specimens shall be formed such that they are roughly cylindrical in shape and uniform in diameter. Uncased test specimens shall be extruded such that they are cylindrical.
- 3.6.2 A test specimen drop guide shall be placed across the top of the bowl, with a 50mm (2-in.) diameter opening positioned 150 mm (6-in.) in front of the center of the seat post holes, equidistance from each hole. Drop guide may be made of plastic or other rigid material, to be no more than 12mm (0.5-in.) thick, and be of sufficient length to span the top of the toilet bowl.
- 3.6.3 Soybean paste test specimens shall be freely dropped in a vertical orientation into bowl through opening in drop guide. Test specimen should be held in such a way that approximately half of the specimen protrudes through the opening in the drop guide prior to release into the bowl. Additional test specimens shall be added, as required, to achieve desired mass loading. Record total mass loading (number of test specimens x 50g each).
- 3.6.4 Freely drop four balls of crumpled toilet paper through drop guide opening.
- 3.6.5 Wait 10 ± 1 seconds.
- 3.6.6 Flush sample. Collect discharged media in strainer or other suitable container positioned below toilet fixture.
- 3.6.7 Record test as Pass or Fail. Test is a Fail if any waste remains in the bowl or trap, or if minimum 50mm (2-in.) trap seal has not been restored.
 - 3.6.7.1 If cased media is used (section 3.2.1.1), remove (rinse) discharged toilet paper from test specimens, and re-form and prepare test specimens for further testing.
 - 3.6.7.2 If uncased (raw) media (section 3.2.1.2) is used, discard discharged media into waste receptacle or other suitable container.
 - 3.6.7.3 Flush sample to clean bowl and trapway and fully restore trap seal.
- 3.6.8 Increase/decrease mass loading as required and repeat test until maximum loading has been reached as described in section 3.1. Testing shall be completed at the following mass intervals: 350g, 400g, 500g, 600g, 800g, and 1000g
 - 3.6.8.1 No testing shall be conducted at a mass loading greater than 1,000g.
- 3.6.9 Record highest mass loading at which toilet test sample successfully removed all test media from fixture and restored minimum 2-in. (51mm) trap seal in at least four of five attempts when cased media is used or two of three attempts when raw (uncased) media is used. This loading represents the maximum performance level for the test sample (i.e., the "MaP score").

3.7 Trap Diameter Ball Pass

- 3.7.1 The toilet trap diameter shall be measured by passing solid balls with known diameters in 1/8-inch (3.175-mm) increments through the trap.
- 3.7.2 The toilet trap diameter ball pass shall be listed as equivalent to the diameter of the largest ball that can pass completely through the trap.

4.0 MaP ‘PREMIUM’ Rating

- 4.1 Tank-type toilet models may be eligible to carry the MaP PREMIUM rating if:
 - 4.1.1 they are certified to the U.S. EPA “WaterSense Specification for Tank-Type Toilets”, and
 - 4.1.2 they achieve a Maximum Performance (MaP) score of at least 600g, and
 - 4.1.3 the rated flush volume of single-flush toilet models does not exceed 4.0 litres (1.1 gallons)³, and
 - 4.1.4 the rated ‘full’ flush volume of dual-flush toilet models does not exceed 4.8 litres (1.28 gallons), and
 - 4.1.4 the effective flush volume⁴ of dual-flush models does not exceed 4.0 litres (1.1 gallons)
- 4.2 Flush volume adjustability

The volumes of water that may be discharged by MaP PREMIUM-rated toilet models, when field adjustment of original equipment tank trim and/or aftermarket tank trim is set at its maximum water-use setting, shall not exceed the following:

Rated flush volume (applies to single-flush fixtures and to both the full and reduced flush of dual-flush fixtures)	Maximum Field Adjustment Allowance
Greater than 1.1 gallons (full flush on dual-flush toilet models)	+0.4 gallons (1.5 litres)
1.1 gallons or less	+0.3 gallons (1.1 litres)

NOTE: The determination of a ‘PREMIUM’ rating shall be made solely by MaP-testing based upon the results of testing to this specification as reported by the MaP-approved testing laboratory.

³ MaP PREMIUM rounds flush volumes to a single decimal place. While we recognize that 1.1 gallons is slightly greater than 4.0 litres, it is our professional opinion that this difference is not materially significant.

⁴ The ‘effective flush volume’ for PREMIUM-rated dual-flush toilets shall be the average of one full flush and one reduced flush.

5.0 MaP Test Media Specifications⁵

5.1 Nominal specifications for soybean paste used in preparation of MaP test media:

5.1.1 34.9% water, 33.1% soybean, 18.5% rice, 12.2% salt, and 1.6% ethyl alcohol, and having a density of 1.15 ± 0.10 g/mL (i.e., density greater than water).⁶

5.2 Cased Test Media:

5.2.1 Latex casing shall be made from non-lubricated latex condoms (e.g., LifeStyles® brand, purchased from Ansell Healthcare Products LLC, Dothan, AL 36303 USA).

5.2.2 Cord used to tie casing shall be 1.0mm diameter polymer cord that will not crack or harden with time (e.g., Stretch Magic Bead & Jewelry Cord, Pepperell Braiding Company, P.O. Box 1487, Pepperell, MA 01463, 800-343-8114)

5.2.3 Each test specimen shall have a mass of 50 ± 4 g and meet the specifications of Section 5.1.

5.2.4 Test specimens should be stored in air-tight containers and refrigerated when not in use. A damp sponge should be placed in bottom of container to prevent test specimen drying.

5.2.5 Temperature of test specimens during testing shall be shall be between 5 to 27°C (41 to 80°F).

5.2.6 Test specimens that have been stored in a refrigerator shall be acclimatized by flushing each specimen a minimum of three times prior to conducting MaP testing.

5.2.7 Individual test specimens shall be discarded after they have been subjected to 100 flushes.

5.2.8 Test specimens with rips, tears, punctures, etc., shall not be used.

5.2.9 Test specimens that are damaged in any way shall not be used.

5.2.10 Test specimens may contain small volumes of air, however, specimens that float shall not be used.

5.3 Uncased (Raw) Test Media:

5.3.1 Uncased test specimens shall be produced by the extrusion process.

5.3.2 Each test specimen shall have a mass of 50 ± 4 g and shall comply with Section 5.1.

5.3.3 Temperature of test specimens during testing shall be shall be between 5°C and 27°C (41°F and 80°F).

5.4 Toilet paper specifications:

5.4.1 Each ball of toilet paper is comprised of six sheets of single ply toilet paper conforming to ASME A112.19.14–2013, section 3.2.4.1. In the absence of toilet paper compliant with the dimensional requirements of 4.5 in. x 4.5 in. (114 mm x 114 mm), a paper of equivalent surface area shall be used, 20 ± 2.0 square inches (130 ± 13 square centimeters).

⁵ NOTE: Bulk test media (soybean paste) or cased test specimens (ready-to-use) may be purchased from: Gauley Associates, Ltd., Acton, Ontario, Canada; phone 416-677-6193, email bill@gauley.ca.

Other sources may be used as long as the test media meets the specification noted in paragraph 5.1.1.

⁶ NOTE: Total percentage exceeds 100% due to rounding.