

WaterSense Performance Overview: *Tank-Type Toilets*

Equal or superior product performance is a pillar of the WaterSense label. Ensuring performance is vital for maintaining program integrity and consumer confidence in WaterSense labeled products. As part of specification development, the U.S. Environmental Protection Agency (EPA) also evaluates whether high-efficiency products will have other environmental or economic impacts. This includes whether there will be unintended or negative impacts to overall system performance, which may affect user satisfaction and health and safety. This Performance Overview details EPA's process for developing performance test methods and criteria for tank-type toilets. In general, as part of the [specification development process](#), EPA involves many WaterSense stakeholders, including manufacturers, certifying bodies and testing laboratories, standard development organizations, trade organizations, water and energy utilities, and other water efficiency experts and advocates. Each of these stakeholders offers a unique perspective and has dedicated technical expertise and other resources that have contributed to the development of performance criteria used to ensure WaterSense labeled products perform as well or better than standard products on the market.



EPA released the [WaterSense Specification for Tank-Type Toilets](#) and associated supporting statement on January 24, 2007. EPA has since completed two minor revisions to the specification, releasing the latest version (Version 1.2) in June 2014.¹

Summary of Performance Requirements

Table 1 summarizes the performance requirements included in the *WaterSense Specification for Tank-Type Toilets*, either directly or by reference to an applicable national standard. Table 1 also describes the purpose of each performance requirement, the applicable standard the WaterSense specification references, and any specific requirements or deviations from the referenced standard. Unless noted, WaterSense labeled tank-type toilets must meet the specific performance requirements outlined in the applicable referenced standard.

¹ More information on EPA's rationale for establishing its efficiency and performance criteria for tank-type toilets can be found in the supporting statement, response to comments, and other background documents found at www.epa.gov/watersense/product-background-materials.

Table 1. Summary of Performance Criteria Included in the *WaterSense Specification for Tank-Type Toilets*

Performance Requirement	Purpose	Referenced Standard (if applicable)	Applies to Conventional Models	Applies to WaterSense Labeled Models
Granule and ball	Assesses a toilet's ability to flush media of different sizes and density (i.e., floating versus sinking media).	American Society of Mechanical Engineers (ASME) A112.19.2/Canadian Standards Association (CSA) B45.1 <i>Ceramic Plumbing Fixtures</i>	✓	✓
Surface wash	Evaluates a toilet's ability to clean the surface of the bowl.	ASME A112.19.2/ CSA B45.1 <i>Ceramic Plumbing Fixtures</i>	✓	✓
Drainline transport characterization	Assesses a toilet's ability to transport waste media through a drainline.	ASME A112.19.2/ CSA B45.1 <i>Ceramic Plumbing Fixtures</i>	✓	✓
Overflow	Ensures toilet tank does not leak or permit water to otherwise escape.	ASME A112.19.2/ CSA B45.1 <i>Ceramic Plumbing Fixtures</i>	✓	✓
Waste extraction	Determines a toilet's ability to clear soybean paste test media and toilet paper (meant to be representative of human waste) from the bowl.	ASME A112.19.2/ CSA B45.1 <i>Ceramic Plumbing Fixtures</i> The specification explicitly requires successful clearance of 350 grams of soybean paste test media and four balls of toilet paper in four of five flushes.	✓*	✓
Adjustability tests	Limits the allowed adjustability of features in the toilet tank that might increase the flush volume.	ASME A112.19.2/ CSA B45.1 <i>Ceramic Plumbing Fixtures</i>		✓†

* The waste extraction test was adopted into ASME A112.19.2/CSA B45.1 *Ceramic Plumbing Fixtures* after its initial inclusion within the *WaterSense Specification for Tank-Type Toilets*. All toilets sold in the United States or Canada are now required to pass this performance test.

† The adjustability tests for tank-type gravity water closets were adopted into ASME A112.19.2/CSA B45.1 *Ceramic Plumbing Fixtures* after initial inclusion within the *WaterSense Specification for Tank-Type Toilets*. All high-efficiency toilets sold in the United States or Canada are now required to demonstrate limited flush volume adjustability.

Development of Performance Requirements

In the early 1990s, new “low-flow” toilets were released into the marketplace in response to the Energy Policy Act of 1992 requiring all new toilets to flush at 1.6 gallons per flush (gpf) or less (down from 3.5 gpf or more). In an effort to comply with the requirements, some toilet manufacturers simply reduced the tank size and flush volume without full consideration for how this might impact the hydraulics and resulting performance of the toilets. This led to a need for multiple flushes and other performance issues. Over the last 20 years, manufacturers have

invested significant resources in redesigning and reengineering toilets so that they can achieve both water efficiency and good performance. When EPA initiated the development of the WaterSense specification for tank-type toilets, it recognized the efforts of manufacturers to address performance issues but also understood user concerns and perceptions with products in the past. EPA worked with a variety of stakeholders to identify and develop meaningful performance criteria to ensure that WaterSense labeled tank-type toilets consistently perform at a high level and meet or exceed user expectations.

In addition to meeting the performance requirements outlined in the ASME A112.19.2/CSA B45.1 *Ceramic Plumbing Fixtures* (the national performance standard for tank-type toilets in the U.S. and Canada), the WaterSense specification incorporated requirements for tank-type toilets to clear 350 grams of soybean paste test media and four balls of toilet paper from the bowl in four of five test flushes. This additional test aims to ensure effective waste extraction and address concerns over the need for flushing multiple times. The WaterSense performance test method and criteria were based on the Uniform North American Requirements (UNAR) for Toilet Fixtures: Guidelines and Specifications, which, at the time of the WaterSense tank-type toilet specification development, was a voluntary system developed by members of the plumbing industry and water utilities with the intention of qualifying water-efficient toilets for rebates and ensuring a high level of customer satisfaction. The UNAR specifications required toilets to dispose of 250 grams of soybean paste test media. WaterSense increased the mass of the soybean paste test media required in the waste extraction test from 250 grams to 350 grams, making its specification more rigorous in order to establish a higher level of performance for tank-type toilets and ensure customer satisfaction with WaterSense labeled toilets.

WaterSense established the 350-gram requirement based on review of a medical study that assessed human waste, *Variability of colonic function in healthy subjects*, 1978, J.B. Wyman, K.W. Heaton, A.P. Manning, and A.C.B. Wicks of the University Department of Medicine, Bristol Royal Infirmary. The study found the greatest single “loading” of the 20 study participants was approximately 450 grams, and the 99.5 percent confidence level of the men in the study equates to a loading of approximately 350 grams.

The WaterSense waste extraction performance requirements have since been adopted into the ASME A112.19.2/CSA B45.1 standard. All toilets (whether WaterSense labeled or otherwise) sold in the United States or Canada are now required to meet these performance requirements. In addition, many toilets sold in the United States are tested for additional performance to the voluntary Maximum Performance (MaP) Testing criteria. MaP measures the maximum quantity of soybean paste test media (up to 1,000 grams) that toilets can clear. Thousands of WaterSense labeled tank-type toilet models, including models flushing with as little as 0.8 gpf, have been MaP tested and demonstrate performance beyond WaterSense’s requirements.²

During the initial specification development, transport of waste through sewer drainlines was also of particular concern for some stakeholders. Commenters questioned whether high-efficiency toilets flushing at 1.28 gpf or less could adequately clear waste through drainlines. WaterSense conducted a number of tests to evaluate drainline carry performance for toilets flushing between 1.0 gpf and 1.28 gpf. During these tests, WaterSense selected a set of more difficult-than-average test conditions. Whereas most building and plumbing codes call for a 3-

² MaP Testing. Tank-Type Toilets Complete MaP List. October 2021. www.map-testing.com/downloads.html.

inch diameter drainline installed at a 2 percent slope to be used for a single toilet fixture, WaterSense used a 4-inch diameter drainline installed at a 1 percent slope. In addition, WaterSense conducted these drainline tests without supplemental flows (such as those from showers, baths, faucets, clothes washers), which are very common in residential drainlines, to provide a conservative assessment. Even under these less-than-ideal conditions, each of the high-efficiency toilet models tested were able to meet or exceed the established performance criteria. Based on this evaluation, WaterSense concluded that toilets that conform to the *WaterSense Specification for Tank-Type Toilets*, when installed in typical residential configurations, will provide sufficient drainline carry of waste material. More information on this study can be found in Appendix A of EPA's *Response to Issues Raised During Public Comment on April 2006 Draft Specification for WaterSense Labeling of Tank-Type High-Efficiency Toilets*.³

WaterSense labeled tank-type toilets are subject to the same performance rigor as standard, less efficient models. In addition to the waste extraction requirements, they must pass a granule and ball test (used to ensure toilets can clear floating and sinking media of different sizes), a surface wash test (used to ensure toilets provide adequate surface wash to cleanse the bowl surface), and a drainline transport test (used to ensure the efficacy of the toilet in transporting liquid and solid waste through the sewer drainline). Each of these tests assesses different elements of performance (described in Table 1 above) and contribute to overall user satisfaction.

³ EPA, 2006. *Response to Issues Raised During Public Comments on April 2006 Draft Specification for WaterSense Labeling of Tank-Type High-Efficiency Toilets*. November 15, 2006. www.epa.gov/sites/production/files/2017-02/documents/ws-background-toilets-comment-response.pdf