# WaterSense® Tank-Type High-Efficiency Toilet Specification Supporting Statement

## I. Introduction

The WaterSense Program released its performance specification for tank-type high-efficiency toilets (HETs) (Specification) on January 24, 2007, to promote and enhance the market for water-efficient toilets. The goal of this Specification is to differentiate products in the marketplace that meet this Specification's criteria for efficiency and performance and help consumers identify these water-efficient products.

This Specification addresses toilets typically found in homes, and in light commercial settings, such as hotels and restaurants. It does not address valve-type commercial toilets typically found in public restrooms (e.g., airports, theaters, arenas, schools) or composting toilets, both of which have different designs, patterns of use, and performance requirements.

## II. Current Status of Toilets

WaterSense estimates there are currently 222 million residential toilets in the United States. This estimate is based on an assumed one-to-one ratio of toilets to bathrooms.[1] In addition to the existing stock, approximately 10 million new toilets are sold each year for installation in new homes or replacement of aging fixtures in existing homes.[2] Residential toilets account for approximately 30 percent of indoor residential water use in the United States—equivalent to more than 2.1 trillion gallons of water consumed each year. [3]

The Energy Policy Act of 1992 established the maximum flush volume for all gravity tank-type, flushometer tank, and electromechanical hydraulic toilets at 1.6 gallons per flush (gpf). These requirements are codified in the *Code of Federal Regulations* at 10 *CFR* Part 430 (specifically §430.32(q) Water Closets). Federal regulations also require that all toilets sold in the United States be tested and certified in accordance with the test requirements specified in American Society of Mechanical Engineers (ASME) A112.19.2–Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals. All dual-flush toilets sold in the United States also must comply with ASME A112.19.14–Six-Liter Water Closets Equipped with a Dual Flushing Device.

In addition, there are several voluntary, non-certification toilet testing programs. These tests are frequently required by water utilities for toilets to qualify for rebates under local water conservation toilet replacement programs. Two of the most popular and widely used voluntary testing programs in North America are the Maximum Performance (MaP) Testing of Popular Toilet Models and the Los Angeles Department of Water and Power Requirements for Ultra-Low-Flush-Toilets, Supplementary Purchase Specification to ASME A112.19.2 (LADWP SPS). MaP is entirely performance based, testing a toilet's maximum ability to remove waste starting

[1] U.S. Census Bureau, American Housing Surveys for the United States, 1970-2003.
[2] Plumbing Fixtures market Overview: Water Savings Potential for Residential and Commercial Toilet and Urinals. D&R International. September 30, 2005
[3] Mayer, Peter W. and William B. DeOreo. Residential End Uses of Water. Aquacraft, Inc. Water Engineering and Management. American Water Works Association. 1998.

with a 50 gram soybean paste sample and increasing at 50 gram intervals. A minimum passing score is 250 grams. The LADWP SPS requires the use of durable, chemical-resistant flush valve seals, and restricts maximum flush volumes under maximum trim adjustment and pressure conditions.

One problem with the number of different voluntary toilet testing programs in existence was the lack of uniformity or consistent requirements. Manufacturers found it difficult and costly to develop products that met the requirements of multiple testing programs, and water authorities were unsatisfied with the limited availability of qualified products. Consumers found the patchwork of toilet specifications, requirements, and "approved toilet lists" confusing at best. To remedy this situation, in 2004, members of the plumbing industry and water utilities combined the MaP Testing and LADWP SPS standards to create the Uniform North American Requirements (UNAR) for Toilet Fixtures: Guidelines and Specifications. UNAR is a voluntary system for qualifying toilet fixtures that achieve sustainable water savings and ensure a high level of customer satisfaction with flushing performance.

In developing this Specification, WaterSense adopted the framework of the UNAR standard while making several significant changes to the water-efficiency and performance criteria. WaterSense estimates that there are currently 68 toilet models on the market that meet the requirements of this specification and would be qualified to apply for and use the WaterSense label.

## III. WaterSense Tank-Type High-Efficiency Toilet Specification

*Scope*
The WaterSense Program developed this Specification to address criteria for improvement and recognition of water-efficient and high-performance tank-type toilets. These toilets are commonly found in residential and light commercial settings and include the standard gravity type found in most homes, pressure assisted, and electrohydraulic assisted toilets. The majority of these fixtures are single flush toilets, toilets with one constant flush volume, though an increasing number of dual flush models are coming to market. Dual flush toilets have two flush volumes—a full flush for solids and a reduced flush for liquids only. WaterSense initially focused on residential toilets because they are the largest water consuming fixture in homes.

Commercial valve-type (a.k.a., flushometer valve) toilets were excluded from this specification because of their differing design, patterns of use, and performance expectations. Commercial valve-type toilets are tankless, relying on water pressure controlled by flushing valves to remove waste rather than gravity. Because of the fundamental difference in design, a different set of technical requirements is needed. Commercial valve-type toilets also have a different pattern of use than residential or light commercial tank-type toilets and will likely require different performance specifications. For example, the test media needing to be cleared by a commercial valve-type toilet may need to include a paper toilet seat cover and potentially more paper. If WaterSense decides to address this type of toilet, it will do so under a separate specification at a later time.

*Water Efficiency Criteria*
The water-efficiency component of the Specification establishes a maximum effective flush volume of 1.28 gpf for all HETs. This value represents a 20 percent reduction from the current

1.6 gpf standard and is consistent with WaterSense's stated goal of increasing product efficiency by at least 20 percent. Under this Specification, there are two ways by which an HET can meet the effective flush volume criteria:

- Single flush toilet must use 1.28 gpf or less; or
- Dual flush toilets must have a full flush no more than 1.6 gpf and a reduced flush no more than 1.1 gpf. Field studies indicate that in actual use such toilets will flush 1.28 gpf or less, on average.

*Performance Criteria*
In light of the history of poor performance and user dissatisfaction with several of the early 1.6 gpf ultra-low flush (ULF) toilets in the early 1990's, WaterSense wanted to ensure that WaterSense labeled HETs consistently perform at a high level and meet or exceed user expectations. The Flush Performance Criteria (Section 4.0) of the Specification ensures this level of performance and is based on the UNAR standard, with two key differences. First, the WaterSense specification increased the mass of the soy bean paste test media from 250 grams to 350 grams. WaterSense decided to make the Specification more rigorous in order to establish a higher level of performance for HETs and ensure customer satisfaction with these products.

Second, WaterSense also decided to switch from cased media, as used in UNAR, to an uncased media. Several manufacturers reported variability in test results when using cased media and expressed concern over the sample reliability. In addition, the primary justification for using cased media—reusability to save time and reduce costs—while important requirements in a research and development mode when many repeated tests are performed, were not as critical in regards to this HET specification, as a maximum of only five tests are required. The uncased media provides a more realistic sample and has a more established testing track record. For these reasons, WaterSense adopted the use of uncased media.

*Potential Water Savings*
The 222 million residential toilets in use today are a mix of the current standard 1.6 gpf fixtures and older, pre-1992 models. Water consumption in these older models range from 3.5 gpf to more than 5.0 gpf, depending on age and model. Table 1 provides a breakdown of the mix of the existing toilet stock.

To estimate the potential water savings impact of HETs, WaterSense assumed that the average person flushes 5.1 times per day at home.[4] With an estimated population of 296 million people in the United States and 222 million residential toilets in use, this equates to 6.8 flushes/toilet/day (see Calculation 1). Assuming that 10 percent of the existing 222 million toilets in the United States could reasonably be expected to be replaced with WaterSense labeled HETs, the total daily savings potential is approximately 246 million gallons per day (see Table 1 and Calculation 2). This equates to more than 89.7 billion gallons each year (see Calculation 3).

*Calculation 1.Average Daily Flushes per Toilet*

[4] Peter W. Mayer and William B, DeOreo. *Residential End Uses of Water*. Aquacraft, Inc. Water Engineering and Management. American Water Works Association. 1998. p. 94.

(5.1 flushes/person/day)(2.96 x $10^8$ people) / (2.22 x $10^8$ toilets) = 6.8 flushes/toilet/day

**Table 1. Number of Toilets by Flush Volume and Potential Savings[5]**

| GPF | # of toilets (millions) | # of toilets replaced given 10% replacement of existing fixtures (millions) | Savings per flush by switching to 1.28 HET (gpf) |
|---|---|---|---|
| 5.0 | 67 | 6.7 | 3.72 |
| 3.5 | 33 | 3.3 | 2.22 |
| 1.6 | 122 | 12.2 | 0.32 |
| Total | 222 | 22.2 | — |

*Calculation 2.Total Daily Savings*
*(If 10% of all existing toilets replaced with 1.28 gpf HET)*

5.0 gpf: (6.7 x $10^6$ toilets) (3.72 gpf) (6.8 flushes/toilet/day) = 169,483,200 gallons/day

3.5 gpf: (3.3 x $10^6$ toilets) (2.22 gpf) (6.8 flushes/toilet/day) = 49,816,800 gallons/day

1.6 gpf: (12.2 x $10^6$ toilets) (0.32 gpf) (6.8 flushes/toilet/day) = 26,547,200 gallons/day

Total Daily Savings 245,847,200 gallons/day

*Calculation 3.Total Annual Savings*

(245,847,200 gallons/day) (365 days/year) = 89,734,228,000 gallons/year
89.7 billion gallons/year

[5] Plumbing Fixtures market Overview: Water Savings Potential for Residential and Commercial Toilet and Urinals. D&R International. September 30, 2005