

Independent 6 L Toilet Testing Program

BACKGROUND

In 1996, the Ontario Building Code introduced a mandatory requirement to install water-efficient, 6 L (1.3 U.K. gal.) toilets in all new construction.¹ The Code does not require this when replacing existing toilets. However, many municipalities provide incentives for homeowners to install 6 L rather than 13 L (2.8 U.K. gal.) toilets, in an effort to reduce water consumption, to defer capital expansions and to be environmentally responsible.

Each 6 L toilet model available in Ontario is expected to meet the Canadian Standards Association (CSA) requirements for certification. Although actual test scores are confidential, each model must achieve a minimum score of 9 out of 15 points to be certified. The testing protocol includes measuring a toilet's flush volume and evaluating its performance. Toilets must flush with an average volume of no more than 6 L based on five flushes at each of 20, 50 and 80 psi (137,895, 344,737 and 551,580 Pa). They are also evaluated on water-change capability, flushing surface and three different carry-out capability tests.

Certified toilets should flush satisfactorily (clear and clean the bowl in a satisfactory manner) with approximately six litres of water or less per flush. However, independent field tests have identified a number of models that flush with considerably more than six litres of water, and others that have an inferior flush performance. Field testing is designed to simulate what a homeowner would experience with a toilet purchased off the shelf.

While many 6 L toilets tested in the field do, in fact, flush at six litres and perform quite well, the poor performance of some appears to be detracting from all 6 L models.

PROGRAM GOAL

In the interest of assessing the actual performance of certified 6 L toilets, six partners—the Canadian Water and Wastewater Association, Canada Mortgage and Housing Corporation, the Region of Durham, the Region of Halton, the Region of Waterloo and the City of Toronto—initiated an independent toilet testing program. Municipalities and homeowners need to be assured that the 6 L toilets they are subsidizing or purchasing are saving water and performing well.

¹ Certain types of buildings are exempt from this requirement, for example, hospitals, jails, historic sites, airports, etc.

METHODOLOGY

Although the independent toilet testing program, performed by Veritec Consulting Inc., was similar in some aspects to CSA's testing, it was not intended to duplicate it. First, toilets tested by CSA have been supplied by the manufacturers, while toilets tested as part of this program were purchased from suppliers and retail outlets. Second, the method used for determining flush volumes was virtually the same, but the materials differed.

CSA uses sponges, crumpled paper balls, paper sheets, sawdust, polyethylene granules and blue dye to measure flush performance. The independent test used blue dye (food colouring) to test liquid carry-out, a powdered drink mix to test washdown and an o-shaped breakfast cereal as a floating media to test solid carry-out. Together, these materials were considered to provide a good measure of flush performance.

The tests for both the CSA and this independent study compare the ability of different toilet models to clear the same test materials under the same conditions. It is important to note that none of the testing materials used either by the CSA or in the independent test accurately simulate a toilet's ability to clear human waste.

The program involved testing a total of 31 different models, using one toilet per model in most cases. As such a small sample is not statistically valid, the test results are only an indication of expected actual use results. They are not a guarantee of performance.

The selection was not intended to represent all of the various makes and models available, nor was the test intended to provide a comprehensive list of toilets that might be expected to perform well or poorly in the field. Still, the selection represented a broad range of designs, styles and price ranges available in the Ontario market.

The following ratings were used to evaluate performance:

- *Flush volume*—Flush volumes of 6 L or less were rated as “Very Good”; flush volumes between 6 and 6.5 L were rated as “Good”; flush volumes between 6.5 and 7 L were rated as “Fair”; and flush volumes greater than 7 L are rated as “Poor.” These scoring criteria were selected arbitrarily.
- *Dye*—This was largely a subjective test. A rating of “Good” was given if virtually no blue dye was visible in the bowl after flushing; a rating of “Fair” was given if a small amount of dye was visible; and if a significant amount of dye was visible, a rating of “Poor” was given.
- *Washdown*—A rating of “Good” was given if virtually no powder was visible on the bowl after flushing; a small amount of visible powder after flushing earned a “Fair” rating; and if a significant amount of powder was visible, a rating of “Poor” was given.
- *Floating media*—Toilets that routinely removed 100 per cent of the floating media were rated “Very Good”, while those that left an average of between one to five pieces were rated “Good”; ones leaving six to 10 units were “Fair”; and those that left more than 10 were rated as “Poor”. Approximately 100 cereal pieces were used in each test, and some toilets left as much as 50 per cent in the bowl.
- *Standard flapper*—Toilets that flushed with less than 8 L when the proprietary flapper was replaced with a standard flapper were rated as “Good”; those that flushed with between 8.1 and 10 L were rated as “Fair”; and those that flushed with more than 10 L were rated as “Poor.”

RESULTS

Table 1 summarizes the results of the flush volume and performance testing for the 31 models.

Table 1 Summary of testing results

Make/Model	Flapper Type	Chain Type	Flush Volume	Dye Test	Washdown Test	Floating Media	Standard Flapper
A.S. Cadet	adjustable float	bead	○	○	★	○	●
A.S. Hamilton	standard	bead	★★	○	★	★★	★
A.S. Marina	adjustable float	bead	●	★	★	○	●
A.S. Plebe	adjustable float	bead	●	★	★	○	●
A.S. Revue	adjustable float	bead	★	★	★	○	○
Briggs Abingdon III	standard	rubber	○	★	○	★	★
Briggs Altima III	standard	rubber	★	★	★	★★	★
Briggs Vacuity	adjustable float	bead	★	★	○	●	★
Caroma Caravelle	proprietary	-	★★	○	★	●	-
Ceralux Mancesa	air-bleed	rubber link	★★	★	★	★	★
Crane Cranada	air-bleed	rubber	★★	●	★	●	●
Eljer Patriot	air-bleed	link	★★	★	★	●	○
Gerber Aqua Saver	air-bleed	rubber	●	○	★	★	●
Gerber Pressure Assist	-	-	★★	★	○	★	-
Kohler Rialto	proprietary	link	★★	★	★	●	-
Kohler Santa Rosa	Buoyant Bulb	link	★	★	★	○	-
Kohler Wellworth	standard	bead	★★	★	★	★	★
Mansfield Alto	Plunger	-	★★	○	★	★	-
Niagara Flapperless	-	-	★	★	★	★★	-
Orion Jupiter	adjustable float	rubber link	★★	●	★	●	●
Orion Novara	adjustable float	link	★★	★	★	★★	●
TOTO 703	air-bleed	link	★★	★	★	★	○
TOTO Drake	proprietary	link	★★	★	○	★	-
TOTO Ultimate	proprietary	link	●	★	○	★	-
TOTO Ultramax	proprietary	link	★★	★	○	★	-
Vitra Atlantis	air-bleed	link	★★	★	★	★	-
Vitra Ecosaver	air-bleed	rubber	○	★	○	★	●
Vitra Wellington	air-bleed	rubber	★	★	○	★	●
Vortens L.C. Vienna 2	air-bleed	link	★★	★	★	●	●
Vortens Lamosa Sahara (GTA)	air-bleed	link	★	★	★	★	●
Western Pottery, Aris	air-bleed	link	●	★	★	★	●

Key: Very Good ★★ Good ★ Fair ○ Poor ●

Notes

- Two samples of the Ceralux Mansesa were received for testing (the second unit was shipped to the testing lab in error). When the first unit was installed on the test rig, it leaked so badly it could not be tested. The results in Table 1 refer to the second unit tested.
- Three other models were installed on the test rig but are not included in Table 1:
 - A sample Foremost toilet could not be tested as the flapper was binding against the side of the insulated tank and could not be made to close.
 - A sample Komet Deco flushed at 14 L when adjusted to the waterline. The unit could not be adjusted to flush with less than 8 L.
 - A sample Style Line SA26720WH could not be tested as the flapper leaked too much.

OBSERVATIONS

1. There was a significant difference in the performance and flush volumes of different toilets.
2. Approximately 50 per cent of the toilets tested flushed with more than 6 L.
3. Toilets with larger tanks tended to flush with between 10 to 16 L when the proprietary flapper was replaced with a standard flapper.² This is a significant problem because many proprietary flappers are not commonly found in retail stores.
4. Toilets with smaller tanks tended to flush with less than 10 L when a standard flapper was used.
5. Toilets with standard flappers tended to flush with the same volume, even when the proprietary flapper was replaced.



Figure 1 Rubber flapper chain and metallic bead flapper chain



Figure 2 Three basic types of flappers
 From left to right: air-bleed (shown with link chain), standard (shown with bead chain) and adjustable float (shown with bead chain)

6. Because white or clear rubber chains can transmit forces to the flapper, causing it to close prematurely or to stay open longer than required, their use can lead to highly variable flush volumes. Link chains can also twist or get “hung up” Metal bead chains appeared to perform best during testing. See figures 1 and 2.
7. The flush volume of toilets equipped with adjustable float flappers can be adjusted relatively easily by homeowners or installers, by moving the position of the float on the flapper chain.
8. Toilets equipped with adjustable float flappers or standard flappers are more susceptible to flush volume changes due to changes in the tank water level (because the minimum volume of water remaining in the tank during a flush stays constant, raising the top water level in the tank will increase the flush volume).
9. Adjustable float flappers may be set incorrectly at the factory or by the installer, thereby increasing or decreasing the designed flush volume and reducing either “water savings or flush performance.
10. Toilets equipped with air-bleed flappers are less susceptible to flush volume changes due to changes in the tank water level (because flappers tend to close after a distinct period of time determined by the rate at which air leaves the flapper bulb).
11. The flush volume of toilets equipped with air-bleed flappers cannot be significantly adjusted by the homeowner or installer unless the proprietary baffle is replaced³ or removed.
12. Baffles can easily be substituted with improper ones at the factory or by an installer, thereby increasing or decreasing design flush volume and reducing either water savings or flush performance.
13. Typical float-style fill valves (ballcocks), generally were more affected by changes in supply water pressures than needle-style valves.
14. Trap size did not appear to significantly affect flush performance or volume.

2 Toilet flappers deteriorate over time (most are warranted for five years). If a proprietary flapper is replaced with a commonly available (and less expensive) standard flapper, the toilet may flush with considerably more water.
 3 This does not include changing the water level in the tank, holding the handle down, etc.

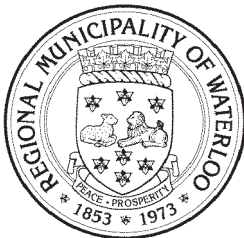
15. Refill tubes that are inserted into the overflow tube and extend below the tank water level may cause siphoning of the tank water down the overflow tube into the bowl (and eventually into the sewer). This problem can be prevented by ensuring the refill tube is not inserted too far into the overflow tube—for example, by attaching the refill tube with a clip.
16. Increasing the supply water pressure tended to decrease the flush volume of toilets fitted with air-bleed flappers, while increasing the flush volume of toilets fitted with buoyant flappers.⁴

CONCLUSION

The independent test indicates there are significant variations in the flush volumes and performance of 6 L toilets. Some of the models tested performed very well and exceeded expectations, while others, unfortunately, did not.

The results of this testing were forwarded to the CSA B45 Committee on plumbing fixtures. The committee intends to conduct its own investigation to ascertain why some of the models tested in this program failed to meet CSA's certification criteria. CSA has formed a task force to investigate some of the results of the independent toilet testing program, and changes to the CSA B45 Series-99 Plumbing Fixtures Standard may be forthcoming based on their recommendations.

⁴ The CSA currently conducts all of its performance testing using a pressure of 20 psi. Such low pressure actually helps the performance of air-bleed flappers, which flush with more water at lower pressures.



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