

Summary Report

6 Litre Toilet Testing Program

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Sponsored By:



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Independent 6 Litre Toilet Testing Program

Background

In 1996 the Ontario Building Code introduced the mandatory installation of water efficient 6-litre (6L) toilets in all new construction¹. The Code does not require the installation of 6L units when replacing existing toilets, however, many municipalities provide incentives towards the installation of 6L toilets over 13L toilets in an effort to reduce water consumption, defer capital expansions, and to be environmentally responsible.

Each model of 6L toilet available in Ontario is expected to pass certain testing requirements for certification, i.e., it is expected to meet the Canadian Standards Association (CSA) requirements. Currently, the test scores are confidential, however, each model must achieve a minimum score of 9 out of 15 points to be certified. The testing protocol includes measuring the toilet's flush volume and evaluating the toilet's performance. Toilets must flush with an average volume of no more than six litres based on five flushes at each of 20, 50, and 80 psi, and each toilet is evaluated based on water-change capability, flushing surface, and three different carry-out capability tests.

In spite of the certification process, however, independent field tests have identified a number of toilet models that flush with considerably more than six litres of water, and others that have an inferior flush performance.

It is believed that *all certified toilets* should flush satisfactorily (i.e., clear and clean the bowl in a satisfactory manner) and use approximately six litres or less per flush. Field-testing results have indicated that certification does not guarantee that a toilet will perform to these standards. Field-testing is designed to simulate what a homeowner would experience from purchasing a toilet "off the shelf". It also seems that the poor performance of some models of 6L toilets are casting all 6L toilets in a bad light – a clear case of having 'a few bad apples spoiling the whole bunch'. Many 6L toilets tested in the field do, in fact, flush at six litres and perform quite well.

Program Goal

In the interest of assessing how certified 6L toilets function 'in the field', the Canadian Water and Wastewater Association, The 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 6L toilets they are subsidizing or purchasing are saving water and performing well.

¹ Certain types of buildings were exempt from this requirement, e.g., hospitals, jails, historic sites, airports, etc

Scope of Independent Toilet Testing

It is important to note that this independent toilet testing program (as performed by Veritec Consulting Inc.) was **not intended to duplicate CSA testing**.

The method of determining toilet *flush volumes* is virtually the same for both the CSA and the independent testing program. The independent *performance testing* procedures, however, vary from those of the CSA. The CSA performance testing uses sponges, crumpled paper balls, paper sheets, sawdust, polyethylene granules, and blue dye to measure flush performance. The independent performance testing uses blue dye (food colouring) to test liquid carry out, Kool-Aid powder to test wash down, and toasted oat O's breakfast cereal as a floating media to test solid carry out. Together, these materials seem to provide a good measure of flush performance.

Both the CSA and independent performance testing protocols are *comparison* tests, i.e., they 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 by either the CSA or the independent testing accurately simulate the toilet's ability to clear human waste.

In most cases a single toilet of each selected make and model was tested – a total of thirty-one different toilet models were tested.

Notes and Considerations

It should be noted that the testing of only one specimen of each toilet does not provide a statistically valid sample size. The results shown in this report should be viewed only as an indication of expected 'field' results.

The selection of toilets tested as part of this program is in no way intended to represent all of the various makes and models available, nor is it intended to provide a comprehensive list of all toilets that might be expected to perform either well or poorly in the field. Toilets selected however, represent a broad range of designs, styles and price ranges available in the Ontario market.

The results obtained during this testing program are not a guarantee of performance.

The following section outlines observations made during the testing program, and ***Table 1*** summarizes the results of the flush volume and performance testing based on the criteria identified in ***Flush Volume/Performance Results*** section.

Observations

1. There is a significant difference in the performance and flush volumes of different toilets.
2. Approximately 50% of the toilets tested flushed with greater than 6.0 litres.
3. Toilets with larger tanks tend to flush with between 10-16 litres if the proprietary flapper is replaced with a standard flapper². This is a significant problem because many proprietary flappers aren't commonly found in retail stores.
4. Toilets with smaller tanks tend to flush with less than 10 litres when standard flapper is used.
5. Toilets with standard flappers tend to flush with the same volume even if the proprietary flapper is replaced.
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 get twisted or 'hung up'. Metal bead chains appeared to perform best during testing. See Figure 1 and Figure 2.
7. The flush volume of toilets equipped with adjustable float flappers can be relatively easily adjusted by home-owners or installers by moving position of float on 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 (i.e., 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 up' incorrectly at factory or by the installer, thereby increasing or decreasing the designed flush volume and either reducing water savings or reducing the 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 home-owner or installer unless the proprietary baffle is replaced³ or removed.
12. Improper baffles can be easily substituted by factory or installer thereby increasing or decreasing design flush volume and reducing either water savings or flush performance.
13. Typical 'float-style' fill valves (ballcocks), e.g., Coast Foundry, were generally more affected by changes in supply water pressures than 'needle-valve-style', e.g., Fluidmaster.
14. Trap size did not appear to significantly affect flush performance or flush volume.
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 to sewer). This problem can be corrected by preventing the refill tube from being inserted too far into the overflow tube (e.g., by attaching the refill tube to the overflow tube via a 'clip').
16. Increasing the supply water pressure tends to decrease the flush volume of toilets fitted with air-bleed flappers, while increasing the flush volume of toilets fitted with buoyant flappers⁴.

² Toilet flappers deteriorate over time (most are warranted for five years). If proprietary flappers are replaced with commonly available (and less expensive) standard flappers the toilet may flush with considerably more water.

³ Statement does not include changing the water level in the tank, holding the handle down, etc.

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

Flush Volume / Performance Results

Table 1 on the following page summarizes the results of the flush volume/performance testing. The following classification system has been used:

Flush Volume: Flush volumes of 6.0 litres or less were classified as Very Good, flush volumes between 6.0 and 6.5 litres were classified as Good; flush volumes between 6.5 and 7.0 litres were rated as Fair, and flush volumes greater than 7.0 litres are classified as Poor. Note that these scoring criteria have been selected arbitrarily.

Dye: Largely a subjective test; a rating of Good was given if virtually no blue dye was visible in bowl after flush, a rating of Fair was given if a small amount of dye was visible after the flush, a rating of Poor was given if a significant amount of dye was visible after the flush.

Washdown: A rating of Good was given if virtually no powder was visible on bowl after flush, a rating of Fair was given if a small amount of powder was visible after the flush, a rating of Poor was given if a significant amount of powder was visible after the flush.

Floating Media: Toilets that routinely removed 100% of the floating media received two black stars (i.e., Very Good), while toilets that left an average of between 1-5 media were rated as Good, toilets that left 6-10 units were rated as Fair, and toilets that left greater than 10 were rated as Poor (note: approximately 100 toasted O's were used in each test and some toilets left as much as 50% in the bowl).

Standard Flapper: Toilets that flush with less than 8.0 litres when the proprietary flapper was replaced with a standard flapper were rated as Good, those that flushed with between 8.1 – 10.0 litres were rated as Fair, and those that flushed with greater than 10.0 litres were rated as Poor.

Figure 1 - Rubber Flapper Chain & Metallic Bead Flapper Chain



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 Potteries, Aris	air-bleed	link	●	★	★	★	●

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

Notes

- Two samples of the Ceralux Mansesa were tested (the second unit was shipped to the testing lab in error). When the first unit was installed on the test rig it was leaking so badly that it could not be tested. The results in **Table 1** refer to the second unit tested.
- Three other models that were purchased and 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 litres when adjusted to the waterline. The unit could not be adjusted to flush with less than 8 litres.
 - A sample Style Line SA26720WH could not be tested as the flapper was leaking too much.

Conclusion

As can be seen in ***Table 1***, there are significant variations in the flush volumes and performance of the toilets tested as part of this independent testing program. Some of the toilet models performed very well and exceeded expectations, while others, unfortunately, did not. It should be noted that toilets currently tested by the CSA are supplied by the manufacturers, while toilets tested as part of this program were purchased from suppliers and retail outlets.

The results of this testing have been forwarded to the CSA B45 Committee on plumbing fixtures, and they have responded that they intend to conduct their own investigations to ascertain why some of the toilet models tested in this program failed to meet their certification criteria. The CSA has formed a Task Force to investigate some of the results stated in this report. Changes to the CSA B45 Series-99 Plumbing Fixtures Standard may be made based on the recommendations put forth by the Task Force.