WATER CLOSETS:  
FLUSHING VOLUME LESS THAN 6 LITRES

Key words: Water closets, flushing, test method

1 SCOPE

This NORDTEST method specifies test methods for WC pans with integral trap, for domestic use, made from vitreous china or stainless steel, which have a nominal flush volume of less than 6 litres.

The tests described here include depth of water seal, flushing tests with toilet paper, plastic balls, sponges and changing of the water in the water trap, sawdust test and over-splashing test.

2 FIELD OF APPLICATION

The test methods can be used by the manufacturers as a tool for developing new products, and as a basis for official approval in the NORDTEST member countries.

The intention is that this method will not prevent the process of product development, and only concerns functional testing of water closets.

3 REFERENCES

VA2.5/DK009:
Foreløbige godkendelser – og prøvningsbestemmelser for vandklosetter med vandlås.

NT VVS 001:
Water closets: Property of flushing.

AS 1172.1-1993:
Water closets of 6/3L capacity.

DS 432:
Norm for afløbsinstallasjoner.

BRL-K621/03:
Close coupled suits.

EN 997:
WC pans with integral trap.

EN 12056-2:
Gravity drainage systems inside building, sanitary pipeworks, layout and calculation.

4 DEFINITIONS

Cold Water: Water with a temperature <20 °C

Absorbing capacity: For toilet paper, it is the absorbing time measured in seconds, according to the Basket method.

Main flush: If the water closet has two flush volumes both below 6 litres, this is the higher flush volume. Alternatively, it refers to the flush volume of a water closet with one flushing volume.

Reduced flush: The lowest flush volume, if there are two below 6 litres, meant for flushing of urine.

Nominal flush: Flushing volume according to manufacturer's information.

5 SAMPLING

The tests in this NORDTEST standard are carried out on three samples, chosen at random from the normal production line.

6 METHOD OF TEST

The following tests are carried out on water closets with one flushing volume or the main flushing volume, if there are two and both are less than 6 litres:

6.4.1 Marking
6.4.2 Load test
6.4.3 Total volume of flushing water
6.4.4 Rinsing capacity
6.4.5.A Flushing of toilet paper
6.4.6.A Flushing of fifty small plastic balls
6.4.6.B Flushing of forty small plastic balls
6.4.7 Flushing of sponges
6.4.8 Check on splashing
6.4.9 Exchange of the water content of the trap for the reduced flushing volume, of two.
6.4.10 Check on water seal level.
If the water closet has two flushing volumes, the following tests are carried out on the reduced flushing volume, meant for flushing of urine:

6.4.3 Total volume of flushing water
6.4.4 Rinsing capacity
6.4.5A Flushing of toilet paper
6.4.8 Check on splashing
6.4.9 Exchange of the water content of the trap for the reduced flushing volume, of two
6.4.10 Check on water seal level.

6.1 Principle
Most of the water closets are close-coupled suites, or one piece WC pans where the bowl and flushing arrangement are integrated. Others have a separate bowl and flushing arrangement. Integral bowls and flushing arrangement are always tested as a unit. Separate bowls are tested with a cistern, delivered or recommended by the producer of the bowl.

WC pans designed for floor mounting are placed on a plane horizontal surface. WC pans designed for mounting on walls are suspended on a plane vertical wall or a frame for that purpose, so that the seat of the pan is level.

All water closets are tested with outflow from the delivery spout, directly into an open vessel. See Figure 1.

The test samples are adjusted to function according to the recommendations of the manufacturer.

6.4 Procedure
The following is a description of the procedures for each of the tests.

6.4.1 Marking
Water closets must be provided with the manufacturer’s name or identity symbol, which is in a clearly visible place when the closet is mounted in the installation.

6.4.2 Load test
Wall hung closets are mounted in a stable arrangement by means of the fastening devices recommended or supplied by the manufacturer.

A wooden beam, ≈ 100 x 100 mm, is placed over the middle of the bowl parallel to the wall. A force of 4 ± 0,05 kN is applied on the wooden beam, positioned across the centre of the opening of the top surface of the WC pan, for a period of 1 h. See Figure 2.

6.4.3 Total volume of flushing water
The cistern shall be adjusted according to the manufacturer’s instructions, and it is filled up. The water pressure in the cistern feed pipe is 200 kPa. The flushing mechanism is operated, and the total volume of flushing water is measured. The total volume of flushing water is the volume measured from the beginning of one flushing operation, until another one can be started. The volume of flushing water shall be calculated as the average of 5 tests, with a tolerance of ±0,2 litres for the main flush, and ±0,3 litres for the reduced flush.

6.4.4 Rinsing capacity
The inner surface of the bowl, from water level to the flushing rim, is moistened and coated as completely and evenly as possible, with fine dry sawdust.

The sawdust over the trap should be flushed out in at least 4 of 5 repeated tests.

This test checks that all the inner parts of the surface have been in contact with water.
6.4.5A Flushing of toilet paper
Toilet paper with a saturation time of $15 \pm 10$ s, verified by the Basket method. See Appendix.
Individual sheets shall have a size of $\sim 140 \times 100$ mm. The mass per unit area of the toilet paper shall be $30 \pm 10$ g/m$^2$.
12 single sheets of toilet paper are loosely crumbled by one hand, and dropped separately one after the other into the WC pan, within a time span of 18 s. The sheets are dropped from the same height as the seat of the WC pan, and dropped so that they hit the middle of the water seal surface.
The flushing mechanism is operated within 3 s of the last sheet being dropped into the WC pan.
This test is repeated 5 times, and all 12 sheets should be flushed out in at least 4 of the 5 tests.

6.4.5B Flushing of toilet paper
Toilet paper with a saturation time of $15 \pm 10$ s, verified by the Basket method. See Appendix.
Individual sheets shall have a size of $\sim 140 \times 100$ mm. The mass per unit area of the toilet paper shall be $30 \pm 10$ g/m$^2$.
4 single sheets of toilet paper are loosely crumbled by one hand, and dropped separately one after the other into the WC pan, within a time span of 15 s. The sheets are dropped from the same height as the seat of the WC pan, and dropped so that they hit the middle of the water seal surface.
The flushing mechanism is operated within 3 s of the last sheet being dropped into the WC pan.
This test is repeated 5 times, and all 4 sheets should be flushed out in at least 4 of the 5 tests.

6.4.6A Flushing of fifty small plastic balls
50 balls of non-absorbent material, each having a mass of $3.7 \pm 0.1$ g (density 883 kg/m$^3$), and a diameter of $20 \pm 0.1$ mm, are dropped into the WC pan, and the flushing mechanism is operated. The test is repeated 5 times, and a minimum of 42 balls should be flushed out each time.

6.4.6B Flushing of forty small plastic balls
40 balls of non-absorbent material, – 30 having a mass of $2.6 \pm 0.1$ g (density 850 kg/m$^3$) and 10 having a mass of $3.2 \pm 0.2$ g, (density 1050 kg/m$^3$), both with a diameter of $18 \pm 0.1$ mm, are dropped into the WC pan, and the flushing mechanism is operated. The test is repeated 5 times, and a minimum of 21 of the balls with a mass of 2.6 should be flushed out each time.

6.4.7 Flushing of sponges
4 natural sponges are used, with holes not larger than 8 mm. The length of these cylindrical test objects shall be $\sim 100$ mm, with a diameter of $\sim 30$ mm. The test objects shall be made from soaked sponges, and they should be squeezed under water, to ensure that they have no remaining pockets of air inside. The soaked test objects are placed in the bowl by dropping one at a time from a level corresponding to the closet seat, and dropped with the purpose of hitting the middle of the water seal surface.
This test is repeated 5 times, and all 4 sponges should be flushed out in at least 4 of the 5 tests.

6.4.8 Check on splashing
In a sheet of cardboard, which clearly shows surface changes when wet, a hole equal to the internal shape of the flushing rim shall be cut. The cardboard sheet is to be placed on the WC pan to cover the flushing rim. The sheet must extend at least 200 mm outside the rim. The WC pan is flushed, and the cardboard is examined for splash marks. See Figure 3. Not more than eight small drops of water beyond the rim of the bowl can be accepted. This test is repeated three times.

6.4.9 Exchange of the water content of the trap for the reduced flushing volume, of two.
Dissolve salt in water to make a solution containing 1% by weight of NaCl. It is recommended that the total volume of solution needed should be made all in one go. This solution is well mixed, and the concentration is analysed by using an Autotitrator or other analysis method with an accuracy of $\pm 1\%$.
This concentration will be regarded as the reference concentration.
Starting with a dry, empty bowl, i.e. no water in the water seal, enough of the water/NaCl solution is poured into the bowl to fill the seal. The flushing mechanism is then operated so that the reduced flushing volume intended for urine is supplied to the bowl. Stir the solution in the bowl with a clean rod, to ensure an even concentration, and then take a sample for analysis. This test is repeated 3 times, and the arithmetic average concentration of the 3 samples should be equal to or less than 10% of the reference concentration in the original solution.
6.4.10 Check on water seal level
The depths of the water seal shall be checked after each flushing according to 6.4.3. The mean depth, measured as an average of 5 tests, must be at least 50 mm.

6.5 Expression of results
All results must be presented in the following units, such that test results from different laboratories are directly comparable.

Flow rate: litres per second = l/s
Pressure: kilo pascal = kPa, 100 kPa = 1 bar
Temperature: degrees Celsius = °C
Force: kilo Newton = kN

6.6 Accuracy
The pressure shall be measured with an accuracy of ±3%.
The water flow volume shall be measured with an accuracy of ±3%.
The temperature shall be measured with an accuracy of ±2 °C.
The concentration of NaCl in water shall be measured with an accuracy of ±1%.

6.7 Test report
The test report shall include the following information, if relevant:
a) Name and address of the testing laboratory.
b) Identification number of the test report.
c) Name and address of the organisation or the person who ordered the test.
d) Purpose of the test.
e) Method of sampling and other circumstances. (Date and person responsible for the sampling.)
f) Name and address of manufacturer or supplier of the tested object.
g) Name or other identification marks of the tested object.
h) Description of the tested object.
i) Date of supply of the tested object.
j) Date of the test.
k) Test method.
l) Conditioning of the test specimens, environmental data during the test. (Temperature, pressure, RH, etc.)
m) Identification of the test equipment and instruments used.
n) Any deviation from the test method.
o) Test results (use SI units, see Section 6.5).
p) Inaccuracy or uncertainty of the test results.
q) Date and signature.
APPENDIX

Stack a number of sheets of paper and cut to a size of 75 x 250 mm. Take a sufficient number of these sheets to get a collective weight of approx. 5 g; roll it up (in the transverse direction) and put into the basket, as shown in Figure 5.

Place the inverted basket containing the paper into a cylindrical glass vessel in accordance with Figure 6, containing water that does not deviate more than ±3 °C from the temperature of the water used for flushing.

Measure the time in seconds from placing the basket into the water, until it is completely immersed. Repeat the test 3 times, and record the arithmetical average time taken.

The test shall be carried out under the same conditions of relative humidity and temperature of air, as for the flushing test.