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**Minimum allowable values of water efficiency and water
efficiency grades for water closets**

坐便器水效限定值及水效等级

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Minimum allowable values of water efficiency and water efficiency grades for water closets

1 Scope

This document specifies the water efficiency grades, technical requirements, test methods and test equipment for water closets.

This document applies to water closets installed on cold water pipes in building facilities, which use water as the main flushing medium, have water sealing function and do not have warm water cleaning function.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 6952, Sanitary wares

GB/T 8170, Rules of rounding off for numerical values & expression and judgment of limiting values

GB/T 9195, Terms and classification of building and sanitary ceramics

GB/T 20810, Toilet tissue paper (including toilet tissue base paper)

GB 28379, Minimum allowable values of water efficiency and water efficiency grades for flush valves of plumbing fixtures

3 Terms and definitions

For the purpose of this document, terms and definitions given in GB/T 6952, GB/T 9195, GB 28379, as well as the following apply.

3.1

minimum allowable values of water efficiency for water closet

The maximum flushing water consumption allowed under specified test conditions for a water closet that complies with the explicit product standards.

The average total length of the accumulated residual ink line after each flushing shall not exceed 50 mm, and the length of each residual ink line shall not exceed 13 mm.

5.3.2 Water seal recovery function

The water seal recovery shall not be less than 50 mm. For a siphonic water closet, there shall be siphon every time.

5.3.3 Sewage replacement function

For a single-flush water closet, the dilution rate shall not be less than 100; for a dual-flush water closet, only a half-flush sewage replacement test is performed, and the dilution rate shall not be less than 25.

5.3.4 Discharge function

5.3.4.1 Ball discharge function

Carry out the test three times in succession, and the average number of balls flushed out of the water closet sewage outlet shall be no less than 90.

5.3.4.2 Particle discharge function

Carry out the test three times in succession, and the average number of visible polyethylene (HDPE) particles remaining in the water closet trap shall not be greater than 125, and the average number of visible nylon balls shall not be greater than 5.

5.3.4.3 Mixed media discharge function

The number of mixed media flushed out of the water closet the first time shall be no less than 22 (The number of mixed media flushed out of the infant-type water closet the first time shall be no less than 11). Residual media, if any, shall be all flushed out the second time.

5.3.5 Toilet tissue paper discharge

Dual-flush water closets shall be subjected to the half-flush toilet tissue paper discharge test three times, and there shall be no visible tissue paper in the toilet bowl each time.

5.3.6 Drainage pipeline transmission characteristics

The average transmission distance of balls shall not be less than 12 m.

5.4 Trap seal

The trap seal of water closets shall not be less than 50 mm.

5.5 Water seal surface dimensions

- c) Keep the water supply system pipeline open and start the flushing device in the normal way (press it to the bottom within 1 second and release it immediately). If the manufacturer has clearly stated the time to start the flushing device, start the flushing device at the specified time, and record the flushing water consumption (including overflow water) of one flushing cycle. For water closets whose water seal cannot be recovered to the full trap seal during the test, the water in the water seal shall not be replenished. Record the test pressure and flushing water consumption for each flush.

Note: For a dual-flush water closet, measure the full-flush water consumption three times continuously under each test pressure specified in Table 2; then, measure the half-flush water consumption three times continuously; record the test pressure and flushing water consumption for each flush.

6.1.3 Result calculation

6.1.3.1 Single-flush water closet

Calculate the average flushing water consumption of the single-flush water closet according to Formula (1), and round off the result according to the requirements of GB/T 8170 (retain one decimal place):

$$V_{\text{single}} = \frac{\sum_{i=1}^n \sum_{j=1}^3 V_{ij}}{3n} \dots\dots\dots (1)$$

Where

V_{single} – average flushing water consumption of a single-flush water closet, in liters (L);

n – number of water closet flushing water consumption test pressures [for water tank (gravity) water closet, $n=3$; for pressure water closet, $n=2$];

V_{ij} – flushing water consumption of single-flush water closet in the j^{th} test under the specified i^{th} test pressure, in liters (L).

6.1.3.2 Dual-flush water closet

Calculate the average flushing water consumption of the dual-flush water closet according to Formula (2) ~ Formula (4), and round off the result according to the requirements of GB/T 8170 (retain one decimal place):

single-segment length of the full-flush and semi-flush tests respectively, with an accuracy of 1 mm.

6.2.3 Water seal recovery test

For a single-flush water closet, conduct a full-flush test. If overflow occurs at the sewage outlet after one flush cycle is completed, the water seal recovery value is the same as the trap seal value. Record the result and the test is over. If no overflow occurs at the sewage outlet, measure the trap seal; then complete six flush cycles in succession; measure and record the trap seal recovered after each flush; report the minimum value of the trap seal recovery during the above test.

For a dual-flush water closet, conduct a semi-flush test first. If overflow occurs at the sewage outlet after one flush cycle is completed, the water seal recovery value is the same as the trap seal value. Record the result and the test is over. If no overflow occurs at the sewage outlet, measure the trap seal; then complete 6 flush cycles in sequence of one full flush and two semi flushes; measure and record the trap seal recovered after each flush; report the minimum value of the trap seal recovery during the above test.

For siphonic water closets, observe whether siphoning occurs each time water is flushed during the test. If siphoning does not occur even once, record the result and the test is over.

6.2.4 Sewage replacement test

Use tap water at about 80 °C to prepare a methylene blue solution with a mass concentration of 5 g/L.

Flush the water closet under test conditions. After the normal water inlet cycle is completed, pour 30 mL of methylene blue solution into the water seal of the water closet and stir evenly; take 5 mL of the solution from the water seal into a container. For a dual-flush water closet, add water to dilute to 125 mL (the standard dilution rate is 25). For a single-flush water closet, add water to dilute to 500 mL (the standard dilution rate is 100). After mixing, transfer to a colorimetric tube as a standard solution for standby use.

The single-flush type is subjected to a full-flush test, and the dual-flush type is subjected to a semi-flush test.

Start the water closet flushing device. After one flushing cycle is completed, stir the water in the water seal evenly. Draw the diluted liquid from the water seal and put it into a colorimetric tube of the same specifications as the standard liquid. Visually observe the color difference with the standard liquid. If the color is darker than the standard solution, the recorded dilution rate is less than the standard dilution rate; if the color is the same as the standard solution, the recorded dilution rate is equal to the standard dilution rate; if the color is lighter than the standard solution, the recorded dilution rate is greater than the standard dilution rate.

Note: For products with similar colors that cannot be visually observed, prepare a methylene blue solution with a mass concentration of 5 g/L using pure water at about 80 °C. After the water flushing test, use a visible spectrophotometer to test the mass concentrations of the dilution and the standard solution. If the mass concentration is higher than that of the standard solution, the recorded dilution rate is less than the standard dilution rate; if the mass concentration is the same as that of the standard solution, the recorded dilution rate is equal to the standard dilution rate; if the mass concentration is lower than that of the standard solution, the recorded dilution rate is greater than the standard dilution rate.

6.2.5 Discharge function test

6.2.5.1 Ball discharge function test

6.2.5.1.1 Test medium

100 solid balls with a diameter of (19 ± 0.1) mm and a density of (850 ± 15) kg/m³. Acceptance of the test medium shall be carried out in accordance with the procedures specified in Appendix B.

6.2.5.1.2 Test procedure

Gently place the solid ball into the trap of the water closet; start the flushing device to perform a full-flush test; check and record the number of solid balls flushed out of the water closet drain outlet. Carry out three consecutive tests and calculate the average value.

6.2.5.2 Particle discharge function test

6.2.5.2.1 Test medium

Particles: $(2\ 500 \pm 50)$ cylindrical polyethylene particles with a diameter of (4.2 ± 0.4) mm, a height of (2.7 ± 0.3) mm, and a density of (935 ± 10) kg/m³;

Small balls: 100 nylon balls with a diameter of (6.35 ± 0.25) mm and a density of (1125 ± 10) kg/m³.

Acceptance of the test medium shall be carried out in accordance with the procedures specified in Appendix B.

6.2.5.2.2 Test procedure

Place the particles and balls in the trap of the water closet; start the flushing device to perform a full-flush test; record the number of visible particles and balls in the trap after the first flush. Carry out 3 tests. Before each test, the particles and balls of the previous test shall be rinsed clean. Calculate the average of 3 tests.

The test medium is a double-layer toilet tissue paper with a basis weight of (16.0 ± 1.0) g/m², a width of (114 ± 2) mm, and a total length of (540 ± 2) mm. Toilet tissue paper shall comply with GB/T 20810 and the following conditions.

- a) The immersion time is not more than 3 s, as verified by the following test: wrap the double-layer toilet tissue paper tightly around a polyvinyl chloride (PVC) tube with a diameter of 50 mm; slide the wrapped tissue paper off the tube; fold the paper tube inwards to form a paper tube with a diameter of approximately 50 mm; slowly lower this paper tube vertically into water; record the time required for the paper tube to be completely soaked.
- b) The wet tensile strength shall be tested by the following test: use a PVC tube with a diameter of 50 mm as a support for the test paper; place a piece of toilet tissue paper on the support; turn the support upside down so that the paper is immersed in water for 5 s; then remove the paper and the support immediately from the water and return them to their original vertical position; place a steel ball with a diameter of about 8 mm and a mass of (2 ± 0.1) g gently in the middle of the wet paper; the paper supporting the steel ball cannot be torn in any way.

6.2.6.2 Test procedure

Carry out the water closet toilet tissue paper discharge test according to the following steps.

- a) Roll the double-layer toilet tissue paper into loose balls with a diameter of approximately 50 mm ~ 60 mm, 4 balls per group.
- b) Place 4 paper balls into the water in the water closet trap (3 paper balls for the infant-type water closet) and allow them to soak completely. Within 5 seconds after being soaked, start the half-flush switch to flush. After the flush cycle is completed, check and record whether there is any tissue paper residue in the water closet; if there is any residual tissue paper, the test is over and record the test results.
- c) If there is no residual tissue paper, repeat the test a second time; if there is residual tissue paper, the test is over and record the test results.
- d) If there is no residual tissue paper, repeat the test for a third time and record the test results.

6.2.7 Drainage pipeline transmission characteristics test

6.2.7.1 Test medium

The test medium is 100 solid balls with a diameter of (19 ± 0.1) mm and a density of (850 ± 15) kg/m³.

6.2.7.2 Test procedure

Appendix B

(Normative)

Discharge function test medium acceptance procedure

B.1 Test medium

The discharge function test media include ball discharge function test media solid balls, particle discharge function test media cylindrical polyethylene particles and nylon balls, mixed media discharge function test media sponge strips and typing paper.

B.2 Acceptance steps

B.2.1 Solid balls

The number of solid balls shall be 100 and meet the following acceptance requirements:

- a) Use a vernier caliper or other suitable measuring tool to measure the diameter of the solid ball. The diameter of each solid ball shall be (19 ± 0.1) mm;
- b) Use the immersion method or other applicable methods to measure the density of the solid ball. The density shall be (850 ± 15) kg/m³;
- c) There is no special requirement for the color of the solid ball. To facilitate test observation, use colors other than white and transparent.

B.2.2 Polyethylene particles

The number of polyethylene particles shall be $(2\ 500 \pm 50)$ and meet the following acceptance requirements:

- a) Polyethylene particles shall be regular cylinders;
- b) Use the immersion method or other applicable methods to randomly measure the density of 125 particles, and the density shall be (935 ± 10) kg/m³;
- c) There is no special requirement for the color of polyethylene particles. To facilitate test observation, use colors other than white and transparent.

B.2.3 Nylon balls

The number of nylon balls shall be 100 and meet the following acceptance requirements:

- a) Use a vernier caliper or other suitable measuring tool to measure the diameter of the nylon ball. The diameter of each solid ball shall be (6.35 ± 0.25) mm;
- b) Use the immersion method or other applicable methods to measure the density of the particles, and the density shall be $(1\ 125 \pm 10)$ kg/m³;

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