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Toilet system for railway passenger car and multiple unit

铁道客车及动车组集便装置

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Foreword

This Standard is drafted according to the rules provided in GB/T 1.1-2009.

This Standard shall be under the jurisdiction of Qingdao Sifang Rolling Stock Research Institute.

Drafting organizations of this Standard: Jinan Railway Vehicles Equipment Co., Ltd., Shandong Huateng Environmental Protection Automation Co., Ltd., CNR Changchun Railway Vehicles Co., Ltd., CRRC SIFANG CO., LTD., Tangshan Railway Passenger Car Co., Ltd. AND CSR Nanjing Puzhen Co., Ltd.

Main drafters of this Standard: Tang Jing, Jiang Jun, Wang Baozhen, Miao Feng, Zhou Hongping, Zhang Shaobin, Liang Caiguo, Wang Lihang and Gao Erjian.

Toilet System for Railway Passenger Car and Multiple Unit

1 Scope

This Standard specifies the terms and definitions, composition and types, technical requirements, test methods, inspection rules, marking, packaging, transportation and storage, etc. for the toilet systems for railway passenger cars and multiple units.

2 Normative references

The following documents are indispensable for application of this document. For the dated documents so quoted, only the dated versions apply to this document. For the undated documents so quoted, the latest versions (including all modification sheets) apply to this document.

GB/T 191 Packaging - Pictorial markings for handling of goods

GB 4208 Degrees of protection provided by enclosure (IP code) (GB 4208-2008, IEC 60529:2001, IDT)

GB/T 9286-1998 Paints and varnishes - Cross test for films (eqv ISO 2409:1992)

GB/T 12817-2004 General technical specifications for railway passenger car

GB/T 21241 Toilet bowl and ceramic tile cleansers

GB/T 21563-2008 Railway applications - Rolling stock equipment Shock and vibration tests (IEC 61373:1999, IDT)

GB/T 24338.4-2009 Railway applications-Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus (IEC 62236-3-2:2003, MOD)

GB/T 25119-2010 Railway applications - Electronic equipment used on rail vehicles (IEC 60571:2006, M0D)

TB/T 1759 Rules for installation of cabling for railway passenger car

TB/T 2249-1996 Test method for electrical wiring insulation resistance of railway passenger cars

TB/T 2879.6-1998 Railway rolling stock - Coating and painting - Part 6: Painting quality inspection and acceptance procedures

TB/T 3138-2006 Technical specification of flame retardant materials for railway locomotive and vehicle

UIC 566 Loadings of coach bodies and their components

EN 12663 Railway applications - Structural requirements of railway vehicle bodies

EN 14420-7 Hose fittings with clamp units - Part 7: Cam locking couplings

DIN 5510-2:2009 Preventive fire protection in railway vehicles - Part 2: Fire behaviour and fire side effects of materials and parts - Classification, requirements and test methods

3 Terms and Definitions

For the purposes of this Standard, the following terms and definitions shall apply.

3.1 Toilet System

Equipment that is to receive and store the toilet sewage in a running railway passenger car or multiple unit to realize sewage collection.

3.2 Flush Components

Components that provide flushing water for toilets, usually including a water booster, a flush valve, etc., and at least a flush valve.

3.3 Vacuum Components

Components that generate and monitor the vacuum in a vacuum toilet system.

3.4 Sewage Tank Valid Volume

The volume that a sewage tank sounds an alarm at its set maximum level.

3.5 Intermediate Tank

A transitional tank in a toilet system that is served to receive and store toile sewage temporarily and then discharge the sewage into a sewage tank.

3.6 Emptying Device

The general term of joints that are fixed on a sewage tank to empty and wash the sewage tank.

5.1.8.1 The toilet system shall on no condition affect the safety of power supplies, water sources, and compressed air sources.

5.1.8.2 Parts and components shall conform to the train safety requirements, Where,

a) generally, current-carrying cables shall use low smoke halogen-free cables; and the electric heating tube cables shall employ the cables resistant to high temperatures.

b) when tested on non-metal material properties and wires and cables under the requirements of flame-retardant properties like oxygen indices, 45˚-angle burning, and smoke density, a passenger car's toilet systems shall have fire behaviors to conform to the provisions in TB/T 3138-2006; when, if fire-protection rating is required, tested under the requirements of fire behaviors like flammability rating, smoke release levels, dripping levels, smoke toxicity, etc., based on the different places where materials and components are installed and used, the toilet systems of passenger cars and multiple units shall have their fire behaviors to conform to the provisions in DIN 5510-2:2009; any specific user requirement shall be agreed upon between both parties.

c) the requirements for sewage tanks to carry loads shall conform to UIC 566 or EN 12663.

d) the pressure-resistance requirements for the components bearing atmospheric or hydraulic pressure shall conform to the specific technical requirements of each component.

5.1.8.3 The electric heating system shall be furnished with short-circuit protection, ground protection, and ground protection signs; heating with electric heating tubes and electric blankets shall be provided with over-temperature protection devices.

5.1.8.4 For the toilet system whose drain valve can be directly seen from the toilet entrance, it is appropriate to provide a warning sign in the toilet to prevent personal injury because of putting hands in the toilet system by mistake.

5.1.9 Surface Treatment

For the under-car parts adopting plastic spraying or painting, the adhesive force of the paint film shall fulfil the Grade 2 requirement set forth in GB/T 9286-1998.

5.2 Toilet System

5.2.1 The appearance and size of a toilet system shall meet its design requirements.

5.2.2 After a toilet flush signal is triggered, the toilet shall flush away the sewage into a sewage tank through the blowdown pipe; when a passenger car and multiple unit is running, the toilet system shall collect and store the sewage; when the passenger car and

area of the blowdown line.

5.2.11 A toilet system shall have emptying function so as to be able to empty all the water and sewage in the system.

5.2.12 When collecting and storing sewage to the maximum alarm level, the toilet system will automatically offer protection and shut down to stop service.

5.2.13 All exposed operable components shall be furnished with operation marks.

5.2.14 The leak tightness of a toilet system shall meet the following requirements:

a) No leakage of water or compressed air under normal operating conditions;

b) The airtightness of the vacuum toilet system that needs to produce vacuum in a sewage tank shall meet the following requirements, at the highest operating vacuum pressure when it has been installed:

— while the sewage tank, whose effective volume is 400L and above, hold the press for 20min, the vacuum pressure rise shall not exceed 3kPa;

— while the sewage tank, whose effective volume is less than 400L, hold the pressure for 20min, the vacuum pressure rise shall not exceed 5kPa.

5.2.15 The air consumption of a toilet system shall meet the following requirements (under the standard atmospheric pressure):

a) The average compressed air consumption of vacuum retentive and intermittent toilet systems in one flush cycle shall be less than (10+V) L;

b) The average compressed air consumption of a vacuum on-line toilet system in every flush cycle shall be less than (50+W)L;

c) The average compressed air consumption of a vacuum push-pull toilet system in every flush cycle shall be less than 60L;

d) The average compressed air consumption of a gravity toilet system in one flush cycle shall be less than 10L.

Note: V is related to the sewage tank volume; the average compressed air consumption is 33L per 100L sewage tank. W is related to the pipe length; the average compressed air consumption per 1m pipe is 30L when the length is greater than 1.5m.

5.2.16 When used in the areas where the ambient temperature is below 0°C, the toilet shall have its under-car part furnished with an electric heater unit.

5.2.17 The weight of the components of a toilet system shall be satisfactory to the user.

compressed air in flush components shall work normally under the maximum air supply pressure by the train.

5.3.9 For the flush components installed separately from a toilet, if electrical connection exists between the flush components and their control system, a junction box shall be used, and the electrical connection shall be carried out by means of the terminals in the junction box or waterproof connectors.

5.3.10 For the flush components installed separately from a toilet, the distance from the outlet of their flush valve to the flush water inlet of the chamber pot shall be not more than 1.5m. If the condition is limited that the distance exceeds 1.5m, consideration shall be given to reduce flush water's pressure loss by enlarging the pipe diameter or other means.

5.3.11 The mounting panel of flush components shall undergo anti-corrosive treatment or shall be made up of corrosion-resistant material.

5.3.12 The connecting pipelines between the parts of flush components, if connected with hoses, shall be controlled in length, and shall be secured if necessary.

5.3.13 Flush buttons shall be artistic, and shall not be jammed or fail during its operation.

5.4 Vacuum Components

5.4.1 They are functional to produce vacuum needed by vacuum toilet systems; and they should adopt low degree of vacuum to reduce energy consumption on condition that producing the effect of cleaning toilets and meeting the requirements for sewage transfer distance.

5.4.2 Vacuum retentive toilet systems shall be equipped with a vacuum gauge.

5.4.3 The mounting position, structure and action control of vacuum components shall prevent the sewage in a sewage tank entering the vacuum generating device.

5.4.4 When the parts are connected with hoses, the hoses shall have their length controlled and shall be secured if necessary.

5.4.5 All the parts exposed to the gas exhausted from a sewage tank shall be resistant against the gas corrosion.

5.4.6 Vacuum components shall be resistant against the environmental corrosion.

5.4.7 The parts having compressed air passing by shall withstand the maximum air supply pressure of the train.

5.5 Blowdown Pipe-line

5.5.1 As for the pipeline of a vacuum toilet system, its layout shall be as short as possible

3kPa;

b) While a vacuum sewage tank, whose effective volume is less than 400L, holds the pressure for 1h on condition that the vacuum pressure is the maximum operating vacuum degree of the toile system, the vacuum pressure rise shall not exceed 5kPa;

c) For the vacuum toilet system using an intermediate tank, while the sealing of the intermediate tank holds the pressure for 1h on condition that the vacuum pressure is the maximum operating vacuum degree of the toile system, the vacuum pressure rise shall not exceed 3kPa;

d) While a gravity sewage tank, to which a 23kPa water pressure is introduced, holds the pressure for 1h, the welds and connections shall have no leakage.

5.6.9 The behavior at low temperature of sewage tanks shall meet the temperature requirements given in GB/T 12817.

5.6.10 Sewage tanks shall be furnished with thermal insulation layers and electric heating equipment. The latter can adopt electric heating tubes, heating cables or others, and the former shall use proper heat insulating material. The thermal conductivity is recommended to be less than or equal to 0.034W/(m·K) (-20°C).

5.6.11 The effective volume of sewage tanks shall meet the operating requirements of a passenger car and multiple unit, with the computing method referring to Annex A.

5.6.12 A sewage tank shall set at least 2 liquid-level switches for sewage liquid-level early warning and high liquid-level alarming. The position of the liquid-level switch for high liquid-level alarming shall be such set to meet the requirements in 5.6.12 for the volume.

5.6.13 If a sewage tank is mounted on an apron board or in an equipment compartment, signs indicating the position of the sewage tank's drain outlet shall be set on the side wall, the apron board, or the side plate of the equipment compartment.

6 Test Methods

6.1 Voltage Fluctuation Immunity Test

While the power supply voltage of a toilet system is adjusted to the upper and lower limits of the voltage fluctuation range given in GB/T 25119-2010, respectively to do the test, the toilet system shall go through normal flush cycles.

6.2 Insulation Resistance Test

When a toilet system carries out an insulation resistance test according to the test requirements given in TB/T 2249-1996, the test results shall conform to 5.1.2.

6.9.2 Flame-retardant Property Test of Non-metallic Material

A flame-retardant property test shall be done to the non-metallic material in a toilet system, and the results shall meet the provisions in b) in 5.1.8.2.

6.9.3 Routine Flush Cycle Test

A routine flush cycle test shall be carried out to check that all parts shall act normally.

6.9.4 Measurement of Time for Flush Cycle

A toilet system being put on standby, the time from pressing down its flush button to it restoring standby shall be recorded. The measurement shall be carried out 3 times to take the arithmetic mean value of the measured times.

For the vacuum toilet system producing vacuum in a sewage tank, the measurement shall be carried out when the sewage tank is empty. If the sewage tank's volume is not 400L, the time for flush cycle can be converted on a proportionality relationship basis that the sewage tank is 400L. The time for flush cycle shall meet users' requirements.

For the vacuum push-pull toilet system, the measurement shall be carried out when its intermediate tank is empty, and the time for flush cycle shall users' requirements.

6.9.5 Measurement of Flushing Water Volume

With 3 actions of normal flush cycle, the flushing water volume shall be measured for every flush cycle of a toilet. The flushing water volume shall be the arithmetic mean value of the 3 measurements. The flushing water volume shall be less than or equal to 0.45L for a vacuum toilet; less than or equal to 0.8L for a gravity toilet. In case of special requirements by the user, the water volume shall meet them.

6.9.6 Test of Chamber Pot Drain Effect

Toilet paper 100mm by 300mm and 0.3kg fermented soybeans are placed at 1/3 height of a chamber pot to make 3 flush cycles. After every flush cycle, a check shall be given to the emptying situation to make sure that there shall be no residues in the pot.

6.9.7 System Airtightness Test

For the toilet system generating vacuum in a sewage tank, the vacuum generating device is started normally or manually to make the vacuum in the sewage tank reach the maximum operation vacuum degree. The sewage tank, whose effective volume is 400L or above, holds the pressure for 20min, the vacuum pressure rise shall not exceed 3kPa; the sewage tank, whose effective volume is below 400L, holds the pressure for 20min, the vacuum pressure rise shall not exceed 5kPa.

For the toilet system generating vacuum in an intermediate tank, the vacuum generating

device is started normally or manually to make the vacuum in the intermediate tank reach the maximum operation vacuum degree. With the pressure held for 20min, the vacuum pressure rise shall not exceed 3kPa.

6.9.8 Air Consumption Test

The test shall be carried out at normal temperature, using a compressed air container to supply air to a toilet system, and toilet paper, fermented soybeans, and clear water to simulate the actual use of a toilet. With 10 times of normal flush cycles, the mean compressed air consumption of one flush shall be computed according to the changes in the pressure of and the volume of the compressed air container.

For the vacuum toilet system producing vacuum in a sewage tank, the test shall be carried out when the sewage tank is empty. If the volume of the sewage tank used is not 400L, the maximum compressed air consumption in one flush cycle shall be converted on a proportionality relationship basis that the sewage tank is 400L.

Mean compressed air consumption of one flush shall be computed according to the formula (1) below:

Error! Reference source not found. ..... (1)

Where,

P_1 - the initial pressure of the compressed air container, in kilopascal (kPa);

P_2 - the final pressure of the compressed air container, in kilopascal (kPa);

P_0 - atmospheric pressure, as 101kPa;

V_0 - the volume of the compressed air container, in liter (L);

V_1 - mean compressed air consumption of every flush, in liter (L).

6.9.9 Electric Heater Unit Operation Test

The electric heater unit switch is operated or low temperature signals are simulated to trigger the electric heater unit to check that the electric heater unit can work normally.

6.9.10 Weighing Test for Components

All the components of a toilet system shall be weighed, and their weight shall meet the user's requirements.

6.9.11 Control and Display Check

By making normal flush cycles and simulating the failure testing items for a toilet system, a test shall be made to its failure and state display to make sure whether it conforms to the

shall not exceed 5kPa; if the intermediate tank holds the pressure for 1h, its vacuum pressure rise shall not exceed 3kPa.

6.13.2 Normal Pressure Sewage Tank

When the steel structures of a sewage tank have been welded and assembled, the other openings of the sewage tank shall be sealed, only leaving one for introducing a 25kPa water pressure into the sewage tank. When the pressure is held for 1h, the sewage tank shall have no leakage.

6.14 Low-temperature Performance Test of Sewage Tank

When the heating and insulating capacity of the tank is tested at the ambient temperature as required, the sewage tank shall work normally.

6.1.5 Effective Volume Test of Sewage Tank

When the water pipe with a metering device is used to fill water into a sewage tank to its 100% level, the indicator light shall come to life. When the water filling water is closed to record the metered volume of water filled, the measured volume shall not less than 95% of the effective volume of the sewage tank.

7 Inspection Rules

7.1 Inspection Classification

The inspection for toilet systems is divided into exit-factory test and type test.

7.2 Exit-factor Test

Before be delivered, sewage systems, along with their fittings, shall be tested according to the drawings approved by this Standard and specified procedures, and the requirements of technical documents. The products that pass the test can be delivered only after they are given a certificate. The factory test items can be referred to Table 1.

7.3 Type Test

7.3.1 A type test shall be carried out in case one of the following occurs:

a) When new products are approved or the approved products are transferred to other plants for production;

b) When there are major changes to the product structure, production equipment, and production process or material;

c) When the production is restored after a halt of more than 2 years;

		Material				
10	Water Booster Pressure Test		—	√	5.3.8	6.10
11	Pressure Tests for Sewage Tank and Intermediate Tank		—	√	5.6.1	6.11
12	Sewage Tank Vibration, Impact Resistance Test		—	√	5.6.2	6.12
13	Pressure Tests for Sewage Tank and Intermediate Tank		—	√	5.6.8	6.13
14	Low-temperature Performance Test of Sewage Tank		—	√	5.6.9	6.14
15	Effective Volume Test of Sewage Tank		—	√	5.6.11	6.15

8 Marking, Packaging, Transportation and Storage

8.1 Marking

8.1.1 On the conspicuous place of a sewage tank, it shall set a nameplate, which shall usually include:

a) Name and type;

b) Volume;

c) Weight;

d) Date of manufacture;

e) Identification number;

f) Name of manufacturer and identification mark.

8.1.2 On the other places, it shall set part nameplates, which shall usually include:

a) Part name and type;

b) Date of manufacture;

c) Identification number;

d) Identification mark of manufacturer.

8.1.3 An electric wiring diagram shall be set on a proper position for maintenance and electric part replacement.

8.2 Packaging

v - frequency of use, in times per hour (times/h); recommended to take 12~15 when the train's running time is more than 12 hours; and 20~30 when less than 12h and overcrowded;

w - running time of a passenger car and multiple unit in 1 discharging cycle, in hour (h);

m - volume of water flushing the toilet 1 time, in liter per time (L/time);

n - average discharge amount of excrement at one time, in liter per time (L/time).

A.4 Method 3 of Computing the Effective Volume of a Swage Tank

The effective volume of a sewage tank can be computed according to the following formula:

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Where,

Q - effective volume of a sewage tank, in liter (L);

P - fixed number of a carriage;

T - running time of a passenger car and multiple unit, in hour (h);

C1 - water consumption for flushing by one passenger in one hour (equal to water consumption for flushing the toilet at one time × frequency of use of the toilet), in liter/hour/person (L/h/person);

C_2 - discharge amount of excrement of a passenger at one time, in liter/hour/person (L/h/person);

K - adjustment coefficient of one-way running time of a passenger car and multiple unit.

_____ END _____