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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 18443.5-2010

Replacing GB/T 18443.5-2001

**Testing method of performance for vacuum insulation
cryogenic equipment - Part 5: Static evaporation rate
measurement**

真空绝热深冷设备性能试验方法 第5部分：静态蒸发率测量

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1 Scope

GB/T 18443.5-2010 is the Chinese national standard on testing method of performance for vacuum insulation cryogenic equipment - part 5: static evaporation rate measurement, in the field of fluid systems and general-purpose components. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 26 September 2010 by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China; Standardization Administration of China, and has been in force since 1 February 2011. Classification: ICS 23.020, CCS J74. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This part of GB/T 18443 specifies the requirements of the test principle and method, test equipment, equipment and instruments, test conditions and test preparations, test procedures, data processing, test records, and test reports for the measurement of the static evaporation rate of vacuum insulated cryogenic equipment. This part applies to the measurement of the static evaporation rate of vacuum insulated cryogenic equipment, such as vacuum insulated cryogenic pressure vessels except for the storage and transportation

of liquid hydrogen medium, and vacuum insulated cryogenic gas cylinders; the measurement of other equipment can be implemented by reference.

2 Normative references

The provisions in the following documents become the provisions of this Part through reference in this Part of

GB/T 18443. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Part, however, parties who reach an agreement based on this Part are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies to this Part.

GB/T 18443.1 Testing method of performance for vacuum insulation cryogenic equipment - Part

3 Terms and definitions

The terms and definitions established in GB/T 18443.1~GB/T 18443.4 and the following apply to this part.

3.1 Percentage loss of product per day The percentage of the mass of cryogenic liquid lost by natural evaporation within 24 h over the mass of cryogenic liquid that is corresponding to the effective volume of the inner pressure vessel, after the cryogenic storage and transportation equipment stands and reaches the thermal equilibrium at the rated fullness rate; the unit is percentage per day (%/d).

4 Test principle and method

4.1 Test principle Use a volume flowmeter or mass flowmeter to measure the natural evaporation of cryogenic liquid per unit time, or use a weighing method to measure the loss of cryogenic liquid per unit time.

4.2 Test method

4.2.1 Use the wet gas flowmeter to measure the gas flow passing through the flowmeter after the liquid in the measured piece evaporates within a unit of time, and calculate the Percentage Loss of Product per Day and the static evaporation rate with the measured gas flow. The schematic diagram of the test device is shown in Figure 1.

4.2.2 Use the gas mass flowmeter to measure the gas mass flow passing through the mass flowmeter after the liquid in the measured piece evaporates within a unit of time, and calculate the Percentage Loss of Product per Day and static evaporation rate with the measured gas mass flow. The schematic diagram of the test device is shown in Figure 2.

4.2.3 When the effective volume of the measured piece is not more than 5 m³, it is allowed

to use the weighing method to measure. When the weighing method is used for measurement, after the measured piece is charged to the rated filling quantity, place the measured piece on the weighing instrument, and measure the mass of the cryogenic liquid evaporated in the vacuum insulated cryogenic equipment with the weighing instrument. Use the evaporation measured with the weighing method to calculate the Percentage Loss of Product per Day and static evaporation rate.

- a) When the range of the flowmeter is less than or equal to 5L/min, the accuracy needs to reach 0.5%; when the range is greater than 5 L/min, the accuracy needs to reach 1.0%;
- b) The rated flow of the flowmeter shall be compatible with the gas flow evaporated by the measured piece;
- c) There shall be ambient temperature, ambient pressure, and flowmeter inlet temperature and pressure measurement devices;
- d) The maximum weighing of the weighing instrument used in the weighing method shall be 1.2~

2.0 times the full load mass of the measured piece, and its accuracy shall meet the following requirements.

--- When the maximum weighing of the weighing instrument is $5T \leq t < 10T$, its allowable deviation shall not exceed 1 kg;

--- When the maximum weighing of the weighing instrument is $3T \leq t < 5T$, its allowable deviation shall not exceed

0.5 kg;

--- When the maximum weighing of the weighing instrument is $1T \leq t < 3T$, the allowable deviation shall not exceed

0.2 kg;

--- When the maximum weighing of the weighing instrument is $t < 1T$, its allowable deviation shall not exceed

6 Test conditions and test preparation

Test conditions and test preparations shall comply with the provisions of GB/T 18443.1.

7.1 Flowmeter method

7.1.1 Liquid nitrogen is generally used as the test medium.

7.1.2 During measurement, the fullness rate of cryogenic liquid shall be the rated fullness rate.

7.1.3 After the liquid filling is completed, it shall be standing for at least 48h. During the standing period, the venting valve of the vacuum insulated cryogenic equipment shall be opened.

7.1.4 When the gauge pressure of the inner liner is close to zero, connect the flowmeter to the venting pipeline. After the flowmeter is connected, except the venting valve is opened, the other valves of the measured piece shall be all closed.

7.1.5 After the flow of evaporated gas is stabilized, collect and record the indicated value of the flowmeter, ambient temperature, atmospheric pressure, flowmeter inlet temperature and pressure with a time interval that shall not be more than 1 h; the data recording time shall be 24 h.

7.1.6 Calculate the static evaporation rate of the measured piece and compare it with the static evaporation rate of the previous 24 h. When the variation range of the static evaporation rate is less than 5%, the recorded data is valid; when the variation range of the static evaporation rate is greater than 5%, it is allowed to record the data once again; the recording time shall not be less than 24 h, and the data are final record data.

7.2 Weighing method

7.2.1 Except for special requirements, the test medium shall be liquid nitrogen.

7.2.2 During measurement, the cryogenic liquid fullness rate shall be rated fullness rate.

7.2.3 After the liquid filling is completed, it shall be standing for 48 h before the start of recording data. During the standing period, the venting valve of the vacuum insulated cryogenic equipment shall be opened.

7.2.4 When the gauge pressure of the inner liner is close to zero, except the venting valve is opened, the other valves of the measured piece shall be all closed; record the initial data of the weighing instrument at the same time.

7.2.5 Record the data of the weighing instrument when the time interval is 24 h and 48 h.

8.1 Percentage loss of product per day α_0

8.1.1 When the wet gas flowmeter is used for measurement, the percentage loss of product per day α_0 is calculated according to formula (1). Where. α_0

--- The percentage loss of product per day, and the unit is percentage per day (%/d); q_v

--- The daily average value of volume flow of evaporated gas, in cubic meters per Where. α_0

--- The percentage loss of product per day, and the unit is percentage per day (%/d); q_g

--- The mass of gas evaporated within 24 hours, in kilograms per day (kg/d); ρ_0