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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 45322.2-2025

Particle - Separation performance test for particle size separator - Part 2: Divided flow method

颗粒 粒度切割器切割性能测试 第2部分:分流法

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1 Scope

This document describes the method of testing the separation performance of a particle size separator by the divided flow method.

This document applies to the testing of the separation performance of particle size separators used for sampling airborne particles (referred to below as separators).

2 Normative references

The contents of the following documents constitute indispensable provisions of this document through the normative references made to them in the text. For dated references, only the edition corresponding to that date applies to this document; for undated references, the latest edition (including all amendments) applies to this document.

GB/T 6682 Water for analytical laboratory use - Specification and test methods.

GB/T 13277.1 Compressed air - Part 1: Contaminants and purity classes.

GB/T 45322.1-2025 Particle - Separation performance test for particle size separator - Part

1: General rules.

3 Terms and definitions

The terms and definitions given in GB/T 45322.1 apply to this document.

4 Principle of the method

The separator is connected into the divided flow line in accordance with the working conditions required of it. The particle concentration is measured upstream and downstream of the separator at different particle sizes, the separation efficiency for each particle size is calculated, the separation efficiency curve is obtained by fitting, and the cut sizes Da84, Da50 and Da16 corresponding to separation efficiencies of 84 %, 50 % and 16 % and the geometric standard deviation are calculated, so that the separation performance of the particle size separator is tested.

5.1 Apparatus

5.1.1 Test system. Its composition and its performance requirements shall conform to Annex A.

5.1.2 Flowmeter. The accuracy class shall be better than 1.0.

5.1.3 Digital pressure gauge. The measuring range is from minus 40 kPa to 0 kPa and the accuracy class shall be better than 1.0.

5.1.4 Particle concentration measuring instrument. An instrument measuring particle number concentration should be selected, and its measuring range shall cover the particle size range and the concentration range to be measured. Within the particle size range to be measured, the interval between adjacent channels of the particle concentration measuring instrument shall be smaller than the interval between adjacent particle sizes of the test aerosol; the indication error of the particle size measurement shall be within plus or minus 15 %; the counting efficiency for particles shall be within 100 % plus or minus 20 %; and the repeatability of the count shall be not greater than 5 %.

5.2 Materials

5.2.1 Test aerosol. The test aerosol shall be chosen on the following principles: a) the particle size of the aerosol shall conform to 5.2.1 of GB/T 45322.1-2025; b) the geometric standard deviation of the particle size distribution of the aerosol shall conform to 5.2.2 of GB/T 45322.1-2025.

5.2.2 Purified water. It shall meet the requirements for grade 2 water of GB/T 6682 and shall then be filtered through a microporous membrane of 0.2 micrometres.

5.2.3 Clean air. It shall meet the requirement of GB/T 13277.1 for a particle class not higher than class 2.

6.1 Preparation before the test

6.1.1 Cleaning the separator. Clean and service the inner surfaces of the separator in accordance with the operating manual of the instrument; where the separation performance of a loaded separator is to be tested, omit this step.

6.1.2 Check of the tightness of the system. Carry out the tightness check of the system as follows: a) install the separator in the divided flow line as required and seal the inlet of the separator and the upstream sampling line; b) start the suction pump and, when the reading of the digital pressure gauge lies between minus 35 kPa and minus 25 kPa, close the valve upstream of the suction pump; c) the change in the reading of the pressure gauge within 30 s shall be not greater than 7 kPa.

6.1.3 Check of the specified flow rate of the separator. Carry out the check as follows: a) connect the flowmeter to the inlet end of the separator; b) close the reference line; c) switch on the particle concentration measuring instrument and the suction pump; d) when the system is stable, read the flowmeter three times in succession; e) calculate the relative error of the mean flow rate using formula (1); the error shall lie within plus or minus 5 %. In formula (1), delta Q is the relative error of the mean flow rate; Qs is the mean of the three flow measurements, in litres per minute; and Qd is the specified flow rate of the separator, in litres per minute.

6.1.4 Generation of the aerosol. The test aerosol generated shall meet the requirements of 5.2.1.

6.1.5 Check of the stability of the system. Carry out the stability check of the system as follows: a) do not install the separator, and connect the line under test; b) generate the test aerosol; c) when the system is stable, use the particle concentration measuring instrument to measure the aerosol concentration at the downstream end of the reference line and of the line under test three times each; d) calculate the relative deviation of the mean concentrations using formula (2); the deviation shall lie within plus or minus 5 %. In formula (2), delta C is the relative deviation of the mean concentrations; CA is the mean of the three concentrations of the reference line, in particles per litre; and CB is the mean of the three concentrations of the line under test, in particles per litre.

6.2 Test of the separation performance of the separator

Carry out the test of the separation performance of the separator as follows: a) complete the preparations before the test as required by 6.1 and make sure the system meets the requirements; b) install the separator to be tested in accordance with the working conditions required of it; c) shut down the aerosol generator and purge the lines of the system with

clean air, ending the purge when the concentration of particles of every size in the lines is not greater than 5 particles per litre; d) start the aerosol generator; e) when the system is stable, use the alternating measurement method to measure the particle concentration upstream and downstream of the separator three times each; f) where the test aerosol is monodisperse, repeat steps c) to e) to obtain the measured values for each particle size.

6.3 Processing of the test data

6.3.1 Judgement of the validity of the separation efficiency test. Judge the repeated measurement results in accordance with 6.2 of GB/T 45322.1-2025: if the relative standard deviation is not greater than 10 %, the test data of that set are valid; if it is greater than 10 %, the test data of that set are invalid.

6.3.2 Calculation of the separation performance parameters. Carry out the calculation as follows: a) take the test data judged valid in accordance with 6.3.1; b) calculate the particle size values obtained by the test and the mean separation efficiency at each of those sizes in accordance with 6.2 of GB/T 45322.1-2025; c) fit the separation efficiency curve in accordance with 6.3 of GB/T 45322.1-2025; d) calculate the correlation index and the residual standard deviation of the fit in accordance with 6.3.4 of GB/T 45322.1-2025; the correlation index of the fit shall be greater than 0.99; e) from the result of the fit of the separation efficiency curve, obtain Da50 and the geometric standard deviation in accordance with 6.4 of GB/T 45322.1-2025; f) report Da50 and the geometric standard deviation to three significant figures.

7.1 Information on the particle size separator under test

The test report shall contain at least the following information. The information on the particle size separator under test shall include: a) the name of the separator; b) its model and specification; c) its structural type (impaction, cyclone and so on); d) its cut size (PM10, PM2.5 and so on); e) its specified flow rate; f) the name of its manufacturer; g) its works serial number.

7.2 Test information

The test information shall include: a) the date of the test; b) the number of this document; c) the environmental conditions of the test (temperature, humidity, atmospheric pressure); d) a description of the test aerosol; e) the particle concentration measuring instrument used; f) the fitting function used; g) where necessary, a description of the loading.

7.3 Test results

The test results shall include: a) the aerodynamic particle sizes and the corresponding separation efficiency values; b) the separation efficiency curve; c) Da50 and the geometric