

Translated English of Chinese Standard: JJF1800-2020

www.ChineseStandard.net → Buy True-PDF → Auto-delivery.

Sales@ChineseStandard.net

JJF

METROLOGY SPECIFICATION OF THE
PEOPLE'S REPUBLIC OF CHINA

JJF 1800-2020

Calibration Specification for Aerosol Photometers

气溶胶光度计校准规范

Issued on: January 17, 2020

Implemented on: April 17, 2020

Issued by: State Administration for Market Regulation

Calibration Specification for Aerosol Photometers

1 Scope

This Specification applies to the calibration of light scattering principle aerosol photometers with a measurement range of (0.01~100) $\mu\text{g/L}$. The aerosol photometers with other measuring ranges can be calibrated with reference to this Specification.

2 Terms

PAO-4 aerosol

Aerosol refers to a colloidal dispersion system formed by solid or liquid small particles dispersed and suspended in a gas medium. It is also called as gas dispersion system. Its dispersion phase is solid, liquid or solid-liquid mixture. PAO-4 aerosol in this Specification refers to polydisperse aerosol, which takes poly-alpha-olefin oil (PAO) with a kinematic viscosity of $4\text{m}^2/\text{s}$ as the generating medium and is generated by the fog mixing device of the aerosol photometer.

3 Overview

Aerosol photometer (hereinafter referred to as the instrument) is an instrument used to measure the leakage rate of high-efficiency filters and the leakage rate of high-efficiency filtration systems installed with high-efficiency filters. Its working principle is that: the instrument draws air samples from the upstream and downstream ends of the high-efficiency filter or high-efficiency filter system under test at a constant flow rate. The sampling unit delivers the air sample to the measuring unit. The measurement unit uses forward scatter measurements to measure the mass concentration of aerosols in air samples. The data processing unit analyzes the measurement results and calculates the ratio of the two, so as to obtain the leak rate of the system under test. Finally, the measurement results are outputted by the display unit. The schematic diagram of the instrument structure is shown in Figure 1.

5.2 Metrology standard instruments

5.2.1 Precision aerosol photometer: the maximum allowable error of mass concentration does not exceed $\pm 10\%$;

5.2.2 Flow standard device: the measurement range is (0~50)L/min; the maximum allowable error does not exceed $\pm 1.0\%$.

5.2.3 Aerosol fog mixing device: a device that can generate PAO-4 aerosol with controllable concentration and uniform mixing. When a low concentration (0.01~1) $\mu\text{g/L}$ aerosol occurs, its concentration stability does not exceed 10%/4h. When a high concentration (10~100) $\mu\text{g/L}$ aerosol occurs, its concentration stability does not exceed 5%/20min.

6 Calibration items and calibration methods

6.1 Preparation before calibration

Connect the calibrated instrument, precision aerosol photometer and aerosol fog mixing device as required. According to the use requirements of each equipment, the normal operation of preheating shall not be less than 10min.

6.2 Calibration items

6.2.1 Sampling flow indication error

Enable the downstream sampling mode of the instrument under test. After it is stable, connect the flow standard device to the downstream sampling port of the instrument through the sampling tube (see Figure 2). Read the standard flow value and the flow indication value of the calibrated instrument, respectively. Calculate the sampling flow indication error according to formula (1). Repeat the above measurement process 3 times. Take the average value of the indication error obtained by 3 measurements as the measurement result.

$$\Delta Q = Q_m - Q_s \quad (1)$$

Where,

ΔQ - The flow indication error, L/min;

Q_m - The indication of flow rate of the calibrated instrument, L/min;

Q_s - The standard flow value, L/min.

- b) Laboratory name and address;
- c) Location where the calibration is performed (if not performed in the laboratory);
- d) Unique identification (such as number) of the certificate or report, identification of each page and the total number of pages;
- e) Name and address of the calibration submitter;
- f) Description and clear identification of the subject being calibrated;
- g) Calibration date. If relevant to the validity and application of the calibration results, the date of acceptance of the subject to be calibrated shall be stated;
- h) Sampling procedures shall be described if relevant to the validity and application of calibration results;
- i) Identification of the technical specification on which the calibration is based, including name and code;
- j) Traceability and validity of the measurement standards used in this calibration;
- k) Description of the calibration environment;
- l) Description of calibration results and measurement uncertainty;
- m) Signature, title or equivalent identification of the issuer of the calibration certificate or calibration report, and the date of issue;
- n) Statement that the calibration result is valid only for the subject being calibrated;
- o) Statement of the certificate or report may not be partially reproduced without the written approval of the laboratory.

8 Recalibration time interval

The recalibration time interval of the instrument shall be determined by the user according to the usage of the instrument, the performance of the instrument itself, and so on. It is recommended that the recalibration time interval shall not exceed 1 year. During the two adjacent calibration periods, if there is doubt about the test data of the instrument or the instrument is replaced with main parts and repaired, the instrument shall be recalibrated.

Annex A

Calibration method for concentration indication error of precision aerosol photometer

A.1 Calibration conditions

A.1.1 Environmental conditions

Temperature: (15~30)°C. Relative humidity: not more than 85%. Supply voltage: AC (220±22)V, (50±1)Hz.

A.1.2 Filter membrane

Round. The diameter is (37±0.25)mm. The pore size is not more than 2μm. The thickness is (0.2~0.25)μm. At a clean air flow rate of 0.45m/s, the pressure drop shall be less than 3kPa. The mass increase value after exposure to 35% RH air for 24h does not exceed 10μg. Inorganic filter membranes such as glass fiber filter membrane and quartz filter membrane can be selected. The retention efficiency of the filter membrane for 0.3μm standard particles is not less than 99.99%.

A.1.3 Calibration system of precision aerosol photometer

- a) Sampling device: The flow range is (0~50)L/min. The stability of 4h is not higher than 5%.
- b) Flow standard device: The range is (0~50) L/min. The maximum allowable error does not exceed ±1.0%. The cumulative sampling volume can be displayed.
- c) Balance: Accuracy level is ①. The actual division value is not more than 1×10^{-6} g.
- d) Aerosol fog mixing device: A device that can generate PAO-4 aerosol with controllable concentration and uniform mixing. Use a precision aerosol photometer to measure the fog concentration of the device. At the low concentration of (0.01~1)μg/L, its concentration stability is not more than 10%/4h. At the high concentration of (10~105)μg/L, its concentration stability is not more than 5%/20min.

A.2 Calibration method

A.2.1 Preparation before calibration

A.2.1.1 Appearance inspection of filter membrane: It shall be ensured that the edge is flat. The thickness is uniform. There is no burr. There is no pollution. There must be no pinholes or any damage.

Annex B

Examples for measurement uncertainty evaluation of mass concentration indication error of precision aerosol photometer

B.1 Overview

The precision aerosol photometer is an instrument for calibrating the aerosol photometer. Therefore, the uncertainty evaluation of the calibration result of the precision aerosol photometer is mainly aimed at the uncertainty evaluation of the measurement result of the indication error of the mass concentration. The uncertainty of mass concentration measurement of precision aerosol photometer mainly includes: uncertainty introduced by repeatability of mass concentration measurement, uncertainty introduced by aerosol concentration instability, uncertainty of filter membrane mass difference before and after sampling as well as sampling volume uncertainty.

B.2 Method analysis

Make the precision aerosol photometer generate aerosols with mass concentration equal to 0.6mg/m^3 , 20mg/m^3 and 100mg/m^3 , respectively. Use tweezers to place the weighed filter membrane into a clean filter membrane holder. Switch the tubing of the standard device to the side where the gas sampling pump, flow meter and filter holder are connected. Perform continuous sampling. Record the sampling volume V . After sampling, use the results before and after the balance weighing to calculate the mass concentration difference $\Delta(\omega)$. The aerosol concentration ρ obtained by the calibration method is calculated from the ratio of the mass concentration difference to the sampling volume. And then the indication error δ_c of the precision aerosol photometer is calculated.

B.3 Measurement model

$$\delta_c = C - \frac{\Delta(\omega)}{V} \quad (\text{B. 1})$$

Where,

C - The indication value of mass concentration of calibrated precision aerosol photometer, mg/m^3 ;

$\Delta(\omega)$ - The difference between the mass of the filter membrane before and after sampling, mg ;

V - The sampling cumulative volume, m^3 .

B.4 Evaluation of each uncertainty component

Annex C

Examples for uncertainty evaluation of indication error of mass concentration of aerosol photometer

C.1 Measurement methods

Select 0.6µg/L in the low concentration range and select 20µg/L and 100µg/L calibration points in the high concentration range to evaluate the uncertainty, respectively. Use the aerosol fog mixing device to respectively generate aerosols with mass concentrations of 0.6µg/L, 20µg/L and 100µg/L. Calibrate according to the calibration method in 6.2.4. Record the standard value C_s of aerosol mass concentration and the measured value C_m of the aerosol mass concentration of the calibrated aerosol photometer. C_m and C_s are respectively the average value of C_{m1} , C_{m2} and the average value of C_{s1} , C_{s2} obtained during a single concentration indication error measurement. Calculate the error δ of the mass concentration indication of the aerosol photometer. The standard values of aerosol mass concentration C_{s1} and C_{s2} here are obtained by direct reading with a precision aerosol photometer.

C.2 Measurement model

$$\delta = C_m - C_s \quad (C.1)$$

Where,

C_s - The measured value of mass concentration of precision aerosol photometer, µg/L;

C_m - The measured value of the aerosol mass concentration of the calibrated instrument, µg/L;

δ - The indication error of mass concentration of aerosol photometer, µg/L.

C.3 Uncertainty source analysis

C.3.1 Uncertainty introduced by random errors in the measurement of the mass concentration of the calibrated aerosol photometer

C.3.2 Uncertainty introduced by systematic errors in precision aerosol photometers

C.4 Evaluation of each uncertainty component

C.4.1 Uncertainty $u(C_m)$ caused by random errors in the measurement of the mass concentration of the calibrated aerosol photometer

Choose a regular-level aerosol photometer. Repeat the measurement 10 times according

This is an excerpt of the PDF (Some pages are marked off intentionally)

Full-copy PDF can be purchased from 1 of 2 websites:

1. <https://www.ChineseStandard.us>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Select your country (currency), for example: USA (USD); Germany (Euro).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Tax invoice can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with download links).

2. <https://www.ChineseStandard.net>

- SEARCH the standard ID, such as GB 4943.1-2022.
- Add to cart. Only accept USD (other currencies - <https://www.ChineseStandard.us>).
- Full-copy of PDF (text-editable, true-PDF) can be downloaded in 9 seconds.
- Receiving emails in 9 seconds (with PDFs attached, invoice and download links).

Translated by: Field Test Asia Pte. Ltd. (Incorporated & taxed in Singapore. Tax ID: 201302277C)

About Us (Goodwill, Policies, Fair Trading...): <https://www.chinesestandard.net/AboutUs.aspx>

Contact: Wayne Zheng, Sales@ChineseStandard.net

Linkin: <https://www.linkedin.com/in/waynezhengwenrui/>

----- The End -----