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GB

National Standard

of the People's Republic of China

GB/T 16157-1996

The determination of particulates and sampling methods of gaseous pollutants emitted from exhaust gas of stationary source

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Foreword

In order to implement the national and provincial standards for emission of atmospheric pollutants, normalize the monitoring of the organized emission from stationary sources, especially the sampling methods, this Standard is drafted.

The determination content of particulates specified in this Standard includes sampling, determination and calculation, monitoring of stationary sources shall usually be executed according to this Standard, unless otherwise specified in relevant emission standards or analysis method standards. For example, the emission standard of thermal power plants - there are other specified provisions in analysis method standard for chrome (sulfuric) acid mist, lead (or other metals) and their compounds - shall also comply [with this Standard]. As the monitoring of gaseous pollutant emission is complicated, the specifications related to sampling in this Standard shall be deemed as general requirements. When sampling, those specific stipulations in relevant emission standards and standards for gaseous pollutants analysis methods shall also be complied.

This Standard does not specifically cover the operating conditions and frequency requirements of completion acceptance monitoring and routine supervisory monitoring of stationary pollutant source. When monitoring, it shall adopt relevant emission standards, monitoring specifications, and the regulations on completion acceptance monitoring of construction projects by the National Environmental Protection Administration.

Because the operating condition requirements of boiler emission monitoring are not specified in the emission standard, it is specified in flue dust test method, therefore, GB 5468-91 "Test Method of Boiler Flue Dust" shall be remained even though this Standard is approved and issued. It shall not be deemed that there is contradiction between this Standard and GB 5468-91. When implementing monitoring, when executing provisions, those unclear matters shall still be based on this Standard. In addition, GB 9078-88 "Test Method of Industrial Kiln Flue Dust" has been covered by this Standard.

After the date of implementation of this Standard, GB 9078-88 "Test Method of Industrial Kiln Flue Dust" shall be abolished.

The General Environmental Monitoring Station of China is authorized for interpretation of this Standard.

The determination of particulates and sampling methods of gaseous pollutants emitted from exhaust gas of stationary source

1 Content and applicable scope

1.1 This Standard specifies the determination methods of particulates in exhaust gas emitted from stationary sources such as flue ducts, chimneys and gas exhaust cylinders (hereafter called “flue duct”), and sampling methods of gaseous pollutants.

1.2 This Standard applies to determination of particulates in exhaust gas emitted from stationary pollution sources such as various boilers, industrial kilns and other pollution sources, and sampling of gaseous pollutants.

2 Definitions

2.1 Particulates

Particulates refer to those solid and liquid particulate matters suspending in the exhaust gas, which are generated during combustion, composition, decomposition of fuel and other substances, or generated during mechanical treatment of various materials.

2.2 Gaseous pollutants

Gaseous pollutants refer to those various pollutants in gaseous state dispersed in the exhaust gas.

2.3 Dry exhaust gas under standard condition

Dry exhaust gas under standard condition refers to the exhaust gas which does not contain moisture at the temperature of 273K, and the pressure of 101,300Pa.

3 Determination and calculation content

3.1 Determination of the exhaust gas parameters (temperature, pressure, moisture and composition).

3.2 Calculation of the exhaust gas density and gas molecular weight.

3.3 Determination of exhaust gas flow speed and flow.

3.4 Determination of particulates in exhaust gas and calculation of emission concentration and emission rate.

3.5 Sampling of gaseous pollutants in exhaust gas and calculation of emission concentration and emission rate.

4 Basic requirements of sampling

4.1 Sampling operating conditions

Sampling shall be conducted when the production equipment is under normal operating conditions, or according to the requirements of relevant pollutant emission standard, to determine under the specified operating conditions.

4.2 Sampling positions and sampling points

4.2.1 Sampling positions

4.2.1.1 Vertical pipe section shall be preferably selected as sampling position. The bend of flue duct and those areas with sharp-section shall be avoided. Sampling positions shall be located no less than 6 times the diameter at downstream from bends, valves and reducers, and no less than 3 times the diameter at upstream from above parts. For rectangular flue duct, its equivalent diameter is $D = 2AB/(A+B)$, where A , B are the lengths of sides.

4.2.1.2 For gaseous pollutants, because it is well mixed, its sampling positions may be not restricted by above specifications, however, it shall avoid vortex area. If the flow of exhaust gas is determined at the same time, the sampling position shall still be selected according to 4.2.1.1.

4.2.1.3 Those places which are hazardous for operation of test personnel shall be avoided as sampling positions.

4.2.2 Sampling holes

4.2.2.1 Sampling hole shall be made at selected measurement position. The sampling hole inner diameter shall not be less than 80mm, length of sampling tube shall not be longer than 50mm. When it is not used, it shall be covered by plate, tube plug or tube cap (Fig.1, Fig.2, and Fig.3). When it is only used for sampling gaseous pollutants, its inner diameter shall not be less than 40mm.

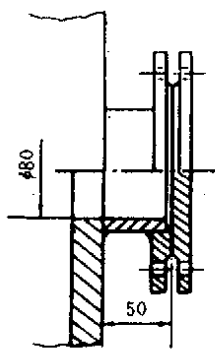


Fig. 1 Sampling hole with plate (unit: mm)

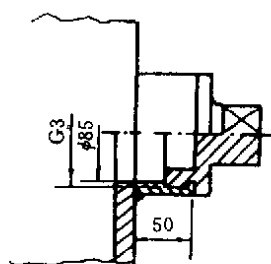


Fig. 2 Sampling hole with tube plug (unit: mm)

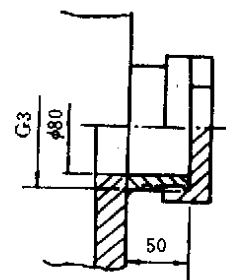


Fig. 3 Sampling hole with tube cap (unit: mm)

4.2.2.2 For flue duct that delivers high temperature or toxic gas under positive pressure, it shall adopt sealed sampling hole with gate valve (Fig. 4).

- a) The vacuum bottle and injector shall be subject to gas leakage test before installation.
 - (1) Leakage test of the vacuum bottle. Connect the vacuum bottle with the vacuum gauge and reduce the pressure by drawing gas until the absolute pressure drops to 1.33kPa. After it is laid aside for 1h, if the absolute pressure in the balloon does not exceed 2.66kPa, the balloon is deemed as gas tight.
 - (2) Leakage test of the injector. After damping the bolt of the injector with water, aspirate air to 1/4 scale and tightly block the inlet hole with a rubber cap. Push in and draw out the bolt for several times. If the bolt returns to the original position every time, the injector may be deemed as gas tight.
- b) Fill the vacuum bottle with proper amount of absorption liquid. Reduce the pressure in the vacuum bottle with the vacuum pump till the absorption liquid boils and close the cock. Before sampling, measure the absolute pressure in the vacuum bottle with vacuum gauge and note it down.
- c) Take a 100ml washing bottle and fill it with wash liquid, i.e. 5mol/L sodium hydroxide solution for acid measured gas and 3mol/L sulfuric acid solution for caustic measured gas, to wash the gas.
- d) Ball-joint or cone joint shall be used for connection of the vacuum bottle or injector with other components.
- e) Connect the vacuum bottle or injector as shown in Fig. 29 and Fig. 30. The vacuum bottle and injector shall be placed as close to the sampling tube as possible.
- f) Leakage test of the sampling system. After tightly blocking the connecting tube at the outlet end of the sampling tube, turn on the aspirator pump to draw gas till the pressure indicated by the vacuum gauge rises to 13kPa, and then close the valve on one side of the pump. If the pressure indicated by the gauge drops no more than 0.15kPa within 1min, the system is deemed as gas tight.

9.4.2.2 Sampling

- a) Before sampling, turn on the aspirator pump and draw gas at 1L/min flow for about 5min, to purge the air in the sampling system.
- b) Open the cock of the vacuum bottle to admit gas into it, and then close the cock and remove the vacuum bottle. In case of sampling with injector, open the injector valve and draw the bolt to suck gas to the preset scale in one time. Then close the injector valve, remove the injector and store it in upside down position.
- c) During sampling, record the operating conditions, ambient temperature and atmospheric pressure for sampling.

9.4.3 In case of continuous sampling with instrument

9.4.3.1 Preparation and installation

- a) The preparation and installation of the sampling tube is the same as that described under 9.4.1.1.
- b) Calibration of the gas valve. Mount a three-way valve at the sampling tube outlet and before the dehumidifier, which is connected to the calibration gas.
- c) Preparation and mounting of the dehumidifier
 - (1) Connect the selected dehumidifier into the sampling system according to the dehumidification requirements of the instrument used. The humidifier shall be placed as close to the sampling tube outlet as possible.

Refer to formula (35) for the flow Q'_{rs} of the rotor flowmeter under typical conditions.

The correction factor of the rotor flowmeter shall be calculated with formula (41):

$$K_r = \frac{Q_{zs}}{Q'_{rs}} \dots\dots\dots (41)$$

Where: Q_{zs} — Flow of soap film flowmeter converted to that under 20°C, 101300Pa, L/min;

V_z — Volume between two scales of soap film flowmeter, L;

t — Time for soap film rising from lower scale to upper scale, min;

t_z — Atmospheric temperature in the calibration room, °C;

P_{zv} — Pressure of saturated vapor based on room temperature t_z , Pa;

12.2.7 Dry type accumulative flowmeter

Calibrate with a calibrated wet type gas flowmeter. Both the dry type accumulative flowmeter and the wet type gas flowmeter shall be positioned at the positive pressure end of the oil-less aspirator pump (preferably a diaphragm pump). The connection sequence is: aspirator pump (used for gas blowing), thermometer, pressure gauge, dry type accumulative flowmeter, wet type gas flow meter.

The correction factor K_{di} and mean correction factor K_d for dry type accumulative flowmeter shall be calculated with formula (42) and formula (43):

$$K_d = \frac{K_w \cdot V_w}{V_d} \cdot \frac{273 + t_d}{273 + t_w} \cdot \frac{(B_a + P_w - P_{wv})}{B_a + P_d} \dots\dots\dots (42)$$

$$\bar{K}_d = \frac{\sum_{i=1}^n K_{di}}{n} \dots\dots\dots (43)$$

Where:

K_w — Correction factor of wet type gas flowmeter;

V_w — Metering volume of wet type gas flowmeter, L;

V_d — Metering volume of dry type accumulative flowmeter, L;

B_a — Atmospheric pressure, Pa;

P_d — Pressure of dry type accumulative flowmeter, Pa;

P_w — Pressure of wet type gas flowmeter, Pa;

P_{wv} — Pressure of saturated vapor at temperature t_w , Pa;

t_d — Atmospheric temperature before dry type accumulative flowmeter, °C;

t_w — Atmospheric temperature of wet type gas flowmeter, °C;

K_{di} — Correction factor for dry type accumulative flowmeter;

$\bar{K}_d$ — Mean correction factor for dry type accumulative flowmeter;

n — Number of calibration points.

12.2.8 Heating temperature for sampling tube

Heat the gas entering the sampling tube to the exhaust gas temperature for regular measurement. Draw gas at common sampling flow, and measure the gas temperature at the sampling tube outlet with thermocouple thermometer or other equivalent thermometers under different adjusted temperatures, so as to calibrate the heating temperature of the sampling tube. Calibration is not required in case the sampling tube outlet is attached with a temperature indication instrument.

12.2.9 Analysis balance. It shall be calibrated with typical weight.

12.2.10 Sampling mouth. Measure its inner diameter with a caliper of 0.05mm accuracy, and take the mathematical mean of three measurements as the result.

Additional Note:

This Standard is proposed by the Scientific & Technical Standard Section of the National Environmental Protection Administration.

This Standard is drafted by Environmental Sanitation & Sanitation Engineering Research Institute of the Academy of Prophylactic Medical Sciences.

The main drafters of this Standard: Liu Guangquan, Chang Dehua, Zhou Yangsheng, Zhou Guangfa and Liu Jiang.

The General Environmental Monitoring Station of China is authorized for interpretation of this Standard.

GB 9078-88 “Test Method of Industrial Kiln Flue Dust” shall be abolished, from the date of implementation of this Standard.

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