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**Automated measuring systems for flue
gas using non-extractive methods**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from Japan Electric Measuring Instruments Manufacturer's Association (JEMIMA) / National Institute of Advanced Industrial Science and Technology (AIST) / Japanese Standards Association (JSA) with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

JIS B 7991 : 2002 and **JIS B 7992 : 2002** are withdrawn and replaced with this Standard.

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Automated measuring systems for flue gas using non-extractive methods

1 Scope

This Japanese Industrial Standard specifies the automated measuring systems (hereafter referred to as “measuring system”) installed *in situ* which perform the long-term continuous measurement of the concentration of sulfur dioxide, nitrogen monoxide, dinitrogen monoxide, nitrogen dioxide, carbon monoxide, carbon dioxide, ammonia, hydrogen chloride, methane and moisture in the gas discharged with combustion of fuel and others or from various manufacturing processes etc. to a chimney or a duct in a factory and a business place using non-extractive methods.

The measurement principle of this Standard shall be based on an infrared absorption method and an ultraviolet absorption method. As other measuring systems, the measuring system by a point method (fixed-point measurement) is given in Annex C.

NOTE : The following International Standards are used as reference in this Standard.

ISO 7935 : 1992 *Stationary source emissions — Determination of the mass concentration of sulfur dioxide — Performance characteristics of automated measuring methods*

ISO 10849 : 1996 *Stationary source emissions — Determination of the mass concentration of nitrogen oxides — Performance characteristics of automated measuring systems*

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 1302 *Insulation resistance testers*

JIS K 0055 *General rules for calibration method of gas analyzer*

JIS K 0211 *Technical terms for analytical chemistry (General part)*

JIS K 0212 *Technical terms for analytical chemistry (optical part)*

JIS K 0213 *Technical terms for analytical chemistry (Electrochemistry part)*

JIS K 0215 *Technical terms for analytical chemistry (analytical instrument part)*

JIS Z 8103 *Glossary of terms used in measurement*

3 Terms and definitions

For the purposes of this Standard, the definitions given in JIS K 0211, JIS K 0212, JIS K 0213, JIS K 0215 and JIS Z 8103, and the following definitions apply.

3.1 sample gas

gas which passes a measuring optical path

3.2 measuring optical path

optical path made with a light emission device and a light reception device installed at the representative location of flue gas flow in a chimney or a duct

3.3 zero gas

gas used in order to calibrate the minimum scale value of a measuring system

3.4 span gas

gas used in order to calibrate the maximum scale value of a measuring system

3.5 wavelength-dispersive method

type of a measuring system with an optical system which performs wavelength dispersion by a prism, a diffraction grating, etc.

3.6 wavelength-nondispersive method

type of a measuring system without an optical system which performs wavelength dispersion using the monochromatic light source such as a semiconductor laser

3.7 zero drift

fluctuation of the indicated value corresponding to the minimum scale value of a measuring system for a certain period of time

3.8 span drift

fluctuation of the indicated value corresponding to the maximum scale value of a measuring system for a certain period of time

3.9 automated measuring system

system which continuously measures and records the concentration of the substance to be measured in flue gas using an automated measuring instrument

3.10 ppm

volume ratio in which concentration is expressed as parts per million

3.11 indication error

percentage of the difference between the indicated value when a midway point gas is introduced into the cell for test and the indicated concentration to the maximum scale

3.12 minimum detection limit

value obtained by doubling the standard deviation of the indicated value at the time of flowing of the gas for test

4 Classification of measuring system and substance to be measured

4.1 Classification

The measuring system for flue gas using a non-extractive method can be classified into two types of a wavelength-dispersive method and a wavelength-nondispersive method according to the measuring method.

- a) **Wavelength-dispersive method** The method which obtains the concentration continuously by irradiating light such as a xenon lamp to the flue gas flow, separating transmitted light into its spectral components, and selecting and detecting the specific absorption wavelength light of the substance to be measured.

It becomes possible to analyze two or more substances simultaneously by successively selecting absorption wavelength light of the substance which has absorption in the ultraviolet region and infrared region.

- b) **Wavelength-nondispersive method** The method which obtains the concentration continuously by irradiating monochromatic light from a semiconductor laser and others which are made to agree with the specific absorption wavelength of the substance to be measured to the flue gas flow.

4.2 Substance to be measured and measuring range

The substance to be measured and the measuring range in 1 m of optical path length by a measuring system in this Standard shall be as given in table 1. The measured value is proportional to the product [$L \times C$ (ppm·m) or (vol%·m)] of the measuring optical path length [L (m)] and the concentration [C (ppm) or (vol%)] of the substance to be measured which exists in the measuring optical path.

The measuring range in optical path length L (m) becomes $1/L$ which is the value given in table 1. The general optical path length in this method is 0.5 m to 10 m.

Table 1 Classification of measuring instrument and substance to be measured, and measuring range in 1 m of optical path length

Substance to be measured	Measuring range	
	Wavelength-dispersive method	Wavelength-nondispersive method
Sulfur dioxide	0 to 200 to 0 to 5 000	—
Nitrogen monoxide	0 to 100 to 0 to 2 500	0 to 500 to 0 to 2 500
Dinitrogen monoxide	0 to 300 to 0 to 5 000	0 to 500 to 0 to 5 000
Nitrogen dioxide	0 to 200 to 0 to 2 500	—
Carbon monoxide	0 to 100 to 0 to 10 000	0 to 0.2 vol% to 0 to 50 vol%
Carbon dioxide	0 to 10 vol% to 0 to 50 vol%	0 to 0.3 vol% to 0 to 50 vol%
Ammonia	0 to 100 to 0 to 1 000	0 to 10 to 0 to 10 000
Hydrogen chloride	0 to 100 to 0 to 5 000	0 to 5 to 0 to 5 000
Methane	0 to 1 000 to 0 to 10 000	0 to 100 to 0 to 10 000
Moisture	0 to 30 vol%	0 to 1 vol% to 0 to 30 vol%
The applicable condition shall be applied when effects of coexisting substances are negligible or when effects are removable.		
NOTE : For the simultaneous measurement of two or more components in the wavelength-dispersive method, the values for 30 s of measurement time per one substance are shown.		

5 Performance of measuring system

The measuring system shall satisfy the performance given in table 2 when the test in clause 7 is performed.

Table 2 Performance of measuring system

Unit : % (percentage to maximum scale value)

Item		Performance										Test method
Substance to be measured		Sul-fur di-oxide	Ni-tro-gen mon-oxide	Di-nitro-gen mon-oxide	Ni-tro-gen di-oxide	Car-bon mon-oxide	Car-bon di-oxide	Am-mo-nia	Hy-dro-gen chlo-ride	Meth-ane	Mois-ture	
Repeatability		±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±3 %	±3 %	±2 %	±2 %	7.4 a)
Zero drift		±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±3 %	±3 %	±2 %	±2 %	7.4 b)
Span drift		±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±3 %	±3 %	±2 %	±2 %	7.4 c)
Indication error		±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±3 %	±3 %	±2 %	±2 %	7.4 d)
Mini-mum detec-tion limit (ppm)	Wave-length-dispersive method	3	1.5	5	2.5	1.5	1 000	1.5	2	10	0.5 vol%	7.4 e)
	Wave-length-non-dispersive method	—	5	5	—	20	30	0.2	0.05	1	0.01 vol%	
Effects of interfering components		±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	7.4 f)
Stability to power supply voltage fluctuation		±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	±2 %	7.4 g)
Withstand voltage		Free from abnormalities										7.4 h)
Insulation resistance		5 MΩ min.										7.4 i)
For the interfering substances such as moisture in which it is difficult to make the gas cell for interference test, the test shall be performed with it installed in situ. When the test is performed by encapsulating moisture of not less than saturated vapour pressure in a gas cell, the gas cell for high temperature which can be heated at 100 °C or higher shall be used. NOTE : The minimum detection limit is a value in 1 m of optical path length (When the cell for calibration of other lengths is used, the converted value in 1 m obtained by dividing by the optical path length of the cell).												

6 Structure and configuration of measuring system

6.1 General structure

The structure of the measuring system shall conform to each of the following items.

- The shape shall be correct, and the finished quality of assembly and each part shall be good and robust.
- It shall normally operate without danger, and work safely and smoothly.
- It shall be structured so that each part does not easily cause mechanical/electrical