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**Continuous analyzers for carbon
monoxide in flue gas**

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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 Manufacturers' Association (JEMIMA)/Japanese Standards Association (JSA), with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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Continuous analyzers for carbon monoxide in flue gas

1 Scope This Japanese Industrial Standard specifies the continuous analyzers (hereafter referred to as “continuous analyzers”), which are capable of measuring continuously for a long term through being set up at a job site with the extractive method, among continuous analytical system and continuous analyzers for the purpose of continuous measurement of carbon monoxide concentration in flue gas which is generated with combustion of fuels and others or is exhausted into chimneys to dissipate in the air during various manufacturing processes, in garbage incineration facilities, factories and establishments.

In addition, this Standard is in principle based on a non-dispersion infrared absorption method and a constant-potential electrolysis method.

NOTE : In addition, there are continuous analyzers based on Fourier transform infrared absorption method (FTIR), a sample gas dilution collecting method and a sample non-extractive method (pass monitor), as shown in Annex (informative) 1 to Annex (informative) 3.

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 B 7551	<i>Variable area flowmeters</i>
JIS C 1302	<i>Insulation resistance testers</i>
JIS K 0001	<i>Reference material—Standard gas—Nitrogen monoxide</i>
JIS K 0002	<i>Reference material—Standard gas—Carbon monoxide</i>
JIS K 0003	<i>Reference material—Standard gas—Carbon dioxide</i>
JIS K 0004	<i>Reference material—Standard gas—Sulfur dioxide</i>
JIS K 0007	<i>Reference material—Standard gas—Propane</i>
JIS K 0055	<i>General rules for calibration method of gas analyzer</i>
JIS K 0095	<i>Methods for sampling of flue gas</i>
JIS K 0151	<i>Non-dispersive infrared gas analyzer</i>
JIS K 0211	<i>Technical terms for analytical chemistry (General part)</i>
JIS K 0212	<i>Technical terms for analytical chemistry (optical part)</i>
JIS K 0213	<i>Technical terms for analytical chemistry (Electrochemistry part)</i>
JIS K 0215	<i>Technical terms for analytical chemistry (analytical instrument part)</i>
JIS Z 8103	<i>Glossary of terms used in measurement</i>

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

- a) **sample gas** gas obtained by pretreating flue gas through a primary filter, a dehumidifier, etc. for the purpose of introducing in an analyzer
- b) **zero gas** gas used for calibration of a minimum scale value of a continuous analyzer
- c) **span gas** gas used for calibration of a maximum scale value of a continuous analyzer
- d) **zero drift** fluctuation of indicated value in an interval corresponding to the minimum scale of a continuous analyzer
- e) **span drift** fluctuation of indicated value in an interval corresponding to the maximum scale of a continuous analyzer
- f) **setup flow** flow of a sample gas and a calibration gas, etc. specified for the continuous analyzer
- g) **ppm** volume ratio of concentration expressed in parts per million
- h) **vol%** volume ratio of concentration expressed in percentage
- i) **indication error** percentages of the difference between the indicated value at the time of introducing an intermediate gas and its displayed concentration to the maximum scale
- j) **response time** combined time of lag time and rise time required for the indicated value of the continuous analyzer to reach a value corresponding to 90 % of the last indicated value after introduction of a test gas
- k) **minimum detection limit** percentage of twice standard deviation of indicated value at the time of flowing a zero test gas to the maximum scale

4 Types and measuring ranges of continuous analyzers The continuous analyzers are classified according to their principles and each measuring range of these continuous analyzers (hereafter referred to as “a range”) are as shown in table 1.

In addition, the range shall be suitably selected from a range shown in table 1.

Table 1 Types and ranges of continuous analyzers

Type	Range (ppm)	Substance to be measured	Applied conditions
IR absorption method	0 to 50 to 0 to 5 000	Carbon monoxide	Applicable when the influence of co-existing carbon dioxide can be neglected or the influence can be removed.
Constant-potential electrolytic method	0 to 200 to 0 to 2 000	Carbon monoxide	Applicable when the influence of co-existing nitrogen oxides, sulfur dioxide, carbon dioxide, hydrogen chloride and hydrocarbons can be neglected or the influence can be removed.

5 Performances of continuous analyzers The continuous analyzers shall satisfy the performances specified in table 2 when the performance test is carried out according to clause 7.

Table 2 Performance of continuous analyzers

Item	Performance	Test method
Repeatability	± 2 % of maximum scale value	7.4 a)
Zero drift	± 2 % of maximum scale value	7.4 b)
Span drift	± 2 % of maximum scale value	7.4 c)
Indication error	± 4 % of maximum scale value	7.4 d)
Minimum detection limits	1 % of maximum scale value or less	7.4 e)
Response time	240 s or less	7.4 f)
Influence of interfering component	± 5 % of maximum scale value	7.4 g)
Stability of indicated value to the fluctuation of flow of sample gas	± 2 % of maximum scale value	7.4 h)
Stability of indicated value to power source voltage	± 2 % of maximum scale value	7.4 i)
Withstand voltage	No abnormality shall be allowed.	7.4 j)
Insulation resistance	5 M Ω or more	7.4 k)

6 Construction

6.1 General construction The construction of continuous analyzers shall comply with the following items.

- The shape shall be right with good assembly and finishing in every part, and the construction shall be robust.
- The continuous analyzer shall be free from risk under normal operation and be safely and smoothly operated.

- c) Each part of the continuous analyzer shall be constructed so as not to easily go out of order mechanically or electrically and cause dangerous conditions.
- d) The continuous analyzer shall be constructed so as to function well even by formation of dew condensation, etc.
- e) The parts contacting heat developing part such as a light source or a heater shall be constructed so that no deformation caused by heat or change in functions occurs.
- f) The continuous analyzer shall be constructed so as to be easy to operate without fear of danger at the time of maintenance or checking.

6.2 Composition The measurement is carried out according to a sample gas extractive method that sample gas is extracted from flue gas and supplied continuously to an analyzer through a duct and a device for pretreatment of samples. As shown in figure 1, the continuous analyzer consists of a sample collecting part, an analyzer, etc.

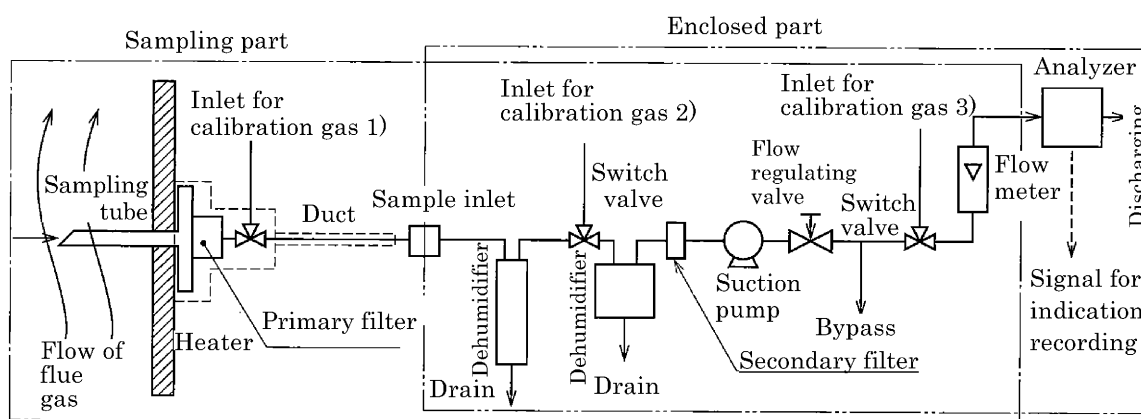


Figure 1 A construction example of a sample gas extractive sampling method

6.3 Sampling parts The parts shall have functions to remove dust in flue gas, remove moisture and corrosive gas including hydrogen chloride or maintain constant moisture, if necessary, and continuously supply a predetermined required amount of the sample gas to the analyzer, while inhibiting the loss of component to be measured as far as possible. It shall be in accordance with JIS K 0095. The part consists of a sampling tube, primary filter, duct, dehumidifier, secondary filter, suction pump, flowmeter, switch valve, and inlet for calibration gas, etc., and materials for each part shall be selected according to the property of flue gas.

- a) **Sampling tube** A sampling tube is a tube attached to a chimney wall, etc. to collect sample gas, and it shall be made of stainless steel, titanium, ceramics, quartz, etc.
- b) **Primary filter** A primary filter is a filter to remove dust in flue gas and shall be used at such a temperatures as not to condense moisture. The net of filter shall be made of glass fibres, stainless steel, etc.

- c) **Duct** A duct is a tube to introduce the flue gas from the primary filter to a sample inlet, and shall be generally made from tetrafluoroethylene resin. It shall be heated, if necessary, to prevent condensation of moisture in the suction path.
- d) **Dehumidifier** A dehumidifier is a device to remove moisture in flue gas using methods including air cooling (ambient air temperature) and electronic cooling, or a semi-permeable membrane gas phase dehumidifying method by selective infiltration of water vapor. Multiple dehumidifiers may be placed depending on the property of the flue gas. The device is also applicable for removal of water soluble gases.
- e) **Secondary filter** A secondary filter is a filter to remove fine dust in sample gas and shall be made of glass fiber, tetrafluoroethylene resin, etc.
- f) **Suction pump** A suction pump is a pump to suck sample gas, etc. and a diaphragm pump is generally applicable. The part contacting the gas shall be made of corrosion-resistant material, for example, a hard vinyl chloride resin, etc.
- g) **Flowmeter** Corrosion-resistance of the meter shall be considered. A floating type area flowmeter, etc. as specified in **JIS B 7551** is applicable.
- h) **Switch valve** A manual or an electromagnetic valve made of a corrosion-resistant material shall be applicable.
- i) **Flow regulating valve** A needle valve, etc. made of corrosion-resistant material shall be applicable.
- j) **Inlet for calibration gas** An inlet for calibration gas is a portion to introduce a calibration gas (standard gas) for calibration of the continuous analyzer. It shall be selected according to the purposes as shown in figure 1⁽¹⁾.

Inlet 1) is used for total calibration of a continuous analyzer, inlet 2) for calibration of process from the dehumidifier and thereafter, and inlet 3) only for calibration of the analyzer ⁽²⁾.

Notes ⁽¹⁾ The gas shall normally be introduced from inlet 1) and calibrated. However, as the procedure requires a long period, inlet 2) or inlet 3) may be selected for daily calibrations.

⁽²⁾ When inlet 3) is selected, the partial pressure of sample gas may be corrected, if necessary, for measurement of the moisture difference in the standard gas and the sample gas treated with the dehumidifier.

6.4 Analyzers

6.4.1 Infrared gas analyzer Molecules constructing substances have inherent vibrations between atoms and absorb a light with a wave length corresponding to the vibration number of the vibration mode. Gas with a constant pressure absorbs a light corresponding to the concentration. As for a carbon monoxide analyzer with non-dispersion infrared absorption method, the concentration of the component is measured by measuring the infrared absorption around 4.7 μm of carbon monoxide. The infrared gas analyzer shall comply with **JIS K 0151** and consists of a light source, rotary sector, optical filter, sample cell, control cell, detector and amplifier, etc., as shown in figure 2.