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JAPANESE INDUSTRIAL STANDARD

**Continuous analyzers
for oxidants in ambient air**

JIS B 7957—1992

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Continuous analyzers for oxidants in ambient air

B 7957-1992

1. Scope

This Japanese Industrial Standard specifies the continuous analyzers used for measuring concentration of oxidant⁽¹⁾ in ambient air continuously based on absorptiometry, chemiluminescence method and ultraviolet absorption method (hereafter referred to as analyzers).

Note ⁽¹⁾ Total oxidant, photochemical oxidant and ozone are applicable objects.

Remarks 1. The Standards cited in this Standard are shown in Attached Table 1.

2. The units and numerical values given in { } in this Standard are based on the traditional unit system, and are appended for informative reference.

2. Common matters

Common matters concerning the analysis employing absorptiometry shall be as specified in JIS K 0050 and JIS K 0115. The sampling method of specimen gas shall be as specified in JIS K 0095.

Informative reference: The method for safety treatment of high-pressure gas shall comply with the High-Pressure Gas Control Law (7 June 1951, Law No. 204).
(Refer to: Working guide for high-pressure gas control, Committee of Safety Counterplan for Ambient Air Measurement, Environment Agency, October 1973.)

3. Definitions

For the purpose of this Standard, in addition to the definitions specified in JIS K 0212, JIS K 0213 and JIS Z 8103, the following principal definitions apply:

- (1) oxidant Generic term of oxidizing substances such as total oxidant, photochemical oxidant and ozone.
- (2) total oxidant Generic term of substances which liberate iodine from neutral potassium iodine solution.
- (3) photochemical oxidant Substances excluding of nitrogen dioxide from total oxidant.
- (4) zero gas Gas used for calibration of the minimum scale value of analyzer.

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- (5) span gas Gas used for calibration of approximately 90 % of the maximum scale value of analyzer.
- (6) Calibration gas Generic terms of gas used for calibration of analyzer such as zero gas, span gas, gas for scale calibration.
- (7) zero drift Fluctuation of indication at the minimum scale of the analyzer during a certain period.
- (8) span drift Fluctuation of indication at the maximum scale of the analyzer during a certain period.
- (9) set flow rate Flow rate of sample gas, calibration gas, etc. set for the analyzer.
4. Classification, principle of measurement, measuring range and object of measurement

The classification, principle of measurement, measuring range (hereafter referred to as range) and object of measurement of analyzers shall be as given in Table 1.

Table 1. Classification of analyzers

Class	Principle of measurement	Range (volppm)	Object of measurement
Oxidant analyzer	Absorptiometry method	0 to 0.5 ⁽²⁾	Total oxidant Photochemical oxidant ⁽³⁾
Ozone analyzer	Chemiluminescence method	0 to 1.0 ⁽²⁾	Ozone
	Ultraviolet absorption method		

Notes ⁽²⁾ There are ranges divided adequately to the purpose of measurement in this range.

⁽³⁾ The photochemical oxidant concentration shall be calculated as follows:

$$A_{ox} = C_{ox} - \left(C_{NO_2} \times \frac{R_{NO_2}}{100} + C_{NO} \times \frac{R_{NO}}{100} \right)$$

where, A_{ox} : photochemical oxidant concentration (volppm₃)

C_{ox} : total oxidant concentration (volppm₃)

C_{NO_2} : nitrogen dioxide concentration (volppm) in ambient air

C_{NO} : nitrogen monoxide concentration (volppm) in ambient air

R_{NO_2} : influence factor of analyzer to nitrogen dioxide (%)

R_{NO} : influence factor of analyzer to nitrogen monoxide (%)

When sulfur oxide scrubber is removed, influence of nitrogen monoxide can be ignored.

5. Rated voltage and rated frequency

The rated voltage of analyzers shall be single phase a.c. 100 V and the rated frequency shall be 50 Hz, 60 Hz or 50/60 Hz.

6. Performances

Analyzers shall satisfy the relevant performances given below.

6.1 Oxidant analyzer

- (1) Repeatability When the test is carried out in accordance with the test method of 8.4.1 (1), the difference in indication shall be within $\pm 2\%$ of the maximum scale value in each range.
- (2) Zero drift When the test is carried out in accordance with the test method of 8.4.1 (2), the zero drift shall be within $\pm 2\%$ of the maximum scale value in each range.
- (3) Span drift When the test is carried out in accordance with the test method of 8.4.1 (3), the span drift shall be within $\pm 4\%$ of the maximum scale value in each range.
- (4) Indication error When the test is carried out in accordance with the test method of 8.4.1 (4), the indication error shall be within $\pm 4\%$ of the maximum scale value in each range.
- (5) Response time When the test is carried out in accordance with the test method of 8.4.1 (5), the response time shall be not more than 10 min.
- (6) Stability against voltage fluctuation When the test is carried out in accordance with the test method of 8.4.1 (6), the change in indication shall be within $\pm 1\%$ of the maximum scale value.
- (7) Dielectric withstand voltage When the test is carried out in accordance with the test method of 8.4.1 (7), no abnormalities shall appear.
- (8) Insulation resistance When the test is carried out in accordance with the test method of 8.4.1 (8), the insulation resistance shall be 2 M Ω or more.
- (9) Influence of interference components When the test is carried out in accordance with the test method of 8.4.1 (9), the influence factor shall be not more than 6 %.
- (10) Stability of sample gas flow rate When the test is carried out in accordance with the test method of 8.4.1 (10), the measured flow rate shall fall within $\pm 7\%$ from the set flow rate.
- (11) Stability of absorption solution flow rate When the test is carried out in accordance with the test method of 8.4.1 (11), the measured flow rate shall fall within $\pm 5\%$ from the set flow rate.

6.2 Ozone analyzer

- (1) Repeatability When the test is carried out in accordance with the test method of 8.4.2 (1), the difference in indication shall be within $\pm 2\%$ of the maximum scale value in each range.
- (2) Zero drift When the test is carried out in accordance with the test method of 8.4.2 (2), the zero drift shall be within $\pm 2\%$ of the maximum scale value in each range.
- (3) Span drift When the test is carried out in accordance with the test method of 8.4.2 (3), the span drift shall be within $\pm 2\%$ of the maximum scale value in each range.
- (4) Indication error When the test is carried out in accordance with the test method of 8.4.2 (4), the indication error shall be within $\pm 2\%$ of the maximum scale value in each range.
- (5) Response time When the test is carried out in accordance with the test method of 8.2.4 (5), the response time shall be not more than 2 min.
- (6) Stability against voltage fluctuation When the test is carried out in accordance with the test method of 8.2.4 (6), the change in indication shall be within $\pm 1\%$ of the maximum scale value.
- (7) Dielectric withstand voltage When the test is carried out in accordance with the test method of 8.4.2 (7), no abnormalities shall appear.
- (8) Insulation resistance When the test is carried out in accordance with the test method of 8.4.2 (8), the insulation resistance shall be 2 M Ω or more.
- (9) Stability against change of sample gas flow rate When the test is carried out in accordance with the test method of 8.4.2 (9), the rate of change in indicated value shall be within $\pm 5\%$.
- (10) Efficiency of ozone decomposing device When the ozone decomposing device accommodated in an analyzer of ultraviolet absorption system is taken out and subjected to the test of 8.4.2 (10), the decomposition efficiency shall be 99.5 % or more.
- (11) Influence of interference components When the test is carried out in accordance with the test method of 8.4.2 (11), the influence of each interference component shall be not more than 5 % of the maximum scale value in each range.

7. Construction

7.1 Construction in general The construction of analyzers shall comply with the following requirements:

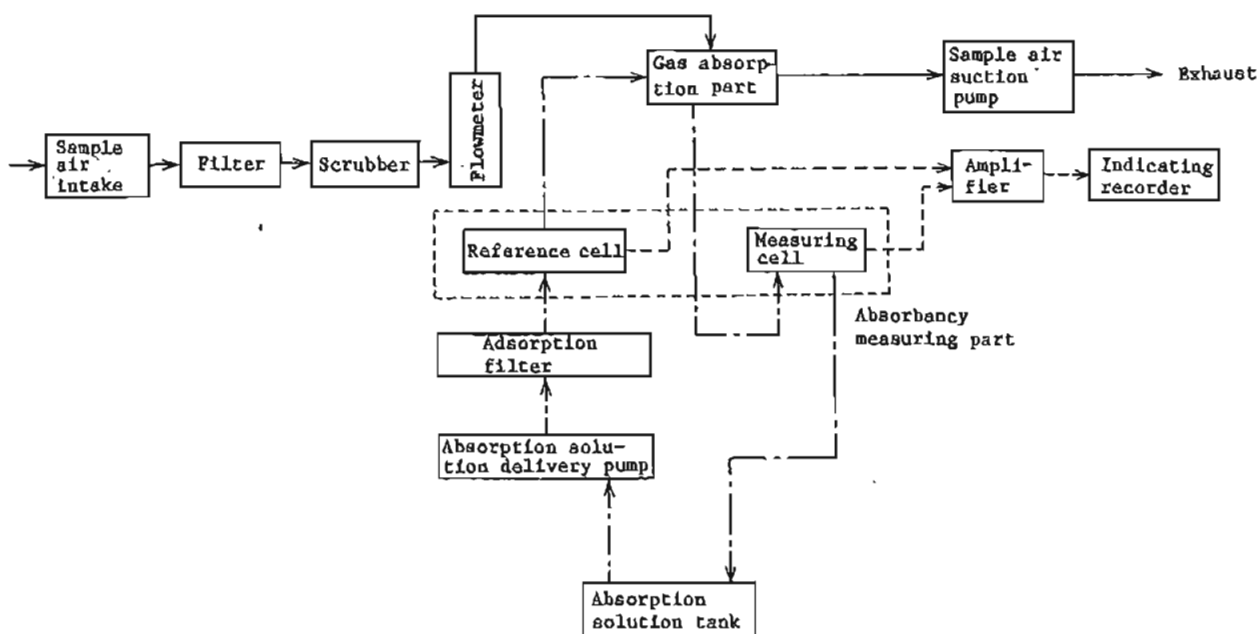
- (1) Analyzers shall be correct in shape, good in assembly and finish, and robust.

- (2) Analyzers shall operate safely and smoothly, without any potential of danger under normal running conditions.
- (3) Each part shall be so constructed that no mechanical or electrical failure takes place and no danger will appear.
- (4) Analyzers shall be so constructed that no trouble appears on the operation of analyzer resulted from dewing or the like.
- (5) The portion which comes in contact with such heat generating parts as the optical source and heater shall be so constructed that no deformation nor change in function takes place.
- (6) Analyzer shall be so constructed that the work is easy without danger at the maintenance and check.

7.2 Analyzer

7.2.1 Configuration of oxidant analyzer (absorptiometry) The analyzer shall be composed of filter, scrubber, flowmeter gas absorption part, sample air suction pump, adsorption filter, absorption solution delivery pump, absorption solution tank, absorbancy measuring part, amplifier, indicating recorder, etc. as shown in the example of Fig. 1.

Fig. 1. Example of oxidant analyzer
(Absorptiometry)



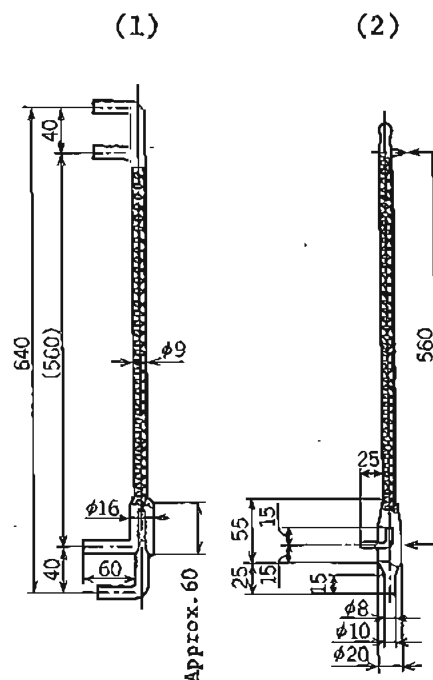
- (1) sample air intake The sample ambient air intake is the part to connect sample ambient air introducing pipe, and shall be able to connect introducing pipe of 6 to 8 mm in inside diameter.
- (2) Filter The filter is used to remove air-borne dust contained in the sample air, and to prevent occurrence of measuring error due to clogging of passage, stain of absorbancy measuring cell, and the dissolution of air-borne dust in the absorption solution or the like, and the materials of the least adsorption of oxidants, for example, polytetrafluoroethylene resin or a material at least equivalent shall be used.
- (3) Scrubber The scrubber is used to prevent influence for the measurement by oxidizing the sulfur dioxide in the sample ambient air to sulfur trioxide, and shall be composed of oxidizing agent made by impregnating sulfuric acid solution of chromium oxide (VI) (CrO_3) into glass fiber filter paper and by drying.
- (4) Flowmeter Because the variation of sample air sampling flow rate becomes the cause of direct error, the flowmeter is necessary to adjust and confirm the flow rate. The flowmeter used for this purpose shall have the maximum scale value of about 1.2 to 2 times the set flow rate and the measuring accuracy shall comply with the specifications of 1.6 (measurement accuracy) specified in JIS Z 8761.
- (5) Absorption solution The absorption solution is neutral phosphate buffer solution of potassium iodide, and shall be prepared by using reagent not containing reducing materials as follows:

For preparation of absorption solution of 10 l, dissolve 200 g of potassium iodide specified in JIS K 8913, 140 g of potassium dihydrogenphosphate specified in JIS K 9007, and 360 g of disodium hydrogenphosphate 12-hydrate specified in JIS K 9019 into 8 l of water. Next, while measuring pH of absorption solution, add sodium hydroxide solution (approximately 10 wt %) or phosphonic acid (approximately 10 wt %) to adjust the pH to 7.0 ± 0.2 , and then make the solution to 10 l by adding water. Use this absorption solution after allowing it to stand for about 24 hours.

- (6) Gas absorption part The gas absorption part shall be a part to make absorption of oxidants in sample ambient air into absorption solution by making contact between them with a constant ratio of flow rate (absorption solution flow rate: sample ambient air flow rate = about 1:1000). Fig. 2 shows one example.

Fig. 2. Example of absorption tube

Unit: mm



- (7) Sample air suction pump The sample air suction pump is the pump to be used for ventilation of sample ambient air to the gas absorption part, and shall have sufficient suction force so as to be able to maintain specified ventilating flow rate, even if the ventilation resistance is increased by the adhesion of air-borne dust on the filter.
- (8) Absorption solution tank As for the absorption solution tank, the materials which are not damaged by the absorption solution, and also do not cause deterioration in quality of the absorption solution shall be used.
- (9) Absorption solution delivery pump The absorption solution delivery pump is a pump to deliver the absorption solution contained in the absorption solution tank to the reference cell and gas absorption part at a constant flow rate.
- (10) Adsorption filter The adsorption filter is used for adsorption and removal of iodine in the absorption solution produced during measurement or the like, and activated charcoal or the like shall be used for circulating use of the absorption solution.
- (11) Absorbancy measuring part The absorbancy measuring part is the part to measure the absorbancy of the absorption solution before and after the ventilation of the sample air, and shall be composed of measuring cell, reference cell, light source lamp, photoelectric tube, metallic interference filter (main wavelength in the vicinity of 350 to 370 nm).

In some absorbancy measuring part the measuring cell also serves as the reference cell.