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Flammable gas detectors

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Foreword

This Japanese Industrial Standard has been established by the Minister of Health, Labour and Welfare and the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by Japan Safety Appliance Association (JSSA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act. This Standard replaces **JIS M 7626:1994** and **JIS M 7653:1996**, which have been withdrawn.

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Flammable gas detectors

Introduction

This Japanese Industrial Standard has been prepared based on **IEC 60079-29-1**: 2016, Edition 2, deleting, however, the requirements for equipment for use in mines as well as making other changes in technical contents in light of local conditions in Japan.

The dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies general requirements for construction, testing and performance, and describes the test methods that apply to portable, transportable and fixed equipment for the detection and measurement of flammable gas or vapour concentrations with air.

This Standard is applicable to flammable gas detection equipment which is intended to provide continuous sensing and an indication, alarm or other output function; the purpose of which is to indicate a potential explosion hazard and in some cases, to initiate automatic or manual protective action(s).

This Standard is applicable to equipment intended to be used for commercial, industrial and non-residential safety applications, as well as diffusion equipment and aspirated equipment with integrated sampling systems.

This Standard does not apply to

- external sampling systems;
- equipment intended for use in mines susceptible to firedamp;
- equipment of laboratory or scientific type;
- equipment used only for process monitoring and/or control purposes;
- open path (line of sight) detectors (only equipment with very short optical paths intended for use where the concentration is uniform over the optical path are within the scope of this Standard).

For equipment used for sensing the presence of multiple gases, this Standard applies only to the detection of flammable gas or vapour.

NOTE 1 This Standard is intended to provide for the supply of equipment giving a level of safety and performance suitable for general purpose applications.

NOTE 2 All equipment calibrated on specific gases or vapours can not be expected to correctly indicate on other gases or vapours.

NOTE 3 Indication of measured concentration in % (v/v) or vol ppm can also be available for equipment with a measurement range of over 20 % LEL up to and including 100 % LEL or a measurement range of up to 20 % LEL. One ppm is equal to 10^{-6} in volume fraction. In that case, units of measurement might need to be selected upon agreement between the

manufacturer and test laboratory when verifying the performance requirements of Annex A.

NOTE 4 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 60079-29-1:2016 *Explosive atmospheres—Part 29-1: Gas detectors—Performance requirements of detectors for flammable gases* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent editions (including amendments) shall be applied.

JIS C 0920 *Degrees of protection provided by enclosures (IP Code)*

NOTE Corresponding International Standard: IEC 60529 *Degrees of protection provided by enclosures (IP Code)*

JIS C 60068-2-6 *Environmental testing—Part 2-6: Tests—Test Fc: Vibration (sinusoidal)*

NOTE Corresponding International Standard: IEC 60068-2-6 *Environmental testing—Part 2-6: Tests—Test Fc: Vibration (sinusoidal)*

JIS C 61326-1:2017 *Electrical equipment for measurement, control and laboratory use—EMC requirements—Part 1: General requirements*

NOTE Corresponding International Standard: IEC 61326-1:2012 *Electrical equipment for measurement, control and laboratory use—EMC requirements—Part 1: General requirements*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

3.1 gas properties

3.1.1

ambient air

normal atmosphere surrounding the equipment

3.1.2

clean air

air that is free of gases or vapours which the sensor is sensitive to or which influence the performance of the sensor

3.1.3

flammable gas or combustible gas

gas or vapour which, when mixed with air in a certain proportion, will form an explosive atmosphere

NOTE For the purposes of this Standard, the term “flammable gas” includes flammable vapours.

3.1.4

lower explosive limit or lower flammable limit, LEL

concentration of flammable gas or vapour in air, below which an explosive gas atmosphere does not form

NOTE The abbreviation LFL may be used instead of LEL.

3.1.5

poisons

substances that lead to temporary or permanent change of performance, particularly loss of sensitivity of the sensing element

3.1.6

upper explosive limit or upper flammable limit, UEL

concentration of flammable gas or vapour in air, above which an explosive gas atmosphere does not form

NOTE The abbreviation UFL may be used instead of UEL.

3.1.7

volume fraction, v/v

quotient of the volume of a specified component and the sum of the volumes of all components of a gas mixture before mixing all volumes referring to the pressure and the temperature of the gas mixture

NOTE The volume fraction and volume concentration take the same value if, at the same state conditions, the sum of the component volumes before mixing and the volume of the mixture are equal. However, because the mixing of two or more gases at the same state conditions is usually accompanied by a slight contraction or, less frequently, a slight expansion, this is not generally the case.

3.1.8

zero gas

gas recommended by the manufacturer, which is free of flammable gases and interfering and contaminating substances, the purpose of which is calibration/adjustment of the equipment zero

3.1.9

standard test gas

test gas with a composition specified for each item of equipment and gas and/or vapour to be used for all tests unless otherwise stated

3.2 types of equipment

3.2.1

alarm-only equipment

equipment with an alarm but not having an indication or output of measured value

3.2.2

aspirated equipment

equipment that samples the gas by drawing it to the gas sensor

NOTE A hand operated or electric pump is often used to draw gas to the sensor.

3.2.3

automatically aspirated equipment

aspirated equipment with an integral pump or separate pump, which is connected directly to the equipment

3.2.4 (Deleted)

3.2.5

diffusion equipment

equipment in which the transfer of gas from the atmosphere to the sensor takes place without aspirated flow

3.2.6

fixed equipment

equipment secured in a specific location when energized

3.2.7 (Deleted)

3.2.8 (Deleted)

3.2.9

portable equipment

equipment intended to be carried by a person during operation

NOTE A portable equipment is battery powered and is operated by the user while it is carried either by hand, by a shoulder strap or carrying harness, and may or may not have a hand directed probe.

3.2.10

transportable equipment

equipment not intended to be carried by a person during operation, nor intended for fixed installation

3.2.11

gas detection transmitter

fixed gas detection equipment that provide a conditioned electronic signal or output indication to a generally accepted industry standard (such as 4 mA to 20 mA), intended

to be utilized with separate gas detection control units or signal processing data acquisition, central monitoring and similar systems, which typically process information from various locations and sources including, but not limited to gas detection equipment

3.2.12

gas detection control unit

equipment intended to provide display indication, alarm functions, output contacts or alarm signal outputs or any combinations when operated with remote sensor(s)

3.2.13

separate gas detection control unit

equipment intended to provide display indication, alarm functions, output contacts or alarm signal outputs or any combination when operated with gas detection transmitter(s)

3.2.14

equipment with integral sensor(s)

equipment that provides display indication, alarm functions, output contacts or alarm signal outputs using a sensor which is within or directly mounted to the equipment housing

3.2.15

accessory

component which can be fitted to the equipment for special purpose

Example External gas pump, sampling probe, hoses, collecting cone, weather protection device

3.3 sensors

3.3.1

sensing element

part of the sensor which is sensitive to the gas/vapour to be measured

3.3.2

sensor

assembly in which the sensing element is housed and that may also contain associated circuit components

3.3.3 (Deleted)

3.3.4

remote sensor

sensor that is separated from the equipment body and is connected to a gas detection control unit or to a gas detection transmitter

3.4 supply of gas to equipment

3.4.1

sample line

means by which the gas being sampled is conveyed to the sensor

NOTE Accessories such as filter or water trap are often included in the sample line.

3.4.2

sampling probe

separate accessory sample line which is optionally attached to the equipment

NOTE It is usually short (e.g. of the order of 1 m) and rigid, although it can be telescopic. In some cases it is connected by a flexible tube to the equipment.

3.4.3

field calibration kit

means of presenting test gas to the equipment for the purpose of calibrating/adjusting or verifying the operation of the equipment in the field

NOTE 1 The field calibration kit can be used for verifying the operation of the alarms if the concentration of the test gas is above the alarm set-point.

NOTE 2 A mask for calibration and test (see 3.4.4) is an example of a field calibration kit.

3.4.4

mask for calibration and test

device that can be attached to the equipment to present a test gas to the sensor in a reproducible manner

3.5 signals and alarms

3.5.1

alarm set point

setting of the equipment at which the measured concentration will cause the equipment to initiate an indication, alarm or other output function

3.5.2 (Deleted)

3.5.3

fault signal

audible, visible or other type of output, different from the alarm signal, permitting, directly or indirectly, a warning or indication that the equipment is not working satisfactorily

3.5.4

special state

any state of the equipment other than those in which monitoring of gas concentration and/or alarming is the intent

NOTE Special state includes warm-up, calibration mode or fault condition.

3.6 times

3.6.1

drift

variation in the equipment indication over time at any fixed gas volume fraction (including clean air) under constant ambient conditions

3.6.2

final indication

indication given by the equipment after stabilization

3.6.3

stabilization

state when three successive readings of an equipment at a constant gas volume fraction, taken at 2 min intervals or twice the respective $t(90)$, whichever is less, indicates no changes greater than $\pm 1\%$ of the measuring range

3.6.4

time of response, $t(x)$

time interval, with the equipment in a warmed-up condition, between the time when an instantaneous change between clean air and the standard test gas, or vice versa, is produced at the equipment inlet, and the time when the response reaches a stated percentage (x) of the stabilized signal on the standard test gas

3.6.5

warm-up time

time interval, with the equipment in a stated atmosphere, between the time when the equipment is switched on and the time when the indication reaches and remains within the stated tolerances

NOTE See Figure 1 and Figure 2.

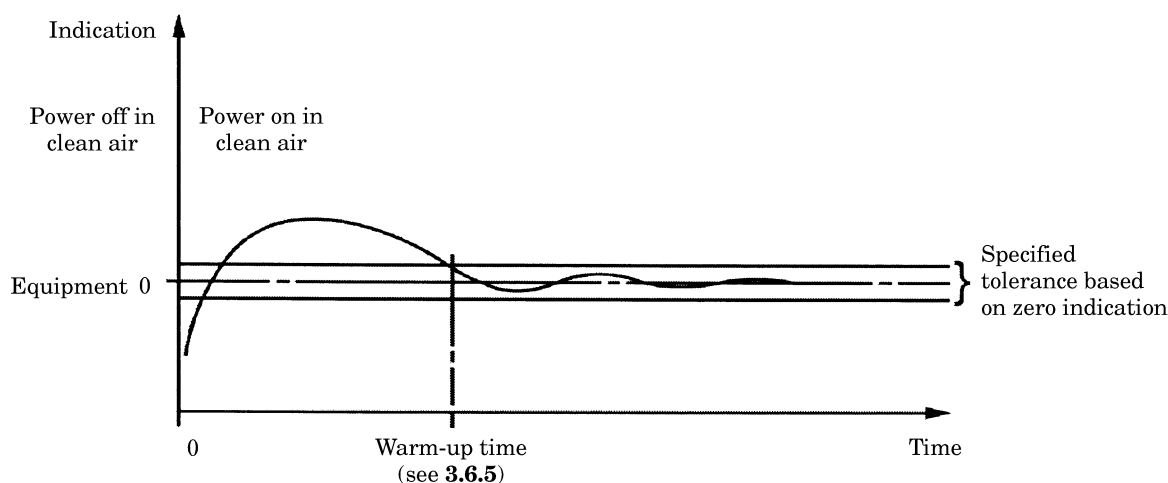


Figure 1 Warm-up time in clean air (typical)

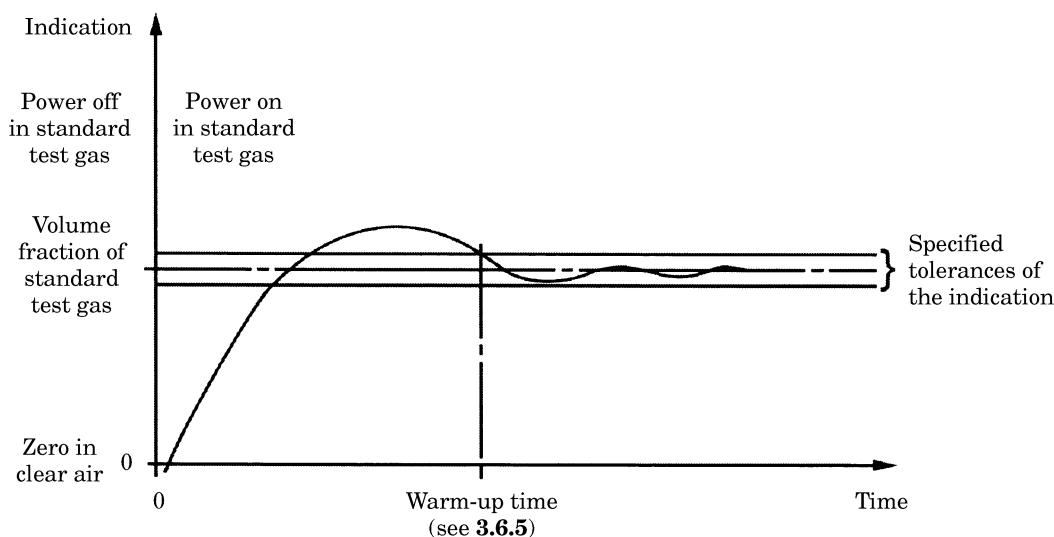


Figure 2 Warm-up time in standard test gas (typical)

3.7 miscellaneous

3.7.1

special tool

tool required to gain access to, or to adjust the equipment controls

NOTE The design of the tool is intended to discourage unauthorised interference with the equipment.

4 General requirements

4.1 Overview

4.1.1 Manufacturer claims

The equipment shall, at a minimum, conform to the requirements of this Standard and performance requirements in Annex A.

Where an equipment manufacturer makes any claims in the instruction manual regarding any special features of construction or superior performance that exceed these minimum requirements, all such claims shall be verified as well as conformance to the minimum requirements. Any additional tests shall be agreed upon by the manufacturer and test laboratory and identified and described in the test report. The test procedures shall be carried out as stated in each clause and shall be extended or supplemented, where necessary, to verify the claimed performance.

Example When a manufacturer claims a sensor accuracy over a temperature range of $-50\text{ }^{\circ}\text{C}$ to $+55\text{ }^{\circ}\text{C}$ which is wider than the range specified in this Standard, $-10\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$, the sensor must meet the specified requirements of 5.4.6 for the temperature range specified in this Standard and meet the manufacturer's claim for the temperature range $-50\text{ }^{\circ}\text{C}$ to $-10\text{ }^{\circ}\text{C}$ and $+40\text{ }^{\circ}\text{C}$ to $+55\text{ }^{\circ}\text{C}$.

There may be applications where equipment with special features are needed.

4.1.2 Equipment ratings

Electrical assemblies and components shall conform to the construction and test requirements of 4.2 and Clause 5, where applicable. In addition, parts of the flammable gas detection equipment intended for use in hazardous areas shall conform to the explosion protection requirements.

The ambient temperature and pressure ranges of equipment conforming to this Standard shall not exceed the ambient temperature and pressure ranges of the explosion protection requirements.

NOTE Explosion protection requirements to be applied include: Article 42 of the Industrial Safety and Health Act stipulating that explosion-protected electrical instruments must not be transferred, leased out, or installed unless they fulfil the standards established by the Minister of Health, Labour and Welfare; and the Explosion-proof Structure Standard for Electrical Instruments stipulated in the Notification of the Minister of Health, Labour and Welfare.

4.2 Construction

4.2.1 General

Gas detection equipment or parts thereof (e.g. remote sensors) specifically intended for use in the presence of corrosive vapours or gases, or which may produce corrosive by-products as a result of the detection process (e.g. catalytic oxidation or other chemical process) shall be constructed of materials known to be resistant to corrosion by such substances.

All equipment shall be constructed to facilitate regular accuracy checks.

All materials and components used in the construction of the equipment shall be used within the manufacturer's ratings or limitations, unless otherwise specified by appropriate safety standards.

Any malfunction of outputs from the gas detection equipment not relevant to safety or health shall not adversely affect the functions of the equipment related to safety.

Example Equipment with 4-20 mA and HART communication where only the 4-20 mA communication is defined in the instruction manual as related to safety. The loss of HART communication is not related to safety.

4.2.2 Indicating devices

4.2.2.1 General

Readily distinguishable indications shall be provided to show that the equipment is energized, in alarm and in special states.

Portable equipment shall provide visual and audible indications for both fault and alarms.

If audible indications are provided for transportable or fixed equipment, alarms shall be indicated as a minimum.

All methods of indication of the measured value shall present the same value within the resolution of each indicator.

The indications related to gas detection transmitters and remote sensors for fixed equipment may be shown only at the (separate) gas detection control unit.

4.2.2.2 Resolution of read-out device

For equipment where the resolution of the read-out device is inadequate to demonstrate compliance with this Standard (e.g. alarm-only equipment or equipment with a low indication resolution), the manufacturer may prepare an external indicating or recording devices for the purpose of testing the compliance of the equipment with this Standard. In this case, the manufacturer shall identify to the test laboratory the suitable points for connecting indicating or recording devices. The indication on the read-out device shall not contradict the results obtained by additional indicating or recording devices.

4.2.2.3 Measurement range

Any over-range measurements shall be clearly indicated as such.

4.2.2.4 Selectable range

If the equipment has more than one measuring range, the range selected shall be clearly identified.

4.2.2.5 Suppression of indication and measured values below zero

It shall be possible to configure the equipment such that in measuring mode any kind of suppression of the measured value is permanently disabled. In calibration mode any kind of suppression of the measured value shall be automatically disabled.

Measured values within the measuring range shall be indicated.

Measured values below 5 % of the measuring range (values below zero included) shall be indicated as:

- a) zero,
- b) another indication that the measured value is below 5 % of the measuring range or
- c) the measured value.

Equipment with a measuring range up to 20 % LEL shall indicate measured values below -10 % of the measuring range or shall provide a fault signal. The equipment shall provide a fault signal at measured values below -20 % of the measuring range at the latest.

All equipment with measuring ranges greater than 20 % LEL shall provide a fault signal at measured values below -10 % of the measuring range at the latest. Portable and transportable equipment shall indicate measured values below -5 % of the measuring range or shall provide a fault signal.

Any suppression of indication shall be explained in the manual [see 4.4 d) 16)].

4.2.2.6 Indicator light

If only one indicator light is provided for signalling alarms, special states and other indications, it shall be coloured red. If separate indicator lights are used or if a multi-coloured indicator light is provided, the colours shall be used in the following order of priority, with a) being the highest priority:

- a) alarms indicating the presence of a gas concentration beyond an alarm set point shall be coloured RED;
- b) equipment special state indicators shall be coloured YELLOW;
- c) power supply indicators shall be coloured GREEN.

If there is more than one indicator light of the same colour with different functions, the lights shall be labelled to show their functions. Text, marks, and icons on a screen display describing the indicator lights are permissible in place of printed labels.

4.2.3 Alarm signals

4.2.3.1 General

Alarm devices shall not be adjustable to operate outside the measuring range.

If alarm devices (including those giving visual or audible indications), output contacts or alarm signal outputs shall be of a latching type requiring a deliberate manual action to reset. If two or more alarm set points are provided, the lower may be non-latching type (automatic reset type) based on user preference. Alarms shall remain in operation while the alarm condition is still present, although audible alarms may be silenced if this audible alarm is not the only alarm.

If it is possible to deactivate alarm devices, output contacts or alarm signal outputs, e.g. for calibration purposes, this deactivation shall be indicated by a signal. For fixed equipment, this shall include a contact or other transmittable output signal. However, the output signal or contacts are not required if the alarms are automatically re-enabled within 15 min.

4.2.3.2 (Deleted)

4.2.3.3 Portable equipment indicating up to 100 % LEL

Alarm devices shall not be adjustable above 60 % LEL. An additional over-range alarm, which indicates when full scale has been exceeded, may be provided.

4.2.4 Fault signals

Fixed and externally powered transportable equipment shall provide a fault signal in the event of failure of power to the equipment, including blackouts.

Externally powered equipment shall provide a fault signal when the power supply falls below the manufacturer's specified minimum supply voltage fault limit.

A short-circuit or open-circuit in connections to any remote sensor or gas detection transmitter shall be indicated by a fault signal.

Under the above conditions the equipment may also indicate alarm.

Measured values below zero (e.g. caused by drift) shall be indicated by a fault signal in accordance with the conditions of **4.2.2.5**.

For equipment where the sensor can be disconnected without opening the housing, the equipment shall provide a fault signal in the event of a disconnection of the sensor.

Automatically aspirated equipment shall be provided with an integral flow-indicating device that produces a fault signal in the event of low flow.

4.2.5 Adjustments

All adjustment devices shall be designed so as to discourage unauthorized or inadvertent interference with the equipment. Examples include password lock function or mechanical devices such as a cover requiring the use of a special tool.

Fixed explosion-protected equipment housed in explosion-protected enclosures shall be designed so that, if any facilities for adjustment are necessary for routine recalibration and for resetting or similar functions, these facilities shall be externally accessible. The means for making adjustments shall not degrade the explosion protection of the equipment.

The adjustments of the zero and sensitivity shall be designed so that

- a) adjustment of one will not affect the other;
- or
- b) it shall not be possible to adjust only one and the sequence of adjustments shall ensure that the affected one is adjusted second.

The equipment shall not perform an automatic zero adjustment during start-up without the user's selection. If equipment prompts the user for zero adjustment during start-up and the user makes no selection, equipment shall continue to start-up without zero adjustment, after a delay of no more than 15 s.

4.2.6 Battery-powered equipment

Equipment powered with integral batteries shall be provided with an indication of low battery condition, and the purpose of this indication shall be explained in the manual [see 4.4 j)].

4.2.7 Gas detection transmitter for use with separate gas detection control units

A specification shall be supplied to the test laboratory that describes the relationship the gas concentration (detected by the equipment) has with the corresponding output signal or indication (transfer function). Such specification shall be detailed to the extent that the accuracy of this transfer function can be verified. As a minimum, the manufacturer shall provide data showing the relationship between the output signal and the gas concentrations corresponding to 0 %, 10 %, 30 %, 50 %, 70 %, 90 % and 100 % of full-scale output indication. Full-scale output and status signals (e.g. fault, inhibit) shall also be specified by the manufacturer.

Where necessary, equipment shall be provided by the manufacturer to interpret the output signal or indication, which will enable the accuracy of the transfer function to be verified by the test laboratory.

4.2.8 Separate gas detection control units for use with gas detection transmitter(s)

A specification shall be supplied to the test laboratory that describes the relationship the input signal has with the calculated gas concentration (transfer function). Such specification shall be detailed to the extent that the accuracy of this transfer function can be verified. As a minimum, the manufacturer shall provide data showing the relationship between the input signal and the gas concentrations corresponding to 0 %, 10 %, 30 %, 50 %, 70 %, 90 % and 100 % of full-scale output indication.