



BS 6020: Part 1 : 1981

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Instruments for the detection of combustible gases

**Part 1. Specification for general requirements
and test methods**

Instruments pour la détection des gaz combustibles
Partie 1. Spécification des exigences générales et méthodes d'essai

Instrumente für Spüren von brennbaren Gasen
Teil 1. Spezifikation für allgemeine Anforderungen und Prüfverfahren

BS 6020 : Part 1 : 1981

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Foreword

BS 6020 has been prepared under the direction of the Gas Standards Committee. The preparation of this standard arises from the recognition, during the early 1970s, of a need for gas detectors of defined performance and reliability to monitor potentially hazardous areas in which flammable gas concentrations may accumulate.

BS 6020 covers the details of construction, safety, performance and testing of portable, transportable and fixed instruments for sensing the presence of combustible gas or vapour concentrations with air. The instruments, or parts thereof, may be installed or used in potentially explosive atmospheres as described in BS 5501 : Part 1 and BS 5345 and also, where applicable, in mines susceptible to firedamp. This standard comprises five Parts, as follows.

Part 1. Specification for general requirements and test methods

Part 2. Specification for safety and performance requirements for Group I instruments reading up to 5 % methane in air

Part 3. Specification for safety and performance requirements for Group I instruments reading up to 100 % methane

Part 4. Specification for performance requirements for Group II instruments reading up to 100 % lower explosive limit

Part 5. Specification for performance requirements for Group II instruments reading up to 100 % gas*

It should be noted that Group I instruments, i.e. those to be used in mines susceptible to firedamp, are not permitted to be used without the additional and prior approval of the Health and Safety Executive in mines under their jurisdiction. Information on the requirements for approval is obtainable from:

HSE (M) Approvals, CIM Section
HM Mines and Quarries Inspectorate
Health and Safety Executive
St Peter's House
Balliol Road
Bootle
Merseyside
L20 3LZ

BS 6020 applies to mains (up to 600 V r.m.s.) or battery operated instruments intended to provide an indication, alarm or other output function, the purpose of which is to give a warning of potential explosion hazard.

BS 6020 covers instruments intended to be used for commercial and industrial safety applications. It does not

cover gas detection instruments of the laboratory or scientific type used only for analysis or measurement, instruments intended by the manufacturer specifically to detect only toxic gases, or instruments used only for process control purposes.

The requirements of BS 6020 are supplemented by the recommendations on the use of gas detectors given in BS 6959

BS 6020 has been developed from an original draft prepared by a Coal, Electricity and Gas (CEG) Working Party set up by the CEG Research Liaison Committee which, itself, provides a liaison channel on research and development topics of common interest to the nationalized fuel industries. This Working Party included representatives from the Post Office and the Health and Safety Executive, because of their interest in and knowledge of gas detection equipment.

The BSI Technical Committee (GSE/29) responsible for the preparation of BS 6020 therefore acknowledges a debt to members of the Working Party for their help in the preparation of this standard.

During the preparation of this standard, and with a clear intention to minimize trade barriers in respect of the instruments covered by the standard, cognizance has been taken of concurrent work on similar standards in other countries.

Particular note has been taken of the requirements of the following.

(a) Canadian standard: CSA 22.2 No. 152 - 1976.

Combustible gas detection instruments

(b) Instrument Society of America standard:

Draft Standard ISA - dS 12.13 - 1978: Performance requirements: Combustible gas detectors

Part 1 of BS 6020 specifies the general requirements, including construction, and the test requirements applicable to all types of instruments covered by this standard.

It should be noted that this Part makes no mention of a radio-frequency interference test because there is no generally accepted test method, although it is recognized that the performance of combustible gas detectors may in some circumstances be affected by such interference. Where radio-frequency interference is expected to be a problem, it is left to the manufacturer and purchaser of the gas detection instrument to agree on an appropriate test.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

*In course of preparation.

British Standard

Instruments for the detection of combustible gases

Part 1. Specification for general requirements and test methods

1. Scope

This Part of this standard covers the details of construction and testing of portable, transportable and fixed instruments for sensing the presence of combustible gas or vapour concentrations with air. The instruments, or parts thereof, may be installed or used in potentially explosive atmospheres as described in BS 5501 : Part 1 and BS 5345 and in mines susceptible to firedamp.

This Part specifies the general requirements and describes the test methods that apply to all instruments covered by BS 6020; the performance requirements specific to the various types of instruments are given in Parts 2, 3, 4 and 5 of this standard.

This Part covers combustible gas detection instruments intended to provide an indication, alarm or other output function, the purpose of which is to give a warning of potential explosion hazard.

This Part applies to instruments operating at supply voltages not exceeding 600 V r.m.s. or operated by any type of battery.

This Part applies to instruments intended to be used for commercial and industrial safety applications. It does not apply to instruments of the laboratory or scientific type used only for analysis or measurement, instruments intended by the manufacturer specifically to detect only toxic gases or instruments used only for process control purposes.

Although instruments of the type described in Parts 2 and 4 of this standard are suitable for detecting a wide range of combustible gases, only methane and propane are specified as the calibration gases for the purpose of practical convenience. The performance requirements specified in Parts 2 and 4 of this standard are therefore to be regarded with caution when the instruments are used to detect other combustible gases, as some parameters (such as speed of response) will be modified.

Instruments of the types described in Parts 3 and 5 of this standard are suitable for use only with the specific gases for which they have been calibrated.

2. References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3. Definitions

For the purposes of this standard the following definitions apply.

3.1 alarm correlation. The correlation between the alarm set point and the meter reading or other alternative output.

3.2 alarm set point. The concentration of gas to which an alarm is set.

3.3 ambient air. The normal atmosphere surrounding the instrument.

3.4 aspirated instruments. Combustible gas detecting instruments which obtain the gas by drawing it to the gas sensor, for example by means of a hand operated or electric pump.

3.5 clean air. Air which is free of combustible gases and contaminating substances.

3.6 continuous duty instruments. Combustible gas detecting instruments which are continuously powered but may have continuous or intermittent sensing.

3.7 continuous sensing. A mode of operation in which the combustible gas detecting sensing element has power continuously applied.

3.8 diffusion instrument. An instrument in which the transfer of gas from the atmosphere to the gas sensor takes place by diffusion, i.e. there is no aspirated flow.

3.9 drift. The variation in instrument reading with time at any gas level (including clean air).

3.10 explosion protected apparatus. Any form of apparatus with a recognized type of protection as defined in BS 5345 : Part 1.

3.11 explosive range. The range of gas or vapour mixtures with air between the explosive (flammable) limits over which the gas mixtures are explosive.

3.12 fault signal. An audible, visible or other indication that the instrument is not working satisfactorily.

3.13 firedamp. A flammable gas, consisting mainly of methane, found naturally in mines.

3.14 fixed instrument. An instrument which is intended to have all parts permanently installed.

3.15 Group I instrument. An electrical gas detection instrument for mines susceptible to firedamp.

3.16 Group II instrument. An electrical gas detection instrument for places with a potentially explosive atmosphere, other than mines susceptible to firedamp.

3.17 intermittent sensing. A mode of operation in which the power to the sensor is supplied according to a pre-determined cycle.

3.18 latching alarm. An alarm which, once activated, requires deliberate action to deactivate it.

3.19 lower explosive limit (LEL). The lower limit of the explosive (flammable) range as given in table 5 of BS 5345 : Part 1 : 1976.

3.20 measurement time (spot reading instruments). The time in which a spot reading instrument makes a measurement depends on the response time and the warm-up time of the instrument. For the purpose of this standard, the measurement time is the time interval between the first

operation of the instrument and the time when the instrument reaches 90 % of the final reading.

3.21 portable instrument. An instrument designed to be readily carried by the user from place to place, as required.

3.22 remote sensor. A sensor which is not integral with the main body of the instrument.

3.23 response time. The time interval, with the instrument operating normally, between the time when an instantaneous variation in gas concentration is produced at the sensor input and the time when the response reaches a stated percentage of the final reading.

3.24 sample line. The pipeline by means of which the gas being sampled is conveyed to the sensor.

3.25 sampling probe. A separate sample line that may or may not be supplied with the instrument, which is attached to the instrument as required. It is usually short (e.g. of the order 1 metre) and rigid (e.g. it may be telescopic), but may be connected by a flexible tube to the instrument.

3.26 sensing period. That period in which an instrument is energized and active (relevant to the mode of operation of intermittent sensing instruments).

3.27 sensor. An assembly in which the sensing element is housed and which may contain associated circuit components.

3.28 special tool. A tool required to gain access to, or to adjust, controls. The design of the tool is intended to discourage unauthorized interference with the instrument.

3.29 spot reading instrument. An instrument intended to be used for short periods of time as required.

3.30 transportable instrument. An instrument not intended to be portable, but which can readily be moved from one place to another.

3.31 upper explosive limit (UEL). The upper limit of the explosive (flammable) range as given in table 5 of BS 5345 : Part 1 : 1976.

3.32 warm-up time. The time interval, with the instrument in clean air, between the time when the instrument is switched on and the time when it indicates a zero concentration within stated tolerances.

4.1 Introduction

4.1.1 Instruments shall comply with the requirements of this Part, together with the appropriate supplementary requirements given in Part 2, 3, 4 or 5 of this standard.

4.1.2 Combustible gas detectors shall comply with the requirements of BS 4743, except that the requirements of the standards for potentially explosive or explosive atmospheres referred to in 4.1.3 to 4.1.5 shall take precedence where they conflict with those of BS 4743.

NOTE 1. BS 4743 expressly exempts those types of direct indicating instruments (and those types of recording instruments), or parts of such instruments, that at the choice of the manufacturer have been designed in accordance with BS 5458, provided that the choice is clearly stated and that the instruments also comply with the 'relevant publications' referred to in the scope of BS 5458 in respect of their performance and accuracy. The exemptions include the following.

- (a) Instruments having an incorporated supply source, in general a battery, provided that the electronic devices are used for processing the indicated (or recorded) value only and that the voltage of the source and any voltage generated from the source does not exceed the limits of safety extra-low voltage. (An external supply source is allowed when the nominal circuit voltage, i.e. circuit insulation voltage, of the measuring circuit does not exceed the limits of safety extra-low voltage.)

- (b) Those parts of an instrument that do not contain any electronic device and are permanently and substantially separated from the parts that contain electronic devices. (Requirements concerning the separation are contained in BS 5458.)

- (c) Other appropriate exemptions in BS 4743 : 1979, for example the exemption from requirements for creepage and clearances for safety class III apparatus in 9.5.1, may also be invoked by agreement with the certifying authority.

NOTE 2. For the purposes of BS 6020, the reference to the 'relevant publications' in BS 5458 is taken to mean the particular publications for the types of measuring instruments listed in 1.1 of BS 5458 : 1977, including BS 6020.

NOTE 3. For the purposes of BS 6020, safety extra-low voltage (SELV) is defined as a voltage that does not exceed 50 V a.c. (r.m.s.) between conductors or between any conductors and earth, in a circuit that is isolated by a transformer or converter with separate windings.

A corresponding d.c. value is under consideration.

The voltage limit should not be exceeded either at full load or no-load, but it is assumed, for the purposes of this definition, that any transformer or converter is operated at its rated supply voltage.

4.1.3 Electrical assemblies and components shall comply with the construction and test requirements specified in 4.2 and clause 5 where applicable. In addition, all parts of the combustible gas detection instrument shall employ materials and construction suitable for continuous operation within an ambient temperature range as specified in Part 2, 3, 4 or 5 of this standard, as appropriate and, in particular:

- (a) flameproof enclosures 'd' shall comply with the requirements of BS 5501* : Part 5, or BS 4683 : Parts 1 and 2;

- (b) intrinsically safe and associated apparatus 'i' shall comply with the requirements of BS 5501* : Part 7 or alternatively, for Group I apparatus only, the requirements of BS 1259;

- (c) increased safety electrical apparatus 'e' shall comply with the requirements of BS 5501* : Part 6 or BS 4683 : Parts 1 and 4;

- (d) pressurized electrical apparatus 'p' shall comply with the requirements of BS 5501* : Part 3;

- (e) any other type of protection of the electrical apparatus used, including 's', shall be suitable for use in a Group II zone 1 area as defined in BS 5345 : Part 1.

NOTE. BS 5501* : Part 1 and BS 4683 : Part 1 specify a reference ambient temperature of +40 °C but provide for the use of other ambient temperatures to meet the needs of instruments intended for operation at such temperatures. This provision should be taken into account in determining the compliance with BS 5501 and BS 4683 of instruments intended for operation at the extremes of temperature covered by this standard, i.e. -40 °C to +75 °C. Thus, for example, it would be inappropriate to determine compliance with BS 5501 at a reference ambient temperature of +40 °C if the instrument were intended to be operated at an actual ambient temperature of +75 °C.

4.1.4 As alternatives to the standards referred to in 4.1.3, any other standard or type of protection listed in BS 5345 : Part 1 shall be considered suitable, within the limitations given in BS 5345.

4.1.5 For Group I apparatus any electrical circuits to be installed in the same area as the sensor, including those within the sensor, shall be certified intrinsically safe ('ia'); the sensing elements shall be intrinsically safe, or their enclosures shall comply with the safety requirements specified in Part 2 or 3 of this standard, as appropriate. Group I apparatus shall also comply with the requirements of BS 5754.

4.2 Construction

4.2.1 General. Gas detection instruments or portions thereof, or remote sensors, which are intended for installation or use in the area where the gas or vapour is to be detected, shall be suitable for use in zone 1 hazardous locations (see BS 5345 : Part 1) or in mines susceptible to firedamp.

Gas detection instruments or remote sensors specifically intended for use in the presence of corrosive vapours or gases, or which may produce corrosive byproducts as a result of a catalytic oxidation or other chemical process, shall be constructed of materials known to be resistant to corrosion by such substances.

All instruments shall be provided with means for facilitating regular accuracy checks. Portable continuous duty instruments of the aspirated type shall include the necessary sample pumping mechanism and the complete assembly shall be tested.

The design of a combustible gas detection instrument shall be such that all materials used in the construction and all components, including electrical and electronic components, employed in the instrument shall be used within the manufacturers' ratings, or limits specified by the material or component manufacturer, unless otherwise specified by appropriate safety standards taking into account the limits of specified operating conditions.

The instrument shall show, in a location on or adjacent to the meter or other indicator, the gas with which it has been calibrated.

Hand held spot reading instruments shall not exceed 1 kg in mass.

4.2.2 Meters and indicators. An indication shall be provided to show that the instrument is switched on.

Instruments fitted with meters intended for measurement of gas concentrations shall have sufficient scale divisions and scale length to permit measurement of the deviations permitted by the requirements of this standard. Meters need not comply with this requirement if an alarm or other indicator that meets the requirements of this standard is fitted to the gas detection instrument and if the meter does not include a calibrated scale.

For Group I instruments reading up to 5 % methane, the width of the needle on the meter shall be less than half of the scale division representing 0.1 % methane. The graduations on the scale shall be equivalent to 0.1 % methane, between 0 % and 2 % methane, and 0.25 % methane, between 2 % and 5 % methane. If digital displays are used, it shall be possible to distinguish intervals of 0.05 % methane.

Where no meter is fitted, the manufacturer shall identify suitable points for connecting a meter or read out device for the purpose of testing the compliance of the instrument with this standard.

Portable continuous duty aspirated instruments should incorporate a suitable indicating device to indicate correct gas flow, but if such an indicating device is omitted the instruction manual shall contain detailed instructions as required by 4.3.4(k).

If individual coloured indicating lights are fitted, they shall be coloured as follows.

- (a) Alarms indicating the presence of gas in potentially dangerous concentrations shall be coloured RED.
- (b) Equipment fault indicators shall be coloured YELLOW.
- (c) Power supply indicator lights shall be coloured GREEN.

In addition to the colour requirements, the indicator lights shall be adequately labelled to show their functions.

4.2.3 Alarm or output functions

4.2.3.1 Continuous duty instruments. Where alarm devices, output contacts, or signal outputs intended to indicate a combustible gas concentration are fitted, they should be of a latching type requiring a deliberate manual action to reset but if a non-latching type is used, this shall be indicated clearly and prominently in the instruction manual (see 4.3.4(j)).

4.2.3.2 Group II portable instruments reading up to 100 % LEL only. Alarm devices provided as part of portable gas detection instruments shall be set to operate at a gas concentration not higher than 60 % of the LEL.

4.2.4 Fault signals. Fixed and transportable gas detection instruments shall provide a fault signal in the event of failure of power to the instrument, loss of continuity or short circuit in one or more of the wires to any remote sensor, or loss of continuity of any gas sensing system (see 5.2.1). This fault signal shall be distinguishable from any other alarm or plant shutdown signal and shall not give a false gas alarm.

Fixed and transportable aspirated type gas detection instruments shall be provided with integral flow proving devices which produce a fault signal in the event of loss of flow or, if not so equipped, the instruction manual shall clearly indicate that suitable flow proving devices have to be provided at the time of installation (see 4.3.4(g)).

Instruments powered with integral batteries shall be provided with an indication of low battery condition and the nature and purpose of this indication shall be clearly explained in the instruction manual (see 4.3.4(h)).

4.2.5 Adjustments. Instruments for Group I applications shall require the use of special tools to gain access to adjustment devices and to reset maintained readings and alarm circuits.

For Group II instruments, external adjustments other than the zero adjustments on spot reading instruments shall require the use of a special tool or key to change the settings.

NOTE. The use of a special tool does not apply to normal operating controls such as range selector switches, on/off switches or channel selection switches. It is intended to apply to those adjustments which, if tampered with, and such tampering would not be immediately obvious, could result in misleading indications or unsafe operation of the instrument.

Fixed instruments housed in explosion protected enclosures shall be designed so that all adjustments necessary for routine recalibration and for resetting or like functions are externally accessible. Routine recalibration shall require

*Marking BS 6020 : Part 2, 3, 4 or 5, as appropriate, on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, British Standards Institution, Maylands Avenue, Hemel Hempstead, Herts HP2 4SQ in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.

the use of a special tool or key to change the settings. The means for making such adjustments shall not degrade the explosion protection of the enclosure.

4.2.6 Batteries

4.2.6.1 Portable continuous duty instruments. Instruments with fresh or fully charged batteries shall be capable of continuous normal non alarm operation for a period of at least 10 h, without replacement or recharge of batteries.

4.2.6.2 Portable spot reading instruments. Instruments with fresh or fully charged batteries shall be capable of operation at a duty cycle of 10 min 'on' and 10 min 'off' for a period of 8 h (total cumulative 'on' time of 4 h) without replacement or recharge of the batteries.

NOTE. If the instrument is provided with a switch which has to be manually held in the 'on' position for the duration of the measurement, the duty cycle may be reduced to 5 min 'on' and 15 min 'off' (total cumulative 'on' time of 2 h).

Alternatively, they shall be capable of performing the following.

- (a) 500 tests, for Group I instruments reading up to 5 % methane.
- (b) 250 tests, for Group I instruments reading up to 100 % methane.
- (c) 200 tests, for all Group II instruments.

Each test comprises an 'on' period of sufficient duration to give an accurate reading followed by an 'off' period of 30 s. Group I instruments shall incorporate a device for checking the on-load battery condition.

4.3 Labelling and instructions

4.3.1 Identification. Each instrument shall carry a label stating the manufacturer's name and the instrument type identification and serial number, together with the number of the appropriate Part of this standard*. This shall be in addition to the labelling requirements contained in the standards to which reference is made in 4.1, as applicable.

4.3.2 Cautions. All gas detection instruments shall be labelled:

'CAUTION: READ AND UNDERSTAND INSTRUCTIONS BEFORE OPERATING OR SERVICING'.

The word 'CAUTION' of the foregoing shall be in capital letters at least 3 mm high. The balance of the wording shall be in capital letters at least 2.5 mm high.

The labels shall be visible, legible and permanently attached on each gas detection instrument in the following manner as appropriate.

- (a) For portable and transportable instruments, the labelling required shall appear on a surface of the instrument and/or its carrying case which is exposed when the instrument is in use.
- (b) For fixed instruments, the labelling required shall appear in a location where it will be visible after installation and in direct sight during the routine periodic recalibration and readjustment.
- (c) For modular control units comprising one or more control modules in a common enclosure or mounting assembly, the labelling need not be repeated on each module but may appear as a single label on the common portion of the assembly.

4.3.3 Calibration gas. Portable and transportable instruments shall carry a label indicating the gas with which the instrument has been calibrated by the manufacturer. This label may be on the meter, if provided, or on the surface of the instrument and/or carrying case (adjacent to the meter, if provided).

Fixed instruments with remote sensors shall carry a label on the sensor indicating the gas with which the sensor has been calibrated by the manufacturer.

4.3.4 Instruction manual. Each gas detection instrument or group of instruments shall be provided with a suitable instruction manual.

The instruction manual shall contain complete, clear, and accurate instructions for safe and proper operation, installation and servicing of the instrument. It shall include the following information.

- (a) Complete installation and initial start-up instructions.
- (b) Operating instructions and adjustments.
- (c) Instructions for checking and/or calibration on a routine basis.
- (d) Details of operational limitations including, where applicable, the following.
 - (1) Range of gases for which the instrument is suitable.
 - (2) Ambient temperature limits.
 - (3) Humidity range.
 - (4) Voltage range.
 - (5) Relevant characteristics and construction of the cable between the control unit and remote sensors.
 - (6) The need for shielding of wiring.
 - (7) Battery life.
 - (8) Maximum and minimum storage temperature limits.
 - (9) Pressure limits.
 - (10) Sample velocity limits.

(e) For Group II applications a reference to BS 6959 Part 1 for information on the adverse effects of contaminating gases or substances and oxygen enriched or deficient atmospheres on the proper performance (and, in the case of oxygen enriched atmospheres, of electrical safety) of the instruments.

For Group I applications, equivalent information shall be provided.

- (f) For instruments of the aspirated type, wording to indicate the minimum and/or maximum flow rate or range of flow rates, pressure and tubing type and size for proper operation.
- (g) Instructions for the provision of flow proving devices (see 4.2.4).
- (h) Clear statements of the nature and significance of all alarms and fault signals, the duration of such alarms and signals (if they are time-limited or self-restoring), and any provisions which may be made for silencing or resetting of such alarms and signals as applicable.
- (i) Details of any method for determination of the possible sources of a malfunction and any corrective procedures.