

Electrical apparatus for the detection and measurement of flammable gases —

Part 1: General requirements and test methods

The European Standard EN 61779-1:2000, with the incorporation of amendment A11:2004, has the status of a British Standard

ICS 13.320; 17.060; 29.260.20

National foreword

This British Standard is the official English language version of EN 61779-1:2000, including amendment A11:2004. It was derived by CENELEC from IEC 61779-1:1998. It supersedes BS EN 50054:1999 which will be withdrawn on 30 June 2003.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags [C] [C]. Where a common modification has been introduced by amendment, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC amendment A11 are indicated by [C11] [C11].

The UK participation in its preparation was entrusted by Technical Committee GEL/31, Electrical apparatus for explosive atmospheres, to Subcommittee GEL/31/19, Gas detectors, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Electrical apparatus for the detection and measurement of flammable gases — Part 1: General requirements and test methods

(includes amendment A11:2004)
(IEC 61779-1:1998, modified)

Appareils électriques de détection et de mesure
des gaz combustibles —
Partie 1: Règles générales et méthodes d'essai
(inclut l'amendement A11:2004)
(CEI 61779-1:1998, modifiée)

Elektrische Geräte für die Detektion und
Messung brennbarer Gase —
Teil 1: Allgemeine Anforderungen und
Prüfverfahren
(enthält Änderung A11:2004)
(IEC 61779-1:1998, modifiziert)

This European Standard was approved by CENELEC on 2000-01-01; amendment A11 was approved by CENELEC on 2004-02-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of IEC 61779-1:1998 was considered by the CENELEC Subcommittee SC 31-9, Electrical apparatus for the detection and measurement of combustible gases to be used in industrial and commercial potentially explosive atmospheres, and it was agreed that the standard could be harmonised as a European Standard with common modifications.

The resulting draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 61779-1 on 2000-01-01.

This European Standard supersedes EN 50054:1998.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-01-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-06-30

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex A and Annex ZA are normative and Annex B and Annex C are informative.

Annex ZA has been added by CENELEC.

Guidance for the selection, installation, use and maintenance of gas detecting apparatus are set out in EN 50073, Guide for selection, installation, use and maintenance of apparatus for the detection and measurement of combustible gases or oxygen.

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and covers essential requirements of EC Directive 94/9/EC.

Endorsement notice

The text of the International Standard IEC 61779-1:1998 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A11

This amendment to the European Standard EN 61779-1:2000 was prepared by SC 31-9, Electrical apparatus for the detection and measurement of combustible gases to be used in industrial and commercial potentially explosive atmospheres, of Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A1 to EN 61779-1:2000 on 2004-02-01. At publication it was renumbered amendment A11.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2004-08-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2004-08-01

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ELECTRICAL APPARATUS FOR THE DETECTION AND MEASUREMENT OF FLAMMABLE GASES –

Part 1: General requirements and test methods

1 General

1.1 Scope

1.1.1 This part of IEC 61779 specifies general requirements for construction and testing and describes the test methods that apply to portable, transportable and fixed apparatus for the detection and measurement of flammable gas or vapour concentrations with air. The apparatus, or parts thereof, are intended for use in potentially explosive atmospheres (see 2.1.8) and in mines susceptible to firedamp. This standard is supplemented by the following standards, concerning the specific requirements for the performance of the various types of apparatus:

IEC 61779-2: *Performance requirements for group I apparatus indicating up to a volume fraction of 5 % methane in air*

IEC 61779-3: *Performance requirements for group I apparatus indicating up to a volume fraction of 100 % methane in air*

IEC 61779-4: *Performance requirements for group II apparatus indicating up to a volume fraction of 100 % lower explosive limit*

IEC 61779-5: *Performance requirements for group II apparatus indicating up to a volume fraction of 100 % gas*

Note deleted

NOTE 1 – Group I and group II apparatus indicating up to a volume fraction of 100 % methane and group II apparatus indicating up to a volume fraction of 100 % gas are suitable for use only with the specific gases for which they have been calibrated.

NOTE 2 – For the purpose of this standard, the terms "lower flammable limit (LFL)" and "lower explosive limit (LEL)" are deemed to be synonymous, and likewise the terms "upper flammable limit (UFL)" and "upper explosive limit (UEL)" are deemed to be synonymous. For ease of reference, the two abbreviations LFL and UFL may be used hereinafter to denote these two sets of terms. It should be recognized that particular authorities having jurisdiction may have overriding requirements that dictate the use of one of these sets of terms and not the other.

1.1.2 This standard is applicable when an apparatus manufacturer makes any claims regarding any special features of construction or superior performance that exceed these minimum requirements. All such claims shall be verified and the test procedures shall be extended or supplemented, where necessary, to verify the claimed performance. The additional tests shall be agreed between the manufacturer and test laboratory.

1.1.3 This standard is applicable to flammable gas detection apparatus intended to provide an indication, alarm or other output function, the purpose of which is to give a warning of a potential explosion hazard and, in some cases, to initiate automatic or manual protective action(s).

1.1.4 This standard is applicable to apparatus, including the integral sampling systems of aspirated apparatus, intended to be used for commercial and industrial safety applications.

1.1.5 This standard does not apply to external sampling systems, or to apparatus of laboratory or scientific type, or to apparatus used only for process control purposes.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61779. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61779 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(351):1975, *International Electrotechnical Vocabulary (IEV) – Chapter 351: Automatic control*

IEC 60079-0:1983, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements*

IEC 60079-1:1990, *Electrical apparatus for explosive gas atmospheres – Part 1: Construction and verification test of flameproof enclosures of electrical apparatus*

IEC 60079-2:1983, *Electrical apparatus for explosive gas atmospheres – Part 2: Electrical apparatus – type of protection "p"*

IEC 60079-5:1967, *Electrical apparatus for explosive gas atmospheres – Part 5: Sand-filled apparatus*

IEC 60079-6:1995, *Electrical apparatus for explosive gas atmospheres – Part 6: Oil immersion "o"*

IEC 60079-7:1990, *Electrical apparatus for explosive gas atmospheres – Part 7: Increased safety "e"*

IEC 60079-10:1986, *Electrical apparatus for explosive gas atmospheres – Part 10: Classification of hazardous areas*

IEC 60079-11:1991, *Electrical apparatus for explosive gas atmospheres – Part 11: Intrinsic safety "i"*

IEC 60079-13:1982, *Electrical apparatus for explosive gas atmospheres – Part 13: Construction and use of rooms or buildings protected by pressurization*

IEC 60079-14:1984, *Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in explosive gas atmospheres (other than mines)*

IEC 60079-15:1987, *Electrical apparatus for explosive gas atmospheres – Part 15: Electrical apparatus, with type of protection "n"*

IEC 60079-18:1992, *Electrical apparatus for explosive gas atmospheres – Part 18: Encapsulation "m"*

IEC 60079-19:1993, *Electrical apparatus for explosive gas atmospheres – Part 19: Repair and overhaul for apparatus used in explosive atmospheres (other than mines or explosives)*

☐ Text deleted ☐

IEC 61000-4-1:1992, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 1: Overview of immunity tests – Basic EMC publication*

IEC 61000-4-3:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test – Basic EMC publication*

ISO 6142:1981, *Gas analysis – Preparation of calibration gas mixtures – Weighing methods*

ISO 6145-1:1986, *Gas analysis – Preparation of calibration gas mixtures – Dynamic volumetric methods – Part 1: Methods of calibration*

ISO 6145-3:1986, *Gas analysis – Preparation of calibration gas mixtures – Dynamic volumetric methods – Part 3: Periodic injections into a flowing gas stream*

ISO 6145-4:1986, *Gas analysis – Preparation of calibration gas mixtures – Dynamic volumetric methods – Part 4: Continuous injection method*

ISO 6145-6:1986, *Gas analysis – Preparation of calibration gas mixtures – Dynamic volumetric methods – Part 6: Sonic orifices*

ISO 6147:1979, *Gas analysis – Preparation of calibration gas mixtures – Saturation method*

☐ Text deleted ☐

☐ EN 50073:1999, *Guide for selection, installation, use and maintenance of apparatus for the detection and measurement of combustible gases or oxygen*

EN 50270:1999, *Electromagnetic compatibility: Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen*

prEN 50271, *Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen – Requirements and tests for apparatus using software and/or digital technologies* ☐

2 Definitions

For the purpose of this part of IEC 61779, and of the standards listed in 1.1.1, the following definitions apply:

2.1 Gas properties

2.1.1

ambient air

normal atmosphere surrounding the apparatus

2.1.2

clean air

air that is free of flammable gases and interfering or contaminating substances

2.1.3

explosive gas atmosphere

mixture with air, under normal atmospheric conditions, of flammable material in the form of gas or vapour, in which, after ignition, combustion spreads throughout the unconsumed mixture

NOTE 1 – This definition specifically excludes dusts and fibres in suspension in air. Mists are not covered by this standard.

NOTE 2 – Although a mixture that has a concentration above the upper flammable limit (see 2.1.9) is not an explosive atmosphere, in certain cases for area classification purposes, it is advisable to consider it as an explosive gas atmosphere.

NOTE 3 – Normal atmospheric conditions include variations above and below the reference levels of 101,3 kPa and 20 °C provided the variations have a negligible effect on the explosive properties of the flammable materials.

2.1.4

firedamp

flammable gas, consisting mainly of methane, found naturally in mines

2.1.5

flammable gas

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

NOTE – For the purpose of this standard the term "flammable gas" includes flammable vapours.

2.1.6

lower flammable limit (LFL)

volume ratio of flammable gas or vapour in air below which an explosive gas atmosphere will not be formed

2.1.7

poisons (of sensors)

substances which lead to temporary or permanent loss of sensitivity of the sensors

2.1.8

potentially explosive atmosphere

atmosphere that could become explosive (The danger is a potential one.)

2.1.9

upper flammable limit (UFL)

volume ratio of flammable gas or vapour in air above which an explosive gas atmosphere will not be formed (see also note 2 to 2.1.3)

2.1.10

volume ratio (v/v)

ratio of the volume of a component gas to the volume of the gas mixture under specified conditions of temperature and pressure

2.1.11

zero gas

gas which is free of flammable gases, and interfering and contaminating substances, the purpose of which is calibration/adjustment of the apparatus zero

2.2 Types of instruments

2.2.1

alarm-only apparatus

apparatus having an alarm but not having a meter or other indicating device that would allow measurement of the deviations permitted by the requirements of the appropriate standards listed in 1.1.1

2.2.2

aspirated apparatus

combustible gas detecting apparatus that obtains the gas by drawing it to the gas sensor – for example, by means of a hand-operated or electric pump

2.2.3

continuous duty apparatus

combustible gas detecting apparatus that is powered for long periods of time, but may have either continuous or intermittent sensing

2.2.4

diffusion apparatus

apparatus in which the transfer of gas from the atmosphere to the gas sensor takes place by random molecular movement, i.e. under conditions in which there is no aspirated flow

2.2.5

fixed apparatus

apparatus that is intended to have all parts permanently installed at a given location

2.2.6

group I apparatus

electrical apparatus for mines susceptible to firedamp

2.2.7

group II apparatus

electrical apparatus for places with a potentially explosive atmosphere, other than mines susceptible to firedamp

2.2.8

portable apparatus

spot-reading or continuous duty apparatus that has been designed to be carried readily from place to place and to be used while it is being carried. A portable apparatus is battery powered and includes, but is not limited to

- a) a hand-held apparatus, typically less than 1 kg, suitable for one-handed operation without accessories (such as sampling probes, sample lines), fitted,
- b) personal monitors, similar in size and mass to the hand-held apparatus, that are continuously operating (but not necessarily continuously sensing) while they are attached to the user, and
- c) another apparatus that can be operated by the user while it is carried either by hand, or by means of a shoulder strap or carrying harness, and which may or may not have a hand-directed probe.

2.2.9

spot-reading apparatus

apparatus intended to operate for periods of only a few minutes for irregular intervals

2.2.10

transportable apparatus

apparatus not intended to be portable, but which can be moved readily from one place to another

2.3 Sensors

2.3.1

remote sensor

sensor that is not integral to the main body of the apparatus

2.3.2

sensor

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

2.4 Supply of gas to instrument

2.4.1

sample line

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

2.4.2

sampling probe

separate sample line which is attached to the apparatus as required, that may or may not be supplied with the apparatus. It is usually short (e.g. in the order of 1 m) and rigid (although it may be telescopic), but it may be connected by a flexible tube to the apparatus

2.5 Signals and alarms

2.5.1

alarm set point

fixed or adjustable setting of the apparatus that is intended to preset the level of concentration at which the apparatus will automatically initiate an indication, alarm or other output function

2.5.2

fault signal

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

2.5.3

latching alarm

alarm that, once activated, requires deliberate action to be deactivated

2.6 Times

2.6.1

drift

variation in the apparatus indication with time, at any fixed gas concentration level (including clean air)

2.6.2

final indication

indication given by the apparatus after stabilization

2.6.3

minimum time of operation (spot-reading apparatus)

time interval between the initiation of a measurement procedure and the time when the apparatus indication reaches a stated percentage of the final indication

2.6.4

measuring span

algebraic difference between the upper and lower limits of the measuring range [IEV 351-05-39 modified]

2.6.5

stabilization

state when three successive readings of an apparatus, taken at two minute intervals, indicates no changes greater than ± 1 % of the measuring range

2.6.6

time of response $t(x)$ (not applicable to spot-reading apparatus)

time interval, with the apparatus in a warmed-up condition, between the time when an instantaneous variation in volume ratio is produced at the apparatus inlet and the time when the response reaches a stated percentage (x) of the final indication

2.6.7

warm-up time (not applicable to spot-reading apparatus)

time interval, with the apparatus in a stated atmosphere, between the time when the apparatus is switched on and the time when the indication reaches and remains within the stated tolerances (see figures 1 and 2)

2.7 Miscellaneous

2.7.1

nominal supply voltage

voltage that is given by manufacturers as the recommended operating voltage of their gas detection apparatus

2.7.2

special tool

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

2.7.3

type of protection

measures applied in the construction of electrical apparatus to prevent ignition of the surrounding explosive atmosphere by such apparatus (see 3.1.2)

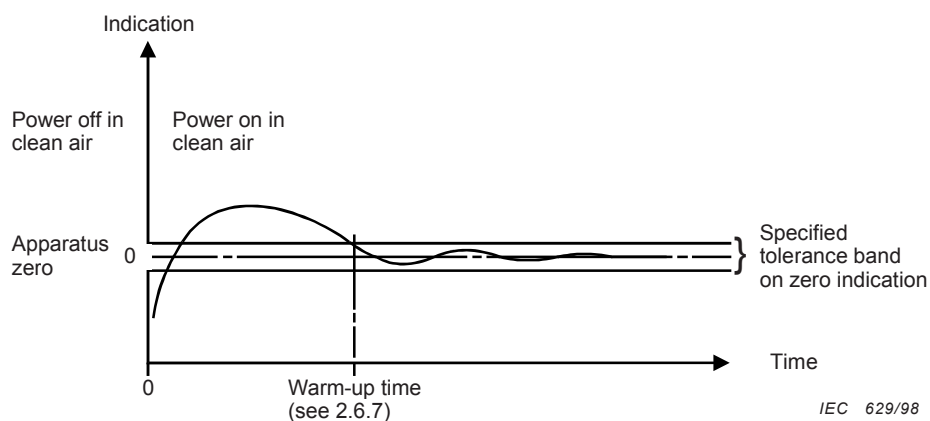


Figure 1 – Warm-up time in clean air (typical)

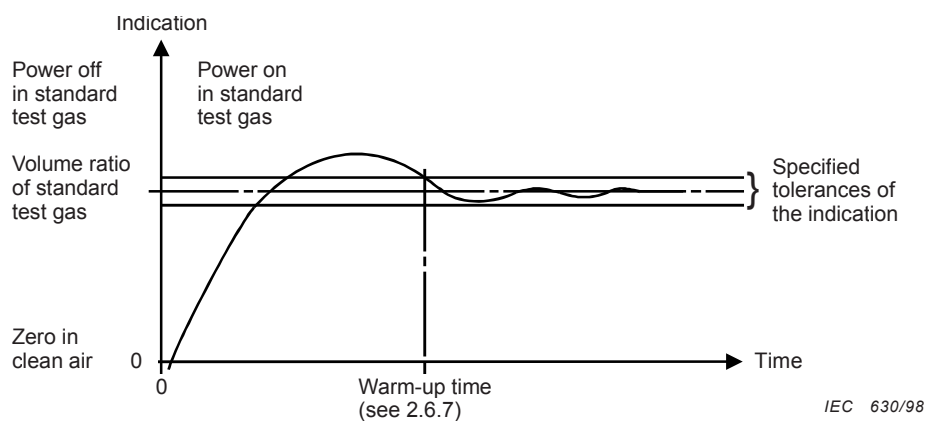


Figure 2 – Warm-up time in standard test gas (typical)

3 General requirements

3.1 Introduction

3.1.1 The apparatus shall comply with both the requirements of this standard and the appropriate standard(s) listed in 1.1.1.

Where an apparatus manufacturer makes any claims regarding any special features of construction or superior performance that exceed these minimum requirements, all such claims shall be verified and the test procedures shall be extended or supplemented, where necessary, to verify the claimed performance.

3.1.2 Electrical assemblies and components shall comply with the construction and test requirements of 3.2 and clause 4, where applicable. In addition, parts of the flammable gas detection apparatus intended for use in hazardous areas shall employ materials, and comply with the construction and explosion protection as specified in the appropriate regulations for explosion protection. **3.1.3** All equipment and components intended for use in potentially explosive atmospheres shall be designed and constructed according to good engineering practice and in conformity with the required categories for group I and II equipment to ensure avoidance of any ignition source. To classify the category of the equipment it shall be subjected to a formal documented hazard analysis. **3.1.4**

3.1.3 IEC text deleted.

3.1.4 In the design of software-controlled apparatus, the risks arising from faults in the programme shall be taken into account.

NOTE – Specific test requirements are being developed in prEN 50271.

3.2 Construction

3.2.1 General

Gas detection apparatus 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 apparatus shall be constructed to facilitate regular accuracy checks.

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

3.2.2 Indicating devices

3.2.2.1 An indication shall be provided to show that the apparatus is energized.

NOTE – The indication can be shown at the central unit.

3.2.2.2 For alarm-only apparatus or apparatus where the resolution of the read-out device is inadequate to demonstrate compliance with this standard, the manufacturer shall identify suitable points for connecting indicating or recording devices for the purpose of testing the compliance of the apparatus with this standard.

3.2.2.3 Where a read-out device is inadequate in this way, it shall be of sufficient quality as not to contradict the results obtained by additional indicating or recording devices.

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

3.2.2.5 If individual coloured indicating lights are provided, they shall be coloured as follows:

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

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

3.2.3 Alarm or output functions

3.2.3.1 Continuous duty apparatus

If alarm devices, output contacts or alarm signal outputs are provided as part of fixed or continuous duty portable apparatus and are intended to operate when a potentially hazardous gas concentration is detected, they shall be of a latching type requiring a deliberate manual action to reset. Where the outputs are connected to an integrated or auxiliary system the means of latching and resetting may be incorporated into these systems. If two or more set or alarm positions are provided, the lower may be non-latching - based on user preference.

NOTE — The integral or latching device may reside in software.

3.2.3.2 Group II portable apparatus indicating up to 100 % LFL

Alarm devices provided as part of a gas detection apparatus shall not be set to operate above 60 % LFL.

NOTE 1 – For other group II apparatus, it is recommended that alarm devices should be set to operate at a gas volume ratio not higher than 60 % LFL.

NOTE 2 – In addition, it is also permissible to fit group II apparatus with an alarm which is designed to indicate when full scale has been exceeded and which is, therefore, set to operate at 100 % LFL.

3.2.4 Fault signals

Fixed and transportable apparatus shall provide a fault signal in the event of failure of power to the apparatus, of loss of continuity in one or more of the wires to any sensor, or of loss of electrical continuity of any gas sensing system. A short circuit or open circuit in connections to any sensor shall be indicated by a fault signal.

Automatically aspirated apparatus shall be provided:

- a) in the case of fixed and transportable apparatus: with an integral flow-indicating device that produces a fault signal in the event of flow failure,
- b) in the case of portable apparatus: with a means of verifying the air flow.

3.2.5 Adjustments

All adjustment devices shall be designed so as to discourage unauthorized or inadvertent interference with the apparatus. Examples would include procedural devices, in the case of a keyboard instrument, or mechanical devices such as a cover requiring the use of a tool.

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

The adjustments of the zero and signal amplification shall be so designed that adjustment of one will not affect the other.

3.2.6 Battery-powered apparatus

Apparatus powered with integral batteries shall be provided with an indication of low battery condition, and the nature and purpose of this indication shall be explained in the manual (see 3.4 j)). All battery-powered apparatus shall be so constructed that, when the apparatus is tested according to 4.4.19, it shall comply with the requirements of the appropriate standards listed in 1.1.1.

 *Clause deleted* 

4 Test methods

4.1 Introduction

The test methods and procedures described in 4.2 to 4.4 are intended as a basis for establishing whether the apparatus conforms with the supplementary requirements for performance given in the appropriate standards listed in 1.1.1.

4.2 General requirements for tests

4.2.1 Samples and sequence of tests

4.2.1.1 For the purpose of type testing, the tests shall be carried out on one apparatus. Another apparatus may be used for tests according to 4.2.1.2.

4.2.1.2 The apparatus shall be subjected to all of the tests applicable to that type of apparatus, as described in 4.4. The test sequence detailed below shall be followed. However, test items 4) and 5) may be carried out to a schedule agreed upon between the manufacturer and the test laboratory.

One apparatus shall successfully complete all the tests, 1) to 7) inclusive. Another apparatus may be used for tests 8) and 9).

1) Unpowered storage (4.4.2)

2) Preparation and verification

Calibration and adjustment (4.4.3)

Alarm set point(s) (4.4.6)

- Flow rate (4.4.11)
- Warm-up time (4.4.15)
- Time of response (4.4.16)
- Minimum time of operation (4.4.17)
- Addition of sampling probe (4.4.22)
- Field calibration kit (clause 5)
- 3) Short-term stability (4.4.4.1)
 - Test on spot-reading apparatus (4.4.5)
- 4) Mechanical
 - Vibration (4.4.13)
 - Drop test (4.4.14)
- 5) Electrical battery capacity (4.4.19)
 - Power supply variations (4.4.20)
 - Power supply interruptions, voltage transients and step changes of voltage (4.4.21)
 - Electromagnetic interference (4.4.25)
- 6) Orientation (4.4.12)
- 7) Climatic
 - Temperature (4.4.7)
 - Pressure (4.4.8)
 - Humidity (4.4.9)
 - Air velocity (4.4.10)
- 8) Stability
 - Long-term tests for continuous duty apparatus (4.4.4.2 to 4.4.4.5)
- 9) Environmental
 - High gas concentration (4.4.18)
 - Dust (4.4.23)
 - Poisons (4.4.24)

4.2.1.3 Tests shall also be carried out, where applicable, to ensure that the apparatus satisfies the construction requirements of 3.2. The requirements for these tests are generally self-evident, except that for short-circuit requirements in 3.2.4, ballast resistors shall be substituted for each wire connecting the instrument to any remote sensor. The values of these resistors shall be those declared, in the instruction manual (see 3.4 d)), to be the maximum lead resistances allowing satisfactory compliance with the standard. The device used for the short circuit shall be of negligible resistance and shall be applied to convenient points in the circuit, at the sensor ends of the ballast resistors.

4.2.1.4 For apparatus having more than one selectable range or scale for the same or different gases or vapours, each range shall be tested. For the second and subsequent ranges the necessary amount of testing shall be agreed upon between the manufacturer and the test laboratory.

4.2.2 Preparation of apparatus before testing

The apparatus shall be prepared and mounted as near to typical service as possible, in accordance with the instruction manual – including all necessary interconnections, initial adjustments and initial calibrations. Adjustments may be made, where appropriate, at the beginning of each test.

In particular, the following points shall be noted:

a) Apparatus having remote sensors

For the purpose of the tests in 4.4, where reference is made to exposure of the sensor to the test conditions, the entire remote sensor (including any or all normally attached protective mechanical parts) shall be exposed.

For apparatus having connection facilities for more than one remote sensor, only one remote sensor needs to be subjected to the tests. The replacement of all but one sensor by "dummy" impedances yielding the worst case load conditions for the test in question shall be permitted. The worst case load conditions shall be determined by the testing laboratory within the limits specified in the instruction manual (see 3.4 d)).

For apparatus having remote sensor(s), all tests shall be performed with resistances (with temperature coefficients similar to those of the recommended interconnecting wire) connected in the detector circuit to simulate the maximum line resistance specified by the apparatus producer, except where minimum line resistance offers a more stringent test in the judgement of the test laboratory.

b) Apparatus having self-contained sensors

The entire apparatus shall be exposed to the test conditions without removal of any normally attached parts, including any sampling probe for tests 4.4.11, 4.4.15, 4.4.16 and 4.4.17.

c) Alarm-only apparatus

For alarm-only apparatus, readings shall be taken using an external meter connected to the test points described in 3.2.2.2.

In all cases, optional parts shall be either attached or removed according to which condition will give the most unfavourable result (at the discretion of the testing laboratory) for the test being conducted.

4.2.3 Mask for calibration and tests

When a mask is used for calibration or for the injection of test gas into the sensor, the design and operation of the mask used by the testing laboratory – in particular the pressure and velocity inside the mask – shall not inadmissibly influence the response of the apparatus or the results obtained.

NOTE – It is recommended that the testing laboratory should consult with the manufacturer in determining the design of the calibration mask. The manufacturer may provide a suitable calibration mask together with details of suggested pressure or flow for application of calibration gases with the apparatus.

4.3 Normal conditions for test

4.3.1 General

The test conditions specified in 4.3.2 to 4.3.10 shall be used for all tests, unless otherwise stated.