INTERNATIONAL STANDARD

IEC 61779-6

First edition
1999-06

Electrical apparatus for the detection and measurement of flammable gases –

Part 6:
Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of flammable gases

Appareils électriques de détection et de mesure des gaz combustibles –

Partie 6:
Directives pour le choix, l'installation, l'utilisation et l'entretien des appareils électriques de détection et de mesure de gaz inflammables

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRICAL APPARATUS FOR THE DETECTION AND MEASUREMENT OF FLAMMABLE GASES -–

Part 6: Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of flammable gases

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61779-6 has been prepared by subcommittee 31L: Electrical apparatus for the detection of flammable gases, of IEC technical committee 31: Electrical apparatus for explosive atmospheres.

The text of this standard is based on the following documents:

FDIS	Report on voting
31L/60/FDIS	31L/61/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A, B, C and D are for information only.

A bilingual version of this standard may be issued at a later date.

INTRODUCTION

Flammable gas detection apparatus may be used whenever there is the possibility of a hazard to life or property caused by the accumulation of a flammable gas-air mixture. Such apparatus can provide a means of reducing the hazard by detecting the presence of the flammable gas and issuing suitable audible or visual warnings. Gas detectors may also be used to initiate specific precautions (for example plant shutdown, evacuation, operation of fire extinguishing procedures).

Apparatus may be used to monitor a gas atmosphere below the lower flammable limit in circumstances where accumulation of gas may result in a concentration of the gas/air mixture to potentially explosive levels.

ELECTRICAL APPARATUS FOR THE DETECTION AND MEASUREMENT OF FLAMMABLE GASES –

Part 6: Guide for the selection, installation, use and maintenance of apparatus for the detection and measurement of flammable gases

1 General

1.1 Scope

1.1.1 This part of IEC 61779 gives guidance on the selection, installation, use and maintenance of electrically operated group II apparatus for the detection and measurement of flammable gases complying with the requirements of IEC 61779-1 to IEC 61779-5. It is a compilation of practical knowledge to assist the user, and applies to apparatus, instruments and systems that indicate the presence of a flammable or potentially explosive mixture of gas or vapour with air by using an electrical signal from a gas sensor to produce a meter reading, to activate a visual or audible pre-set alarm or other device, or any combination of these.

NOTE – When in classified areas, the apparatus should be so installed and used that it is not capable of itself igniting a combustible gas-air mixture. It should therefore comply with the requirements of IEC 60079-10.

For the purpose of this standard, flammable gases shall include flammable vapours.

1.1.2 This standard applies only to group II apparatus intended for use in industrial and commercial safety applications, involving areas classified in accordance with IEC 60079-10.

For the purpose of this standard, apparatus includes

a) fixed apparatus;

b) transportable apparatus; and

c) portable apparatus.

1.1.3 This standard is not intended to cover the following:

a) apparatus intended only for the detection of non-flammable toxic gases;

b) apparatus of laboratory or scientific type intended only for analysis or measurement purposes;

c) apparatus intended for underground mining applications;

d) apparatus intended for applications in explosives processing and manufacture;

e) apparatus intended only for process control applications;

f) apparatus intended for the detection of a potentially flammable atmosphere resulting from dust or mist in air.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61779. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, 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. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(426):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 426: Electrical apparatus for explosive atmospheres*

IEC 60079 (al parts), *Electrical apparatus for explosive gas atmospheres*

IEC 60079-0:1998, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements*

IEC 60079-10:1995, *Electrical apparatus for explosive gas atmospheres – Part 10: Classification of hazardous areas*

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)*

IEC 60079-20:1996, *Electrical apparatus for explosive gas atmospheres – Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus*

IEC 61779-1:1998, *Electrical apparatus for the detection and measurement of flammable gases – Part 1: General requirements and test methods*

IEC 61779-2:1998, *Electrical apparatus for the detection and measurement of flammable gases – Part 2: Performance requirements for group I apparatus indicating up to 5 % methane in air*

IEC 61779-3:1998, *Electrical apparatus for the detection and measurement of flammable gases – Part 3: Performance requirements for group I apparatus indicating a volume fraction up to 100 % methane in air*

IEC 61779-4:1998, *Electrical apparatus for the detection and measurement of flammable gases – Part 4: Performance requirements for group II apparatus indicating a volume fraction up to 100 % lower explosive limit*

IEC 61779-5:1998, *Electrical apparatus for the detection and measurement of flammable gases – Part 5: Performance requirements for group II apparatus indicating a volume fraction up to 100 % gas*

2 Definitions

For the purpose of this part of IEC 61779, the following definitions apply.

2.1
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
catalytic sensor
sensor, the operation of which depends upon the oxidation of gases on an electrically heated catalytic element

2.3
clean air
air that is free of flammable gases and interfering or contaminating substances

2.4
continuous duty apparatus
combustible gas detecting apparatus that is powered for long periods of time, but may have either continuous or intermittent sensing

2.5
continuous sensing
mode of operation in which power is applied continuously to the sensing element and readings are taken continuously

2.6
diffusion apparatus
apparatus in which the transfer of gas from the atmosphere to the gas sensing element takes place by diffusion, i.e. there is no aspirated flow

2.7
electrochemical sensor
sensor, the operation of which depends upon changes of the electrical parameters of electrodes placed in an electrolyte due to redox reactions of the gas on the surface of the electrodes

2.8
electromagnetic radiation absorption sensor
sensor, the operation of which depends upon the absorption of electromagnetic radiation by the gas being detected

2.9
explosion protected apparatus
apparatus incorporating a type of protection covered by the IEC 60079 series of standards

2.10
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 air. Mists are not covered by this standard.

NOTE 2 – Although a mixture that has a concentration above the upper explosive 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 reference levels of 101,3 kPa and 20 °C provided the variations have a negligible effect on the explosive properties of the flammable materials.

2.11
explosive range
range of gas or vapour mixtures with air between the explosive (flammable) limits

2.12
fixed apparatus
apparatus which is intended to have all its parts permanently installed

2.13
flashpoint
lowest liquid temperature at which, under certain standardized conditions, a liquid gives off vapours in a quantity such as to be capable of forming an ignitable vapour/air mixture

2.14
group II apparatus
electrical apparatus for places with a potentially explosive atmosphere, other than mines susceptible to firedamp

2.15
infrared absorption sensor
sensor, the operation of which depends upon the absorption of infrared radiation by the gas being detected

2.16
intermittent sensing
mode of operation in which the power or flow to the sensor is applied intermittently according to a predetermined cycle and readings taken at the predetermined cycle

2.17
lower flammable limit (LFL)
volume ratio of flammable gas or vapour in air below which an explosive gas atmosphere does not form, expressed as a percentage (see annex A)

NOTE – This is also known as lower explosive limit (LEL).

2.18
open path infrared sensor
sensor capable of detecting gas at any location along an open path traversed by an infrared beam

2.19
portable apparatus
spot reading or continuous duty apparatus that has been designed to be readily carried from place to place and to be used while it is being carried. Portable apparatus is battery operated and includes, but is not limited to

a) hand-held apparatus, typically less than 1 kg, suitable for single-handed operation;
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) larger apparatus up to 5 kg that can be operated by the user while it is suspended by hand, by a shoulder strap or by a carrying harness; it may or may not have a hand directed probe

2.20
relative density
density of gas or vapour relative to the density of air at the same pressure and at the same temperature (air is equal to 1,0)

2.21
release rate
quantity of flammable gas or vapour emitted per unit time from the source of release which itself could be a liquid surface

2.22
remote sensor
sensor which is not integral with the main body of the apparatus

2.23
sample line
pipeline by means of which the gas being sampled is conveyed to the sensor

2.24
sampling probe
separate sampling line, that may or may not be supplied with a portable apparatus that is attached to the apparatus as required.

NOTE – The sampling probe is usually short (for example of the order of 1 m) and rigid (for example it may be telescopic) but may be connected by a flexible tube to the apparatus.

2.25
semi-conductor sensor
sensor, the operation of which depends upon changes of the electrical conductance of a semi-conductor due to chemisorption of the gas being detected at its surface

2.26
sensor
assembly in which the sensing element is housed that may contain associated circuit components

2.27
sensing element
that part of a sensor that reacts in the presence of a flammable gas mixture to produce some physical or chemical change that can be used to activate a measuring or alarm function, or both

2.28
single point sensor
sensor capable of detecting gas at a single point location

2.29
source of release
point or location from which a flammable gas, vapour or liquid may be released into the atmosphere such that an explosive gas atmosphere could be formed. [IEV 426-03-06, modified]

2.30
spot reading apparatus
apparatus intended to be used for short periods of time as required (typically 5 min or less)

2.31
thermal conductivity sensor
sensor, the operation of which depends upon the change of heat lost by conduction of an electrically heated element located in the gas to be measured, compared with that of a similar element located in a reference gas cell

2.32
transportable apparatus
apparatus not intended to be portable, but which can be readily moved from one place to another

2.33
upper flammable limit (UFL)
volume ratio of flammable gas or vapour in air above which an explosive gas atmosphere does not form, expressed as a percentage (see annex A)

NOTE – This is also known as upper explosive limit (UEL).

2.34
ventilation
movements of air and replacement with fresh air due to the effects of wind, temperature gradients or artificial means (for example fans or extractors)

3 Measuring principles

The measuring principles of various sensors are given below as well as typical advantages and disadvantages of each.

3.1 Catalytic sensor

The principle of operation of the catalytic sensor depends upon the oxidation of flammable gas at the surface of an electrically heated catalytic element (filament or bead). This oxidation causes, for example the temperature of the sensing element to change as a function of the concentration of gas so detected. The resultant change of electrical resistance is determined. A reasonable concentration of oxygen in the order of 10 % or greater is required for catalytic sensors to operate.

By their very nature, catalytic sensors will directly detect flammable gases; the other types of sensors described in 3.2 to 3.6 indirectly infer the presence of flammable gases by the response of the sensor to other gas properties.

Since oxidation depends upon the presence of oxygen, detection apparatus should use only this type of sensor for gas concentrations up to the lower flammable limit.

The catalytic sensor may be used in either

a) diffusion mode; or

b) aspirating mode.

3.1.1 Advantages

The sensors detect flammable gases by a process of combustion and are suitable for the detection of a wide range of flammable gases but with possible variations in sensitivity.

3.1.2 Disadvantages

The main disadvantages with catalytic sensors are the following:

a) Range limitation

The catalytic sensor depends upon catalytic oxidation for its principle of operation and it functions only when sufficient oxygen is present. This type of sensor should be used for the detection of gas/air mixtures up to the lower flammable limit.

WARNING – ABOVE THE LOWER FLAMMABLE LIMIT, A CATALYTIC SENSOR MAY RESPOND AMBIGUOUSLY AND IN SOME CASES THE INSTRUMENT MAY ERRONEOUSLY INDICATE THAT THE FLAMMABLE GAS AND AIR MIXTURE IS BELOW THE LFL.

b) Interfering gases and vapours

If the atmosphere to be monitored contains gas(es) that dilute(s) or displace(s) air, for example nitrogen or carbon dioxide, the catalytic sensor may give a low or even zero response. Similar problems may occur in steam-laden atmospheres, quite often owing to saturation of the sintered flame arrestor due to condensation. High concentrations of inert gas (for example argon or helium) may also change the thermal balance of the sensor resulting in apparent reading of combustible gas.

c) Inhibition (catalyst poisoning)

Catalytic sensors are susceptible to permanent or temporary inhibition of the catalyst by certain airborne contaminants such that the sensor may eventually produce low, or zero response to the presence of gas.

NOTE – For this reason, it is therefore important that all catalytic gas detection apparatus is regularly tested in accordance with 9.2.

This inhibition may be permanent or temporary according to the nature of the contaminant. Permanent inhibition, usually known as "catalyst poisoning", may result from exposure to such substances as silicones, tetraethyl lead, sulphur compounds and phosphate esters. In some cases substances such as halogenated hydrocarbons may cause temporary inhibition.

While many catalytic sensors are highly resistant to such contaminants and require no additional protection in this regard, those that are not may be protected, in some cases, by the use of activated carbon or other types of filter. However, carbon filters should be used with great care because, while they may offer excellent protection from contaminants, they may also prevent the detection of most hydrocarbons other than methane and may cause considerably increased response times.

Their performance may also be affected by the level of humidity in the atmosphere.

An alternative technique sometimes used to reduce the effects of inhibition is the electrical operation of the sensor in intermittent mode. However, there are circumstances in which such sensors may give a false response, for example when they are suddenly exposed to a high concentration of gas during the "power-off" part of the switching cycle. Particular caution is necessary when using such portable apparatus in leak-detection mode or in similar operations.

The manufacturer's guidance should be sought where the presence of contaminants is suspected, or where temporary or permanent inhibition is experienced.

3.2 Thermal conductivity sensor

The principle of operation of the thermal conductivity sensor depends upon the heat loss by conduction of an electrically heated resistance element (i.e., filament, bead or thin film resistor) located in a gas sample stream of fixed velocity or in a diffusion chamber. The resulting change of electrical resistance is then determined.

This type of sensor is best suited for detecting individual gases of high or low conductivity relative to air.

Thermal conductivity sensors are suitable for monitoring those gases whose thermal conductivity differs substantially from that of air (where air is the reference environment) but only at relatively high concentrations, usually above the lower flammable limit. Apparatus incorporating thermal conductivity sensors should not be used for measuring gas concentrations below the LFL except in the case of gases such as hydrogen for which such sensors are especially sensitive.

Errors may result if

a) the apparatus is used to attempt to detect gases for which it is not calibrated;

b) a flow-sensitive type of thermal conductivity sensor is used and the gas sample flow is not stable;

c) the gas sample is not conditioned to remove water vapour or other interfering vapours or gases, some of which may even result in negative response;

d) there are variations in ambient temperature without compensatory ambient temperature control on the complete sensor;

e) additional gases of different thermal conductivities compensate the resulting conductivity so that the signal may even be zero.

3.2.1 Advantages

The sensor is capable of measuring high concentration and is independent of the oxygen level in the gas-flow.