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Part 45 - Electrical Ignition Systems for Internal Combustion Engines

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



31/1686/CD

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IEC TC 31 : EQUIPMENT FOR EXPLOSIVE ATMOSPHERES	
SECRETARIAT: United Kingdom	SECRETARY: Mr Tom Stack
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	

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- any relevant patent rights of which they are aware and to provide supporting documentation,
- any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "in some countries" clauses. See AC/22/2007.

TITLE:

Explosive atmospheres – Part 45 - Electrical Ignition Systems for Internal Combustion Engines

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –**Part 45: Electrical Ignition Systems for Internal Combustion Engines****FOREWORD**

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International Standard IEC 60079-45 has been prepared by subcommittee PNW 31-1359: Explosive atmospheres – Part XX - Electrical Ignition Systems for Internal Combustion Engines, of IEC technical committee TC31.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

133 This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

134 The committee has decided that the contents of this document will remain unchanged until the
135 stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the
136 specific document. At this date, the document will be

- 137 • reconfirmed,
- 138 • withdrawn,
- 139 • replaced by a revised edition, or
- 140 • amended.

141

142 The National Committees are requested to note that for this document the stability date is 2024.

143 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT
144 THE PUBLICATION STAGE.

145

INTRODUCTION

This part also refers to IEC 60079-0 and its associated standards for the construction, testing and marking requirements of suitable electrical Ex Equipment.

This international standard has been developed from ANSI/UL 122001 Standard for safety, *General Requirements for Electrical Ignition Systems for Internal Combustion Engines in Class I, Division 2 or Zone 2, Hazardous (Classified) Locations*.

The original content was developed primarily by the user community in response to operations and maintenance problems arising from the use of shielded ignition systems (flameproof or explosionproof) on reciprocating engines driving compressors and pumps handling flammable materials and installed in hazardous areas. Experience has shown that these types of ignition systems are subjected to significant dielectric stress due to being completely encapsulated in grounded metallic raceways and suffer premature failure resulting in engine cylinder misfiring and engine miss-operation and shutdown.

The standard is intended to supplement IEC 80079-41 with the requirements for the ignition systems for reciprocating spark-ignited engines to be installed in hazardous areas for Gc applications. In addition, it is also a standalone set of requirements for a complete ignition system or for the individual components thereof to be installed on a reciprocating engine located in a Zone 2 hazardous area in a repair or replacement activity.

Examples of reciprocating gas engines located in a Zone 2 are:

- a) Offshore oil and gas platforms that are typically crowded or congested by design and the gas engine and driven equipment is located in a Zone 2.
- b) Onshore facilities where the gas engine and driven equipment assembly is located in an enclosed building for environmental protection or noise suppression.

NOTE Certified ignition systems may also be considered as an alternative replacement to non Ex systems for engines located in a non-hazardous area where the driven equipment is located in a Zone 2 location. This could provide the additional explosion protection for larger than anticipated flammable releases.

On-going inspection, maintenance and repair aspects also play an important role in control of hazardous area installations and the user's attention is drawn to IEC 60079-17, IEC 60079-19 and manufacturer's instructions for further information concerning these aspects.

In any industrial installation, irrespective of size, there can be numerous sources of ignition apart from those associated with electrical Equipment. Precautions are necessary to ensure safety from other possible ignition sources, but guidance on this aspect is outside the scope of this standard

EXPLOSIVE ATMOSPHERES –

Part 45: Electrical Ignition Systems for Internal Combustion Engines

1 Scope

This part of IEC 60079 is intended to enhance the safety of personnel by providing minimum requirements for electrical ignition systems for spark-ignited reciprocating internal combustion engines, parts of which provide EPL Gc.

This standard provides minimum construction and test requirements in addition to manufacturer installation and maintenance recommendations for the safe operation of ignition systems and components for spark-ignited reciprocating internal combustion engines providing EPL Gc for equipment Group IIB+H₂, IIB or IIA. These requirements apply to systems rated for normal operation with secondary voltages less than or equal to 60kV.

This standard is intended to apply only to the ignition systems or the individual ignition system components used on reciprocating internal combustion engines that are stationary when in operation except for forklift trucks and other mobile machinery where the internal combustion engine may be potential source of ignition. Applications addressed by the scope of this document include but are not limited to gas compressors, electric power generators, forklift trucks, and pumps.

This standard does not apply to:

- a) engine ignition systems that utilize a breaker point or magneto type ignition systems as these would not be suitable for use in a hazardous area
- b) Road vehicles
- c) Low voltage parts and electrical installation that are not included in the ignition system, such as the engine control module (ECM), various sensors and thermocouples, throttle actuator, fuel control valve(s), human machine interface (HMI), respective harness and wiring and all the other items that might belong to the integrated control system besides the ignition system.

This standard supplements and modifies the general requirements of IEC 60079-0 and the requirements ISO/IEC 80079-41. Where a requirement of this standard conflicts with IEC 60079-0 or ISO/IEC 80079-41, the requirement of this standard takes precedence.

NOTE See ISO/IEC 80079-41 for the requirements for explosion protection for EPL Gc reciprocating internal combustion engines.

2 Normative references

ANSI/UL 2556, Wire and Cable Test Methods

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

IEC 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*

- 215 IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and*
216 *erection*
- 217 IEC 60079-15, *Explosive atmospheres – Part 15: Equipment protection by Type of Protection “n”*
- 218 IEC 60079-18, *Explosive atmospheres – Part 18: Equipment protection by encapsulation “m”*
- 219 IEC 60079-25, *Explosive atmospheres – Part 25: Intrinsically safe electrical systems*
- 220 IEC 60079-46, *Explosive atmospheres – Part 46: Equipment assemblies*
- 221 ISO 11565: 2006, *Road vehicles — Spark-plugs — Test methods and requirements; Second edition*
- 222 ISO/IEC 80079-41, *Explosive atmospheres – Part 41: Reciprocating internal combustion engines*
223 *(in development)*
- 224 SAE J2031 - *High-Tension Ignition Cable, 2020*

225 **3 Terms and definitions**

226 For the purposes of this document, the following terms and definitions apply.

227 ISO and IEC maintain terminological databases for use in standardization at the following
228 addresses:

- 229 • IEC Electropedia: available at <http://www.electropedia.org/>
- 230 • ISO Online browsing platform: available at <http://www.iso.org/obp>

231 **3.1** 232 **Reserved**

233 **3.2**
234 **ignition coil**
235 an inductive device used to convert primary voltage to secondary voltage intended to bridge a spark
236 gap and initiate combustion

237 **3.3**
238 **ignition control unit (ICU)**
239 a component assembly that transforms energy from the ignition system power source and provides
240 it to the primary distribution system.

241 NOTE The ignition control unit is sometimes referred to as an ignition control module

3.4**engine control module (ECM)**

electronic processor managing the timing relationship of the engine, transfer of data between engine sensors, actuators, control elements, and information-storage and -display units

3.5**ignition system**

an electrical system designed to produce and distribute electrical energy to bridge a spark gap and initiate combustion

NOTE 1 An ignition system may be a part of integrated control system of the engine and hence connected to the engine control module ECM.

NOTE 2 An ignition system can be a capacitive discharge type or an inductive type.

3.5.1**capacitive discharge ignition system**

In this type of ignition system, a charging circuit creates an intermediate voltage on a capacitor, and at the instant of ignition timing applies the capacitor energy and voltage to the ignition coil primary which subsequently reflects to the secondary coil winding and spark plug.

3.5.2**inductive discharge ignition system**

In an inductive-discharge ignition system, the primary winding is directly tied to Battery and stores energy while the primary winding conducts current from the battery. At the desired ignition timing, the primary winding current is interrupted which drives a flyback event on the primary, which reflected to the secondary and generates a voltage high enough to ionize the spark plug gap. Following ionization of the spark plug gap, most of the ignition coil energy is driven through the spark plug gap.

3.6**installation drawing**

a drawing or other document prepared by the equipment manufacturer that details the allowed interconnections of ignition system components, indicates any special conditions of use, provides initial parameters if required, and provides the necessary information for operational use of the system or any component

3.7**integral ignition coil**

an ignition coil that is spark-plug mounted (coil on plug)

3.8**maximum open circuit voltage <ignition system>**

the maximum peak voltage produced by the ignition system with the secondary lead disconnected from the spark plug

3.9**normal operation**

operation of equipment conforming electrically and mechanically with its design specification and used within the limits specified by the manufacturer.

NOTE This includes as a minimum:

- a) supply voltage, current, and frequency;
- b) environmental conditions;
- c) minimum and maximum engine operating and cranking speeds;
- d) all removable parts in place; and
- e) all operator-accessible adjustments at their most unfavourable settings within the normal range.

SOURCE 426-04-10; Notes modified

3.10**engine driven power source**

any power source that relies on mechanical energy from the engine for conversion to ignition system electrical energy

3.11**external power source**

any power source that relies on energy from a source other than the engine for ignition system electrical energy

3.12**primary distribution system**

the components that deliver the primary voltage (typically less than 1000 V) and current from the power supply and ignition control unit to the ignition coil, including the coil primary terminations

3.13**primary lead assembly**

an assembly of primary wires interconnecting the ignition coil with the balance of the primary distribution system

3.14**primary wire**

an insulated conductor interconnecting the ignition control unit and the ignition coil

3.15**primary voltage**

the voltage produced across the primary of the ignition coil under normal operating conditions

3.16**primary wiring harness**

a group of wires transporting voltage to the primary of the ignition coil

3.17**raceway**

an enclosure for routing, protecting, and supporting wires or cables

3.18**secondary distribution system**

the component assembly that electrically interconnects the ignition coil and the spark gap, including the coil secondary terminations

3.19**secondary lead, secondary lead assembly**

a part of the secondary distribution system, either rigid or flexible, electrically interconnecting the coil and the spark plug

3.20**secondary voltage**

the open circuit voltage produced across the spark gap

3.21**spark gap**

the space between two conductors across which electrical energy is discharged

3.22**spark plug**

an electromechanical device that provides a spark gap intended to ignite a fuel mixture

3.23**stationary <ignition systems>**

an installation that operates in a fixed location

3.24**flashover**

electric breakdown between conductors in a gas or a liquid or in vacuum, at least partly along the surface of solid insulation (e.g., where a spark occurs from the internal live wires of the ignition system to an external metal surface such as the secondary lead to surrounding metallic surface)

3.25**conductive interface**

the point at which two conductive elements are joined between subcomponents. Examples include the connection between an ignition coil and an extender, or the connection between an extender and the nipple of a spark plug.

4 General requirements

Any portion of an ignition system providing EPL Gc shall not, under normal operating conditions, produce arcs, sparks, or heat that could ignite a surrounding flammable atmosphere. This may be achieved through conformance with the construction requirements of Clause 5 and utilizing at least one of the protection methods indicated in 4.1, 4.2 or 4.3. or any combination thereof (see 4.4). The portions of the ignition system which operate at voltage levels of 15 kV and less may use other types of explosion protection defined in IEC 60079 series standards (considering the voltage restrictions allowed within the specific standard).

4.1 Spark containment

Any portion of the ignition system providing EPL Gc shall be constructed such that arcs or sparks that could occur under normal operating conditions are contained in a manner that precludes ignition of a surrounding flammable atmosphere. See Clause 6 for requirements for spark containment.

4.2 Spark prevention

Any portion of the ignition system providing EPL Gc shall be constructed such that arcs or sparks under normal operating conditions are prevented from occurring outside of the combustion chamber. See Clause 7 for requirements for spark prevention.

4.3 Spark detection/prevention

Any portion of the ignition system providing EPL Gc shall be designed and constructed such that conditions leading to arcs or sparks in any portion of the ignition system outside of the combustion chamber are detected and remedied before such sparks occur. See Clause 8 for spark detection and prevention requirements.

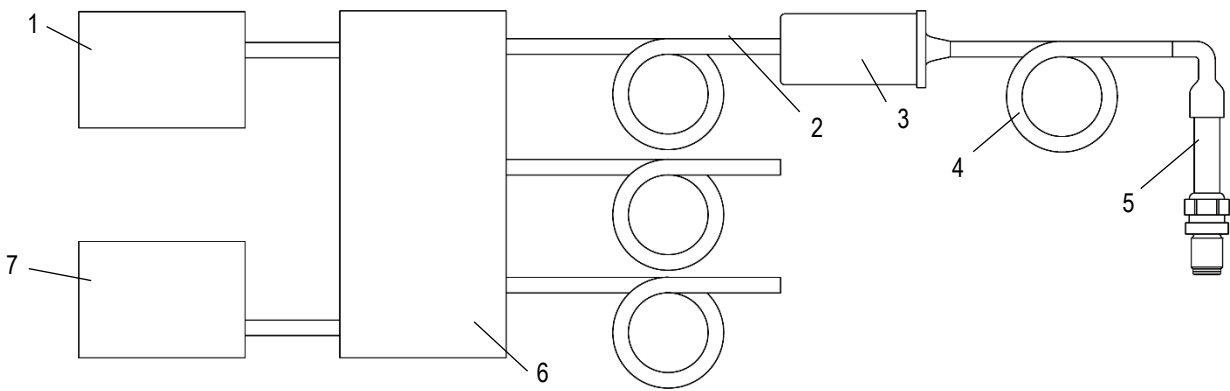
4.4 Ignition System Equipment

Parts of ignition systems can be examined separately for conformance with the applicable requirements of this standard or other types of explosion protection defined in other IEC 60079 series standards.

The parties assembling the completed ignition system are responsible for total system documentation and demonstrating conformance of the completed ignition system to this standard.

Components shall be marked as detailed in Clause 10.

A typical ignition system with all of its components is illustrated in Figure 1.



- | | |
|-------------------------------|-------------------------------|
| Item 1: Power Source | Item 2: Primary Wiring |
| Item 3: Ignition Coil | Item 4: Secondary Leads |
| Item 5: Spark Plug | Item 6: Ignition Control Unit |
| Item 7: Engine Control Module | |

NOTE 1 The order and arrangement of components in an ignition system may be different, only basic ignition system components are shown in this diagram.

NOTE 2 Ground conductors may be insulated conductors or part of a metallic frame.

Figure 1 – Components of an electrical ignition system

4.5 Engine enclosed systems

For any ignition system components that are contained completely within an enclosed volume of the engine that is subject to the positive pressure from the crankcase, are by definition not exposed

to a flammable atmosphere, therefore the requirements for explosion protection outlined in this standard do not apply.

NOTE 1 For additional information concerning the enclosed volumes of engines and their possibility of having an explosive mixture internally, see IEC 80079-41.

5 Construction and testing requirements

5.1 General

Ignition systems shall be constructed to withstand the service temperatures to which they will be exposed in normal operation. Different temperature ratings may apply to separate devices of an ignition system. Maximum surface temperature of all equipment within the ignition system shall be determined in accordance with the test procedures as defined by maximum surface temperature in IEC 60079-0, modified for a system input voltage of $\pm 25\%$ for DC systems. The equipment shall be marked as specified in Clause 10.

Ignition systems shall be constructed to withstand the effects of vibration levels they are likely to encounter during normal operation such that they are prevented from becoming a potential source of ignition. The test in 12.4 demonstrates conformance with this requirement.

For all protection methods the complete test program for the system and component level is defined in Table 1.

5.2 Impact

All parts of the ignition system intended for installation in a hazardous area shall meet the Resistance to Impact Test as specified in IEC 60079-0. Specific parts fabricated from ceramic or other similar materials may be supplied with a cover or shroud that will be included with the system and shall be in place for the impact test.

5.3 Chemical Compatibility

Enclosures and insulating materials shall provide protection to prevent deterioration that could adversely affect the suitability of the parts of the equipment intended to be installed in a hazardous area. The list of compounds in Table 2 includes chemicals representative of those to which ignition systems would likely be exposed in normal operation.

All non-metallic enclosure materials, secondary leads, secondary lead assembly, or secondary lead harness, and insulation compounds associated with the ignition system utilized on exterior of the engine shall comply with the chemical compatibility tests of 1.1. All test chemicals in Table 2 shall be included in the test. One or more of the test chemicals may be omitted from the test if the installation drawing prepared in accordance with Clause 10 states that the equipment is not suitable for use in locations where the omitted test chemical is present. The manufacturer of the device shall make available information necessary to determine if critical materials of construction are compatible with substances not included in Table 2 that may be present in an installation area.

5.4 Terminations and Connections

All electrical terminations and connections for the secondary lead system intended to be installed in a hazardous area shall be mechanically secured against unintentional disconnection. Terminations shall be constructed such that, when connected as specified on the installation drawing, a separating force specified in the pull test described in 12.8, is required for disconnection. Terminations shall also maintain continuity when subjected to the vibration test specified in 12.3. The vibration test shall be completed as a prerequisite to the pull test described in 12.8.