International Standard

ISO 8528-13

Reciprocating internal combustion engine driven alternating current generating sets —

Part 13: Safety

Groupes électrogènes à courant alternatif entraînés par moteurs alternatifs à combustion interne —

Partie 13: Sécurité

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 270, *Internal combustion engines,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 8528-13:2016), which has been technically revised.

The main changes are as follows:

— scope has been modified;

— normative references have been updated;

— definition of «high voltage electrical equipment» has been added;

— Clause 6 has been renumbered to Clause 4;

— Annex C has been updated and renumbered as Annex D ;

— new Annex C has been added.

A list of all parts in the ISO 8528 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a type-C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organisations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in the case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or -B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Reciprocating internal combustion engine driven alternating current generating sets —

Part 13: Safety

1 Scope

This document specifies the safety requirements for reciprocating internal combustion (RIC) engine driven generating sets up to 1 000 V alternating current (AC) or 1 500 V direct current (DC) and voltages above 1 000 V (AC) and not exceeding 36 kV consisting of an RIC engine, an AC generator including the additional equipment required for operating, e.g. controlgear, switchgear, auxiliary equipment.

This document is applicable to generating sets for land and marine use (domestic, recreational and industrial application). This document is not applicable to generating sets used on board of seagoing vessels and mobile offshore units as well as on aircraft or to propel road vehicles and locomotives.

This document is not applicable to gensets and components manufactured before the date of its publication.

NOTE This document does not apply to arc welding equipment (IEC 60974 series).

This document does not specify the special requirements needed to cover operation in potentially explosive atmospheres and is not applicable for such environments.

The hazards relevant to RIC engine driven generating sets are identified in Table A.1.

This document deals with the special requirements of test and safety design which are observed in addition to the definitions and requirements in ISO 8528-1:2018, ISO 8528-2:2018, ISO 8528-3:2020, ISO 8528-4:2025, ISO 8528-5:2025, ISO 8528-6:2023 and ISO 8528-10:2022, where applicable. This document specifies safety requirements in order to protect the user from danger.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2261:1994, *Reciprocating internal combustion engines — Hand-operated control devices — Standard direction of motion*

ISO 6826:2022, *Reciprocating internal combustion engines — Fire protection*

ISO 8528-1:2018, *Reciprocating internal combustion engine driven alternating current generating sets — Part 1: Application, ratings and performance*

ISO 8528-4:2025, *Reciprocating internal combustion engine driven alternating current generating sets — Part 4: Controlgear and switchgear*

ISO 8528-5:2025, *Reciprocating internal combustion engine driven alternating current generating sets — Part 5: Generating sets*

ISO 8528-10:2022, *Reciprocating internal combustion engine driven alternating current generating sets — Part 10: Measurement of airborne noise*

ISO 11429:1996, *Ergonomics — System of auditory and visual danger and information signals*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*

ISO 14314:2004, *Reciprocal internal combustion engines — Recoil starting equipment — General safety requirements*

ISO 15534-2:2000, *Ergonomic design for the safety of machinery — Part 2: Principles for determining the dimensions required for access openings*

IEC 60034-1:2022, *Rotating electrical machines — Part 1: Rating and performance*

IEC 60034-5:2020, *Rotating electrical machines — Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) — Classification*

IEC 60204-1:2016/A1:2021, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60204-11:2018, *Safety of machinery — Electrical equipment of machines — Part 11: Requirements for equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV*

IEC 60335-1:2020/A11:2023, *Household and similar electrical appliances — Safety — Part 1: General requirements*

IEC 60364-4-41:2005, *Low-voltage electrical installations — Part 4-41: Protection for safety — Protection against electric shock*

IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and identification — Coding principles for indicators and actuators*

IEC 61310-1:2007, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals*

IEC 61310-2:2017, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking*

IEC 61936-1:2021, *Power installations exceeding 1 kV AC and 1,5 kV DC — Part 1 : AC*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60071-2:2023, *Insulation co-ordination — Part 2: Application guidelines*

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

IEC 62271-100:2021, *High-voltage switchgear and controlgear — Part 100 : alternating-current circuit-breakers*

IEC 62271-200:2021, *High-voltage switchgear and controlgear — Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
layperson
person who does not necessarily recognize potential danger resulting from electricity, moving parts or hot parts

Note 1 to entry: The layperson has normally a lack of training, knowledge and experience.

3.2
close proximity
30 mm space immediately around the operating and adjusting controls and carrying handles, including their whole movement range

3.3
rated power
electric power assigned by the manufacturer

Note 1 to entry: The electrical power assigned according to ISO 8528-1:2018, Clause 14 (COP, PRP, LTP, ESP, DCP), except for low power generating sets to ISO 8528-8:2016, 3.3 (COP).

3.4
low power generating sets
power generating sets which are determined by specific features:

Note 1 to entry: The specific features are:

— low power is taken to mean rated power of a magnitude up to 10 kW/50 Hz, 12 kW/60 Hz;

— users normally are layperson;

— complete generating set is usually transportable, or mobile;

— electrical output is connected by means of plugs, sockets and screwed terminal except for extra low voltages;

— generating set is ready for use without any additional installation work by the user.

Note 2 to entry: See ISO 8528-8:2016, Clause 1.

3.5
frame contour
outmost of low power generating sets, consisting of robust parts

Note 1 to entry: Example of parts include the frame made of pipe, the fuel tank, the handle, the control box.

3.6
operator interface
means by which information is communicated between a human operator(s) and the control system (e.g. LCD, indicating lights, push-buttons, horns, alarms)

Note 1 to entry: The operator interface is sometimes referred to as the human-machine interface (HMI).

3.7
control device
device connected into the control circuit (circuit used for the control, including monitoring) and used for controlling the operation of the machine (e.g. relay, contactor, position sensor PLC module, actuator…)

3.8
controlgear
switching device and its combination with associated control, measuring, protective and regulating equipment, intended in principle for the control of electrical energy consuming equipment

3.9
enclosure
part providing protection of equipment against external influences and, in any direction, protection against direct contact

Note 1 to entry: See also definition 3.14 "canopy".

3.10
electrical equipment
material, fitting, device, component, appliance, fixture, apparatus, and the like using electric currents or electromagnetic fields, except for the safety extra low voltage circuits

3.11
control
operation consisting of interacting by touching the machine in the places defined for this purpose during the starting, functioning and stopping phases

3.12
monitoring
operation consisting of observing the operating parameters of the machine during its operation while maintaining appropriate safety distances depending on the risks identified

3.13
maintenance
all operations intended to prevent or repair breakdowns that occur on the machine

Note 1 to entry: The recommendations and schedule of the machine manufacturer are followed. Maintenance is carried out with the machine stopped and in electrical safety.

3.14
canopy
element ensuring the protection of the complete generating set against external influences such as weather and solid foreign objects

3.15
protective extra-low voltage
PELV
voltage to protect persons against electric shock from indirect contact and limited area direct contact

Note 1 to entry: PELV circuits shall satisfy the following condition. The nominal voltage shall not exceed:

— 25 V AC r.m.s. or 60 V ripple-free DC when the equipment is normally used in dry locations and when large area contact of live parts with the human body is not expected; or

— 6 V AC r.m.s. or 15 V ripple-free DC in all other cases.

Note 2 to entry: "Ripple-free" is conventionally defined for a sinusoidal ripple voltage as a ripple content of not more than 10 % r.m.s.

Note 3 to entry: See IEC 60204-1:2016/A1:2021, 6.4.1 a).

4 Safety requirements and/or protective/risk reduction measures and verification

4.1 General

Machinery shall conform with the safety requirements and/or protective measures/risk reduction measures of this clause.

In addition, the machine shall be designed and assessed in accordance with the principles of ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document.

The hazards relevant to RIC engine driven generating sets that shall be accounted for in order to prevent personal injury are listed in Table A.1.

4.2 Starting system

4.2.1 Requirements

Starting systems can be triggered manually or automatically.

Electrical starting systems normally operate at voltages of 24 V or below. Electrical starting systems above 24 V are not dealt with in this document and the installer of the engine shall ensure safe operation after connecting the engine to the driven machinery.

For engines with compressed air starting, the starting pneumatic system shall conform with the installation requirements and with the operation and safety information specified in the manuals provided by the starting system components suppliers.

— Starting handles shall have sufficient clearance from the mounting surface to ensure safe turning.

— Diesel engines with a manual starter shall have a decompression facility which shall not be required to be hand-held during cranking.

The only permissible hand starting systems are crank handle (as defined above) and recoil starting devices in accordance with ISO 14314:2004. The marking required in ISO 14314:2004, 7.3 shall not apply.

4.2.2 Verification

Conformance with the requirements shall be verified by inspection and testing of the starting systems.

4.3 Stopping

4.3.1 Requirements

4.3.1.1 Normal stopping

All generating sets shall have a normal switch or other normal stopping device which can be manually or automatically actuated. Stopping controls shall remain in the stop position when operated. This shall operate by a device ensuring the cutting off of the fuel or the ignition (for spark ignition engines) supply.

4.3.1.2 Stopping in case of failure

Generating sets except low power generating sets shall be provided with an automatically actuated stopping device in case of failure.

This device shall monitor one or more signals of the generating set and if these signals are out of the allowable range, it shall trigger the automatic stop.

The main signals used to actuate automatic stopping may include, but not be limited to, the following:

a) for the RIC engine
   1) overspeed;
   2) low lubricating oil pressure;
   3) high coolant temperature; and
   4) low coolant level;

b) for the generator
   1) excessive overvoltage; and
   2) overload.

These signals or other measures used to actuate automatic stopping shall be specified depending on the application.

4.3.2 Verification

Normal stopping shall be verified by inspection and testing of the stopping device in manual and in automatic modes (if provided in the application).

Automatic stopping in case of failure shall be verified by testing the action of typical failure modes in operating conditions (an appropriate method shall be used to create typical failure conditions, e.g. manual triggering, short-circuiting of contacts).

4.4 Emergency stopping

4.4.1 Requirements

Emergency stopping devices are required for remote controlled generating sets and generating sets with a canopy or container accessible by persons. In accordance with the risk assessment in ISO 12100:2010, 6.3.5.2, an emergency stopping device is not required for low power generating sets, as it shall not lessen the risk by reducing the stopping time.

Emergency stopping devices shall be actuated manually. As for normal stopping, emergency stopping shall operate by a device ensuring the cutting off of the fuel supply or ignition (for spark ignition engines). This device should include an air supply cut-off.

Emergency stopping devices shall conform with IEC 60204-1:2016/A1:2021, 10.7.

Emergency stopping devices shall also meet the requirements of ISO 13850:2015, category 0, and the reset shall not initiate a restart or any hazardous conditions.

Manually actuated emergency stopping device shall be located inside and outside the canopy or container in which a generating set is located and which is accessible for personnel to carry out maintenance or control operations when generating sets are in operation.

For canopies, containers or where there is no physical access for personnel at least one emergency stopping devices shall be located outside.

4.4.2 Verification

Emergency stopping devices shall be verified by inspection and testing in operating conditions.

4.5 Control devices

4.5.1 Design, safety and mechanical strength

4.5.1.1 Requirements

Control devices for the RIC engine of the generating set shall meet the following requirements:

— hand controls shall be designed to withstand 1,2× the maximum actuating forces given in Table 1;

— for handles, knobs, grips, levers and similar devices, requirements and tests shall be in accordance with IEC 60335-1:2020/A11:2023, 22.12;

— controls shall act positively and smoothly and without delay or unexpected action and be in accordance with ISO 2261:1994;

— the surface temperature of the controls that shall be manually actuated while the engine is running shall be within the following limits in accordance with ISO 13732-1:2006 for a contact time of 10 s:

  — 55 °C for metallic surfaces; and

  — 70 °C for non-metallic surfaces;

— sharp edges or corners on, or close proximity to manual controls shall be removed. Edges shall have a chamfer of at least 0,5 mm.

Table 1 — Clearance between controls

Operation by	Spacing (mm)	Maximum actuating force (N)
Finger tip	10	10
Finger grasp		
— toggles	20	50
— knobs	20	50
Hand		
— upward	50	400
— fore-aft	50	300

4.5.1.2 Verification

Control devices of the RIC engine shall be verified by inspection and testing.

Control devices of the generating sets shall be verified in accordance with IEC 60204-1:2016/AMD1:2021, 10.1 and 10.2.

For surface temperature measurement of the control devices (RIC engines and generating sets), the following method shall be conducted:

a) the generating set shall be operated at its rated power until the surface temperatures stabilize;

b) the test shall be conducted in a well-ventilated location not directly exposed to sunlight;

c) if the test is conducted at an ambient temperature outside of the nominal (20 ± 3) °C the reported temperatures shall be corrected by Formula (1):

$$T_c = T_r - T_a + 20 \quad (1)$$

where

T_c is the corrected temperature, in °C:
T_r is the reported temperature, in °C:
T_a is the ambient temperature, in °C.

4.5.2 Identification

4.5.2.1 Requirements

The control devices of the RIC engines shall be identified according to the function they perform, or their function shall be explained in the operating manual. They shall be identified in accordance with IEC 61310-2:2017. Colour coding shall be in accordance with IEC 60073:2002.

The marking on the engine controls shall be legible throughout the engine life.

Identification should preferably be by symbols in accordance with ISO 7000:2019 or ISO 8999:2001 or, if there are no suitable symbols, by words placed on the control or adjacent to it. Design, location and marking principles shall be in accordance with IEC 61310-1:2007.

Emergency shut-off control handles or buttons shall be prominently located and shaped as well as being coloured red, in order to be identified among the other controls.

The control devices on electrical equipment shall conform with the requirements of IEC 60204-1:2016/A1:2021, 10.1 and 10.2 with the exception as given in Table B.1.

4.5.2.2 Verification

Conformance with the requirements shall be verified by inspection.

4.5.3 Accessibility

4.5.3.1 Requirements

Controls should preferably be grouped.

Controls should be located within reach of the operator. Access shall be provided in accordance with ISO 15534-2:2000. The spacing between controls shall be sufficient to allow operation without unintentional actuation of adjacent controls. For the minimum clearances between controls recommended for the given maximum actuating force, see Table 1.

4.5.3.2 Verification

Conformance with the requirements shall be verified by inspection and measurement.

4.6 Monitoring devices

4.6.1 Requirements

4.6.1.1 Instrument identification

Monitoring instruments shall be identified on or adjacent to them, preferably by a symbol in accordance with ISO 8999:2001 or a descriptive wording for the system being monitored.

4.6.1.2 Instrument visibility

Monitoring instruments should be visible to the operator. They shall be illuminated for nighttime or indoor operation so that they are legible from the operator's position where the application requires it.

4.6.1.3 Instrument colour code

Monitoring instruments and monitoring systems should preferably be colour coded in accordance with IEC 60073:2002. Red is recommended for malfunction or unsafe situation; green for a satisfactory situation or to indicate a system is operating.

The instruments for the monitoring of the electrical equipment shall conform with IEC 60204-1:2016/A1:2021, 10.3.

4.6.2 Verification

Conformance with the requirements shall be verified by inspection.

4.7 Warning devices

4.7.1 Requirements

Warning devices, signs, markings and colours shall meet the requirements of ISO 11429:1996.

4.7.2 Verification

Conformance with the requirements shall be verified by inspection.

4.8 Guarding

4.8.1 General

4.8.1.1 Requirements

The following clauses give the requirements for the common hazards related to guarding and any generating set or installation shall conform with these requirements.

Guards shall be designed in accordance with ISO 14120:2015.

Fixing systems of fixed guards shall remain attached to the guards or to the generating set when the guards are removed. This requirement is limited to fixed guards that need to be removed during normal maintenance operations as described in instructions of use.

For fixed installed generating sets, the need of guarding shall be agreed between generating set manufacturer and installer considering that persons shall be protected during operating and routine servicing.

Because it is not possible to envisage the layout of fixed installation, the overall requirements for this situation are not dealt with in this document. Therefore, for fixed installations, the need for additional guarding to protect persons during operation and routine servicing shall be established after discussion between the generating set manufacturer, user and installer.

NOTE The provider of additional guarding for fixed installations that is outside the scope of this document is responsible for ensuring its suitability.

4.8.1.2 Verification

Conformance with the requirements shall be verified by inspection.