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**Reciprocating internal combustion
engine driven alternating current
generating sets —**

**Part 13:
Safety**

iTeh STANDARD PREVIEW
*Groupes électrogènes à courant alternatif entraînés par moteurs
alternatifs à combustion interne —
Partie 13: Sécurité*
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 70, *Internal combustion engines*.

ISO 8528 consists of the following parts, under the general title *Reciprocating internal combustion engine driven alternating current generating sets*:

- *Part 1: Application, ratings and performance*
- *Part 2: Engines*
- *Part 3: Alternating current generators for generating sets*
- *Part 4: Controlgear and switchgear*
- *Part 5: Generating sets*
- *Part 6: Test methods*
- *Part 7: Technical declarations for specification and design*
- *Part 8: Requirements and tests for low-power generating sets*
- *Part 9: Measurement and evaluation of mechanical vibrations*
- *Part 10: Measurement of airborne noise by the enveloping surface method*
- *Part 12: Emergency power supply to safety services*
- *Part 13: Safety*

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This corrected version of ISO 8528-13:2016 incorporates the following corrections plus other minor editorial modifications.

6.8.3.5 was corrected as follows:

- ~~b) When the accessible hot surfaces are less than 10 cm² they shall be verified in accordance with [6.8.3.1](#).~~
- b 1) The surfaces temperatures shall be verified by measurement,
- c 2) The generating set shall be operated at its rated power until the surface temperatures stabilize,
- d 3) The test shall be conducted in a well-ventilated location not directly exposed to sunshine,
- e 4) If the test is conducted at an ambient temperature outside of the nominal (20 ± 3) °C the reported temperatures shall be corrected by [Formula \(1\)](#):

Annex C b) 7) was corrected as follows:

Since the choice of protection arrangement to be carried out ~~depending~~ **depends on the** characteristic of the generator, running conditions and scheme of grounded liaisons determined by the user, the instructions and operation and instructions manual shall contain all information needed to the user to carry out correctly these protective measures according to the user (information for grounded, allowable lengths of connection cables, devices of complementary protection, etc.).

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Reciprocating internal combustion engine driven alternating current generating sets —

Part 13: Safety

1 Scope

This part of ISO 8528 specifies the safety requirements for reciprocating internal combustion (RIC) engine driven generating sets up to 1 000 V consisting of an RIC engine, an alternating current (AC) generator including the additional equipment required for operating, e.g. controlgear, switchgear, auxiliary equipment.

It is applicable to generating sets for land and marine use (domestic, recreational and industrial application). It 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.

NOTE This part of ISO 8528 does not apply to arc welding equipment (IEC 60974 series).

The special requirements needed to cover operation in potentially explosive atmospheres are not covered in this part of ISO 8528.

The hazards relevant to RIC engine driven generating sets are identified in [Annex A](#).

This part of ISO 8528 deals with the special requirements of test and safety design which should be observed in addition to the definitions and requirements in ISO 8528-1, ISO 8528-2, ISO 8528-3, ISO 8528-4, ISO 8528-5 and ISO 8528-6, where applicable. It specifies safety requirements in order to protect the user from danger.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 2710-1, *Reciprocating internal combustion engines — Vocabulary — Part 1: Terms for engine design and operation*

ISO 2710-2, *Reciprocating internal combustion engines — Vocabulary — Part 2: Terms for engine maintenance*

ISO 3046-1, *Reciprocating internal combustion engines — Performance — Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods — Additional requirements for engines for general use*

ISO 3046-6, *Reciprocating internal combustion engines — Performance — Part 6: Overspeed protection*

ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 6826:1997, *Reciprocating internal combustion engines — Fire protection*

ISO 7967-1, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 1: Structure and external covers*

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ISO 7967-2, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 2: Main running gear*

ISO 7967-3, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 3: Valves, camshaft drives and actuating mechanisms*

ISO 7967-4, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 4: Pressure charging and air/exhaust gas ducting systems*

ISO 7967-8, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 8: Starting systems*

ISO 7967-9, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 9: Control and monitoring systems*

ISO 8528-1:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 1: Application, ratings and performance*

ISO 8528-2, *Reciprocating internal combustion engine driven alternating current generating sets — Part 2: Engines*

ISO 8528-3, *Reciprocating internal combustion engine driven alternating current generating sets — Part 3: Alternating current generators for generating sets*

ISO 8528-4:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 4: Controlgear and switchgear*

ISO 8528-5:2013, *Reciprocating internal combustion engine driven alternating current generating sets — Part 5: Generating sets*

ISO 8528-6, *Reciprocating internal combustion engine driven alternating current generating sets — Part 6: Test methods*

ISO 8528-7, *Reciprocating internal combustion engine driven alternating current generating sets — Part 7: Technical declarations for specification and design*

ISO 8528-8:2016, *Reciprocating internal combustion engine driven alternating current generating sets — Part 8: Requirements and tests for low-generating sets*

ISO 8528-9, *Reciprocating internal combustion engine driven alternating current generating sets -- Part 9: Measurement and evaluation of mechanical vibrations*

ISO 8999:2001, *Reciprocating internal combustion engines — Graphical symbols*

ISO 11102-1, *Reciprocating internal combustion engines — Handle starting equipment — Part 1: Safety requirements and tests*

ISO 11102-2, *Reciprocating internal combustion engines — Handle starting equipment — Part 2: Method of testing the angle of disengagement*

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

ISO 11684:1995, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Safety signs and hazard pictorials — General principles*

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

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

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

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ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14122-2:2001, *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, *Ergonomic design for the safety of machinery — Part 2: Principles for determining the dimensions required for access openings*

IEC 60034-1:2010, *Rotating electrical machines — Part 1: Rating and performance*

IEC 60034-5:2006, *Rotating electrical machines — Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) — Classification*

IEC 60245-4, *Rubber insulated cables of rated voltages up to and including 450/750 V — Part 4: Cords and flexible cables*

IEC 60204-1:2009, *Safety of machinery — Electrical equipment of machine — Part 1: General requirements*

IEC 60335-1:2013, *Household and similar electrical appliances — Safety — Part 1: General requirements*

IEC 60364-1, *Low-voltage electrical installations — Part 1: Fundamental principles, assessment of general characteristics, definitions*

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

IEC 60068-2-75, *Environmental testing - Part 2-75: Tests - Test Eh: Hammer tests*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2710-1, ISO 2710-2, ISO 3046-1, ISO 3046-6, ISO 7967-1, ISO 7967-2, ISO 7967-3, ISO 7967-4, ISO 7967-8, ISO 7967-9, ISO 8528-1, ISO 8528-2, ISO 8528-3, ISO 8528-4, ISO 8528-5, ISO 8528-6, ISO 8528-7, ISO 8528-8, ISO 8528-9, ISO 8528-10, ISO 12100, IEC 60364-1 and the following apply.

3.1

layman

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

Note 1 to entry: The layman 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 according to ISO 8528-1:2005, Clause 13 (COP, PRP, LTP, ESP), except for low power generating sets to ISO 8528-8:2016, 3.3 (COP)

3.4

low power generating sets

power generating sets for the purpose of this part of ISO 8528 which are determined by the following special features:

- low power is taken to mean rated power of a magnitude up to 10 kW/50 Hz, 12 kW/60 Hz;
- users normally are laymen;
- 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.

[SOURCE: ISO 8528-8:2016, Clause 1]

3.5

frame contour

outmost of low power generating sets, consisting of robust parts such as, the frame made of pipe, the fuel tank, the handle, the control box, etc.

3.6

operator interface

means by which information is communicated between a human operator(s) and the SIS (for example, CRTs, 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 (ex. relay, contactor, position sensor,...)

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

electrical operating area

room or location for electrical equipment to which access is intended to be restricted to skilled or instructed persons (1) (2), by the opening of a door or the removal of a barrier without the use of a key or tool, and which is clearly marked by appropriate warnings signs

Note 1 to entry: Persons (1) and (2) are defined as follows:

- (1) person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create;
- (2) person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid hazards which electricity can create.

3.10 enclosure

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

3.11 hazardous-live-part

live part which, under certain conditions, can give a harmful electric shock

3.12 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

4 General

If the installation of a generating set can create hazards in addition to those covered by this part of ISO 8528, the safety requirements and/or protective measures related to these additional hazards are the responsibilities of the installer, if necessary with the agreement of the manufacturer of the generating set. The installer will be responsible for ensuring compliance for the additional hazards arising because of the installation.

5 Hazards

The hazards relevant to RIC engine driven generating sets that shall be considered in order to prevent personal injury are listed in [Annex A](#) (standards.iteh.ai)

6 Safety requirements and tests

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6.1 General

Machinery shall comply with the safety requirements and/or protective measures of this Clause. In addition, the machine shall be designed according to the principles of ISO 12100 for relevant but not significant hazards, which are not dealt with by this part of ISO 8528.

6.2 Starting system

6.2.1 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 part of ISO 8528 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 comply with the installation requirements and with the operation and safety information specified in the manuals provided by the starting system components suppliers.

Crank handle starting systems shall meet the requirements specified in ISO 11102-1 and ISO 11102-2. In addition, the following requirements apply:

- 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 as described in ISO 14314. The marking required in ISO 14314:2004, 7.3 shall not apply.

6.2.2 Verification

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

6.3 Stopping

6.3.1 Requirements

6.3.1.1 Normal stopping

All generating sets shall have a 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. This device should include an air supply cut-off.

6.3.1.2 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 [ISO 8528-13:2016
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 - 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.

6.3.2 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).

6.4 Emergency stopping

6.4.1 Requirements

Emergency stopping devices are required for remote controlled generating sets and generating sets with an enclosure 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 also meet the requirements of ISO 13850, category 0, and the reset shall not initiate a restart or any hazardous conditions.

Manually actuated emergency stopping devices shall be located inside and outside the enclosure 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.

6.4.2 Verification

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

6.5 Control devices

6.5.1 Design, safety and mechanical strength

6.5.1.1 Requirements

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

- hand controls shall be designed to withstand $1,2\times$ the maximum actuating forces given in [Table 1](#);

Table 1 — Clearance between controls

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

- for handles, knobs, grips, levers and similar devices, requirements and tests shall be in accordance with IEC 60335-1:2013, 22.12;
- controls shall act positively and smoothly and without delay or unexpected action and be in accordance with ISO 2261;
- 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 for a contact time of 10 s,
 - 55 °C for metallic surfaces, and