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Reciprocating internal combustion engine driven alternating current generating sets —

Part 12:
Emergency power supply to safety services

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

Partie 12: Alimentation électrique de secours de services de sécurité

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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*.

This second edition cancels and replaces the first edition (ISO 8528-12:1997), of which it constitutes a minor revision. The changes are as follows:

— structure updated according to the current ISO template;

— normative references updated;

— previous Clause 4 deleted – the symbols used in ISO 8528-5 now apply;

— Clause 7 split into subclauses;

— hanging paragraphs removed from Clauses 8 and 9;

— values in Table 3 modified based on the values in ISO 8528-5:2022, Table 4;

— minor editorial changes.

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.

Reciprocating internal combustion engine driven alternating current generating sets —

Part 12:
Emergency power supply to safety services

1 Scope

This document applies to generating sets driven by reciprocating internal combustion (RIC) engines for emergency power supply to safety services.

This document applies, for example, to safety equipment in hospitals, high-rise buildings and public gathering places. It establishes the special requirements for the performance, design and maintenance of generating sets used in these applications referred to previously and takes into account the provisions of ISO 8528-1 to ISO 8528-6 and ISO 8528-10.

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

ISO 8528-2:2018, *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 8528-5:2022, *Reciprocating internal combustion engine driven alternating current generating sets — Part 5: Generating sets*

ISO 8528-6:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 6: Test methods*

IEC 60364-7-710, *Low-voltage electrical installations — Part 7-710: Requirements for special installations and locations — Medical locations*

IEC 60622, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Sealed nickel-cadmium prismatic rechargeable single cells*

IEC 60623, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Vented nickel-cadmium prismatic rechargeable single cells*

IEC 60896-11, *Stationary lead-acid batteries — Part 11: Vented types — General requirements and methods of tests*

IEC 60896-21, *Stationary lead-acid batteries — Part 21: Valve regulated types — Methods of test*

IEC 61951-1, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Secondary sealed cells and batteries for portable applications — Part 1: Nickel-Cadmium*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8528-1 to ISO 8528-6 and the following 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
changeover time
t_{co}
time interval from the appearance of a malfunction of the normal electrical power supply system until the safety services are again connected to the emergency power supply

Note 1 to entry: This connection to the safety services may be applied in several load steps.

3.2
bridging time
t_B
minimum time for which the generating station supplies the consumers with electrical power under predetermined operating conditions

Note 1 to entry: The bridging time corresponds with the rated operating time as defined in IEC 60601-1.

3.3
safety services
equipment for the safety of persons which is installed and kept prepared in case of failure of the usual electrical power supply system

3.4
consumer power demand
total of all intended demands of the connected consumers, taking into consideration the actual load steps

3.5
power demand for safety services
required power demand to fulfil the safety service requirements

4 Additional regulations and requirements

If special requirements or additional regulations are to be observed, they shall be stated by the customer and agreed upon between manufacturer and customer.

5 Classification designation

5.1 General

Classification of generating sets for safety services is based on performance class G2 as defined in ISO 8528-1 and the required changeover time, t_{co}, according to IEC 60364-5-56 and Table 1.

Table 1 — Classification by changeover time

Generating sets	No break	Short break	Long break	
Changeover time	0	< 0,5 s	< 15 s	> 15 s
Classification	1	2	3	4

5.2 Typical examples of classification

Typical examples of classification as defined in Table 1 are given in Table 2.

Table 2 — Examples

Classification	Typical examples
1	The mains voltage drops below the rated voltage by more than 10 %. After a changeover time of 0 s the power for the consumer power demand for safety services shall be available. The design of the no-break generating sets depends on the required frequency and voltage deviations.
2	The mains voltage drops below the rated voltage by more than 10 %. After a changeover time of 0,5 s the power for the consumer power demand for safety services shall be available. The design of the short-break generation set depends on the required frequency and voltage deviations.
3	The mains voltage drops below the rated voltage by more than 10 % for a period longer than 0,5 s. After a changeover time of maximum 15 s, power for 100 % of the consumer power demand for safety services shall be available in steps.
4	The mains voltage drops below the rated voltage by more than 10 % for a period longer than 0,5 s. After a changeover time of maximum 15 s, power for 80 % of the consumer power demand for safety services shall be available in two steps, and the power for 100 % of the consumer demand shall be available after an additional 5 s has passed.

6 Generating set design

6.1 Criteria for determining the required power

To ensure a reliable supply of electrical power by the generating set, the generating set manufacturer shall be informed of the power requirements of the installations to be supplied.

The power requirements shall include short load peaks when switching in electrical installations (e.g. lifts, pumps, fans, lighting equipment and nonlinear electrical installations). Where applicable, for example for reasons of redundancy, the use of several generating sets operating in parallel will possibly be required.

Since many modern RIC engines are turbocharged, it will be necessary to arrange load acceptance in several steps.

For load acceptance, the definitions and values laid down in ISO 8528-5:2022, 8.4, Figure 5 and Figure 6 apply, where the load acceptance capability of the generating set is shown to be dependent on the brake mean effective pressure of the RIC engine.

If larger steps are used than those recommended in ISO 8528-5:2022, Figure 5 and Figure 6, either suitable additional measures shall be taken or the generating set power rating and, where applicable, the rotating mass of the flywheel shall be increased.

The information provided by the checklist in Clause 13 is recommended for designing the generating set.

Essential equipment of emergency generating sets, such as a cooling system, a fuel system including storage tank and a lubrication system, shall be provided to ensure the operation of the generating set for the required period.

The cooling system of the RIC engine shall be self-contained.

6.2 Power determination

ISO 8528-1:2018, Clauses 13 and 14 apply for determining the power requirement.

6.3 Operating limit values

The operating limits shall at least meet the requirements of performance class G2 in ISO 8528-5:2022.

Special requirements for the limit values are given in ISO 8528-5:2022, Table 4.

The transient operating limits given in ISO 8528-5:2022, Table 4 generally apply.

Classifications given in Table 2 are listed in Table 3.

Table 3 — Special requirements for examples given in Table 2

Parameter	Symbol	Unit	Reference	Classification			
				1	2	3	4
Frequency droop	δf_{st}	%	ISO 8528-5:2022, 3.1.26	AMC[a]	AMC	≤ 5	≤ 4
Steady-state frequency band	β_f	%	ISO 8528-5:2022, 3.1.23	AMC	AMC	≤ 1,5	≤ 0,5
Transient frequency deviation from rated frequency	δf_{dyn}^{-}	%	ISO 8528-5:2022, 3.2	AMC	AMC	–10	–10
Steady-state voltage deviation	ΔU_{st}	%	ISO 8528-5:2022, 3.1.28	AMC	AMC	≤ ± 2,5	≤ ± 1
Transient voltage deviation	ΔU_{dyn}^{+} ΔU_{dyn}^{-}	% %	ISO 8528-5:2022, 3.2	AMC	AMC	+20 –15	+10 –10
Voltage recovery time	$t_{u,de}$ $t_{u,in}$	s s	ISO 8528-5:2022, 3.2 ISO 8528-5:2022, 3.2	AMC	AMC	4	4
Unbalanced load current ratio	I_2 / I_N [b]	1	IEC 60034-1:2017, 7.2.3	33[c] 15[d]	33[c] 15[d]	33[c] 15[b,d]	33[c] 15[d]
Total voltage harmonic distortion	k_u	%	IEC 60034-1:2017, 9.11	AMC	AMC	–	5[e]

NOTE All other values are given in ISO 8528-5.

[a] AMC agreement between AC generating set manufacturer and customer.

[b] See also definition in IEC 60034-1:2017, 7.2.3.

[c] For generating sets with ratings above 300 kVA.

[d] For generating sets with ratings below 300 kVA.

[e] This applies also to the voltage between conductors and the neutral conductor under linear and symmetrical loading.

7 Additional requirements

7.1 Characteristics of batteries and battery charger for auxiliaries and starter

A continuous power supply for monitoring and controlling voltages shall be backed up by batteries. Batteries for this application shall conform to the requirements of either IEC 60622, IEC 60623, IEC 60896-11, IEC 60896-21 or IEC 61951-1.

Such batteries, if suitable, may also be used for starting the engine. Partial voltages shall not be tapped. The battery shall not be used for any other purpose than starting the engine and as a power supply for the monitoring or controlling voltages.

The battery (or battery bank) is to be of such a capacity that it provides enough current to start, monitor and control the generating set at an ambient temperature of 10 °C under float-charged conditions, enabling three starts of 10 s duration each with a 5 s break between starts. The voltage drops each time the starter is operated shall not negatively influence the control system.

For each battery (or battery bank), charging equipment of a controlled type with limited constant current and limited constant voltage characteristics (I-U curve), changing to a float charge characteristic at the end of the charging period, shall be provided. The battery charger shall be capable of automatically recharging a discharged battery (or battery bank) to 80 % of its rated capacity (in Ah) as follows:

— for classification 4, generating sets in within 6 h;

— for classification 3, generating sets in within 10 h.

In addition to charging the battery (or battery bank), the charging equipment shall supply adequate energy for continuous operation of the monitoring and control equipment.

Equipment which continuously monitors the battery voltage and health and includes a malfunction alarm shall be provided. The circuit for this alarm shall fail in the alarm mode. This alarm shall sound at or be repeated to a permanently manned monitoring station. Voltage drops of short duration, for example during the start event or while charging, shall not initiate an alarm.

Malfunctions of the battery charger (e.g. loss of AC supply voltage for more than 3 min or tripping of AC or DC miniature circuit breaker) shall also initiate an alarm.

The design of the battery charger and its associated system shall be such that the voltage appearing at the output terminals shall not exceed the maximum rated voltage of permanently connected control and actuating equipment.

Starter motor cables shall be dimensioned for a total cable voltage drop while cranking the engine, not exceeding 8 % of the nominal battery voltage.

If separate batteries are used for controlling the generating set and for starting the generating set, each battery (or battery bank) shall be provided with an individual battery charger in accordance with the requirements of this subclause.

7.2 Compressed air starter

For RIC engines which are started using compressed air, the size and number of air bottles shall be such that the RIC engine can be run at five times the firing speed in both hot and cold conditions. An automatic compressor system shall be provided to recharge the air bottles. The charging system shall be able to fill the air bottles to the operating pressure within 45 minutes of starting. The pressure in the air bottles shall be indicated at all times.

If the required air pressure is not maintained, an alarm shall be initiated.

An automatic and manual water drain shall be provided on each air bottle.

7.3 Fuel capacity

The bridging time during which a generating set driven by an RIC engine can supply consumers with electrical power depends primarily on the amount of fuel supplied.

The amount of fuel available for classification 3 generating sets shall be adequate for at least eight hours of operation; for classification 4 generating sets, this shall be for at least 24 h of operation at the rated power, including the fuel required for test operation.

The amount of fuel available can be increased based on an agreement between customer and manufacturer for special services when the generating set is operated for longer time periods in the case of disasters such as earthquakes.

The fuel service tank capacity for liquid fuelled engines shall be large enough for at least two hours of operation at rated power. It shall be placed close to the engine. To ensure reliable starting the bottom edge of the service tank shall be at least 0,5 m above the injection pump of the RIC engine, unless otherwise specified by the engine manufacturer. The service tank shall have bleed and venting equipment. To avoid overfilling and to detect leakages, appropriate protection measures shall be provided.

Other requirements for duration of operation and fuel storage shall be by agreement between customer and manufacturer.

The tanks shall be provided with level indicators or dipsticks as well as an indication of their capacity.

7.4 Ventilation louvers

Movable ventilation louvers, where fitted, shall be opened automatically by the emergency power supply.

These ventilation louvers shall also be manually operable.

7.5 Electric power supply

Malfunctions of the normal electrical power supply systems of less than 0,5 s shall not initiate engine start, except for no-break and short-break generating sets.

7.6 Robustness against vibrations

If necessary, effective measures shall additionally be provided against vibrations due to earthquakes. A daily maintenance of the emergency generating set is recommended by checking, for example, fuel oil level, filter clogging condition and battery charging level.

NOTE 1 Damage due to earthquakes to any single component of the emergency generating set, including piping and cabling, can stop the generating set from supplying power to safety services.

NOTE 2 If safety services and/or cables to them are damaged due to an earthquake, supplying power from emergency generating sets can cause a secondary disaster.

NOTE 3 If the disaster happens over a wide area, emergency generating sets can be expected to supply power to safety services for a long time before the normal electrical power supply system is repaired. It took 153 h to repair – in some cases temporarily – the normal electric power supply system to all consumers after the disaster in the Kobe area of Japan in January 1995. A few emergency generating sets were unable to start after the disaster due to poor daily maintenance.