INTERNATIONAL STANDARD

ISO 8528-2

Second edition
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Reciprocating internal combustion engine driven alternating current generating sets —

Part 2: Engines

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

Partie 2: Moteurs

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 8528-2 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*.

This second edition cancels and replaces the first edition (ISO 8528-2:1993), which has been technically revised.

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 11: Rotary uninterruptible power systems — Performance requirements and test methods*[1)]

— *Part 12: Emergency power supplies to safety services*

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1) Part 11 will be published as ISO/IEC 88528-11.

Reciprocating internal combustion engine driven alternating current generating sets —

Part 2: Engines

1 Scope

This part of ISO 8528 specifies the principal characteristics of a Reciprocating Internal Combustion (RIC) engine when used for alternating current (a.c.) generating set applications.

It applies to RIC engines for a.c. generating sets for land and marine use, excluding generating sets used on aircraft or to propel land vehicles and locomotives.

For some specific applications (e.g. essential hospital supplies, high rise buildings), supplementary requirements may be necessary. The provisions of this part of ISO 8528 should be regarded as the basis for establishing any supplementary requirements.

The terms which define the speed governing and speed characteristics of RIC engines are listed and explained where they apply specifically to the use of the engine for driving a.c. generators.

For other reciprocating-type prime movers (e.g. steam engines), the provisions of this part of ISO 8528 should be used as a basis for establishing these requirements.

2 Normative references

The following referenced documents are indispensable for the application 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 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 3046-4, *Reciprocating internal combustion engines — Performance — Part 4: Speed governing*

ISO 3046-5, *Reciprocating internal combustion engines — Performance — Part 5: Torsional vibrations*

ISO 8528-1[2)], *Reciprocating internal combustion engine driven alternating current generating sets — Part 1: Application, ratings and performance*

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

2) ISO 8528-1 and ISO 8528-5 are under revision.

3 Symbols, terms and definitions

An explanation of the symbols and abbreviations used in this International Standard is shown in Table 1.

Table 1 — Symbols, terms and definitions

Symbol	Term	Unit	Definition
n	Engine speed	min^{-1}	
n_r	Declared speed	min^{-1}	Engine speed at declared power corresponding to the rated frequency of the generating set.
n_{sf}	Firing speed	min^{-1}	Engine speed to which an engine must be accelerated from rest by the use of an external supply of energy separate from the fuel feed system before the engine becomes self-sustaining.
n_{max}	Maximum permissible speed	min^{-1}	Speed of the engine specified by the RIC engine manufacturer which lies a safe amount below the speed limit (see Note 1 and Figure 3).
n_a	Partial-load speed	min^{-1}	Steady-state engine speed of an engine running at a % of the declared power given by: $a = 100 \times \frac{P_a}{P_r}$ EXAMPLE: at 45 % power, $a = 45$ (see Figure 2) For $a = 45$ $n_a = n_{i,r} - \frac{P_a}{P_r}(n_{i,r} - n_r)$ $= n_{i,r} - 0{,}45\,(n_{i,r} - n_r)$ Corresponding values of declared speed and partial-load speed are based on an unchanged speed setting.
$n_{i,r}$	Declared no-load speed	min^{-1}	Steady-state engine speed without load at the same speed setting as for the declared speed n_r.
$n_{i,min}$	Lowest adjustable no-load speed	min^{-1}	Lowest steady-state engine speed without load obtainable on the governor speed setting device.
$n_{i,max}$	Highest adjustable no-load speed	min^{-1}	Highest steady-state engine speed without load obtainable on the governor speed setting device.
$n_{d,s}$	Setting speed of overspeed limiting device	min^{-1}	Speed of the engine, the exceeding of which activates the overspeed limiting device (see Figure 3).
$n_{d,o}$	Operating speed of overspeed limiting device	min^{-1}	Speed of the engine at which, for a given setting speed, the limiting device starts to operate (see Note 2 and Figure 3).

Table 1 (*continued*)

Symbol	Term	Unit	Definition
δn_s	Speed setting related range	%	Range of speed setting, expressed as a percentage of the declared speed given by: $\delta n_s = \frac{n_{i,max} - n_{i,min}}{n_r} \times 100$
Δn_s	Speed setting range	min^{-1}	Range between the highest and lowest adjustable no-load speeds given by: $\Delta n_s = n_{i,max} - n_{i,min}$
$\Delta n_{s,do}$	Speed setting downward range	min^{-1}	Range between the declared no-load speed and the lowest adjustable no-load speed given by: $\Delta n_{s,do} = n_{i,r} - n_{i,min}$
$\delta n_{s,do}$	Speed setting related downward range	%	Downward range of speed setting, expressed as a percentage of the declared speed given by: $\delta n_{s,do} = \frac{n_{i,r} - n_{i,min}}{n_r} \times 100$
$\Delta n_{s,up}$	Speed setting upward range	min^{-1}	Range between the highest adjustable no-load speed and the declared no-load speed given by: $\Delta n_{s,up} = n_{i,max} - n_{i,r}$
$\delta n_{s,up}$	Speed setting related upward range	%	Upward range of speed setting, expressed as a percentage of the declared speed given by: $\delta n_{s,up} = \frac{n_{i,max} - n_{i,r}}{n_r} \times 100$
v_n	Speed setting rate of change	$\%\cdot s^{-1}$	Rate of change of speed setting under remote control, expressed as a percentage of the related range of speed setting per second given by: $v_n = \frac{(n_{i,max} - n_{i,min})/n_r}{t} \times 100$
	Adjustment range	min^{-1}	Speed range over which the overspeed limiting device may be adjusted.
δn_{st}	Speed droop	%	Difference between the declared no-load speed and the declared speed at declared power, for a fixed speed setting (see Figure 1). It is expressed as a percentage of the declared speed given by: $\delta n_{st} = \frac{n_{i,r} - n_r}{n_r} \times 100$
$\Delta\delta n_{st}$	Speed/power characteristic deviation	%	Maximum deviation from a linear speed power characteristic curve in the power range between no-load and declared power, expressed as a percentage of the declared speed (see Figure 2).
	Speed/power characteristic curve		Curve of steady-state speeds in the power range between no-load and declared power plotted against RIC engine power (see Figures 1 and 2).

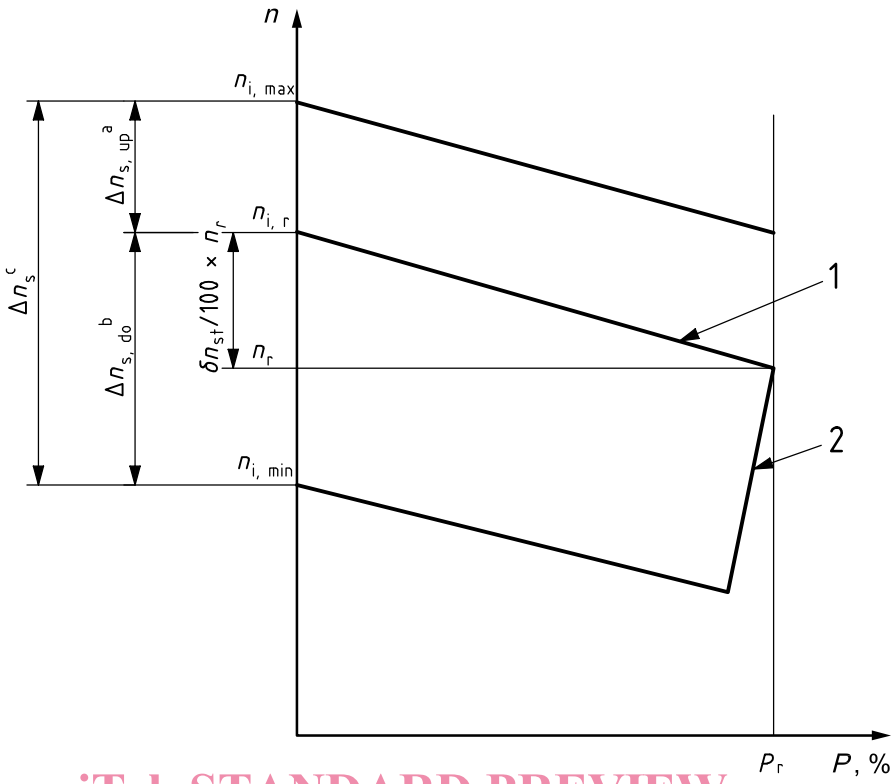
Table 1 (*continued*)

Symbol	Term	Unit	Definition
P	Engine power	kW	
P_a	Actual engine power	kW	
P_r	Declared engine power	kW	
t_r	Response time	s	Time between activation of the overspeed limiting device and commencement of its operation.
p_{me}	Brake mean effective pressure	kPa	
V_{st}	Engine swept volume	l	

NOTE 1 The speed limit is the maximum calculated speed which the engine may sustain without risk of damage.

NOTE 2 For a given engine, the operating speed depends on the total inertia of the generating set and the design of the overspeed protection system.

NOTE 3 100 kPa = 1 bar.



Key

P engine power

n engine speed

1 speed/power characteristic curve

2 power limit

a Upward speed setting.

b Downward speed setting range.

c Range of speed setting.

Figure 1 — Speed/power characteristic, range of speed setting