

Svenska Elektriska Kommissionen, SEK

Fastställt	Utgåva	Sida	Ingår i
2004-10-25	1	1 (1+48)	SEK Område 2

© Copyright SEK. Reproduction in any form without permission is prohibited.

Förbränningsmotordrivna växelströmgeneratorer – Del 11: Utrustning för avbrottsfri elförsörjning (UPS) – Prestandafordringar och provning

*Reciprocating internal combustion engine driven alternating current generating sets –
Part 11: Rotary uninterruptible power systems –
Performance requirements and test methods*

Som svensk standard gäller europastandarden EN 88528-11:2004. Den svenska standarden innehåller den officiella engelska språkversionen av EN 88528-11:2004.

Nationellt förord

Europastandarden EN 88528-11:2004

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 88528-11, First edition, 2004 - Reciprocating internal combustion engine driven alternating current generating sets - Part 11: Rotary uninterruptible power systems - Performance requirements and test methods**

utarbetad inom International Electrotechnical Commission, IEC.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

Svenska Elektriska Kommissionen, SEK, svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK

Box 1284
164 29 Kista
Tel 08-444 14 00
www.sekom.se

**Reciprocating internal combustion engine driven
alternating current generating sets
Part 11: Rotary uninterruptible power systems -
Performance requirements and test methods
(IEC 88528-11:2004)**

Groupes électrogènes à courant alternatif
entraînés par moteurs alternatifs
à combustion interne
Partie 11: Alimentations sans interruption
à accumulation d'énergie cinétique -
Prescriptions de performances
et méthodes d'essai
(CEI 88528-11:2004)

Stromerzeugungsaggregate
mit Hubkolben-Verbrennungsmotoren
Teil 11: Dynamische, unterbrechungsfreie
Stromversorgung -
Leistungsanforderungen
und Prüfverfahren
(IEC 88528-11:2004)

This European Standard was approved by CENELEC on 2004-04-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 2/1275/FDIS, future edition 1 of IEC 88528-11, prepared by IEC TC 2, Rotating machinery and ISO TC 70, Internal combustion engines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 88528-11 on 2004-04-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2005-01-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2007-04-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 88528-11:2004 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60034-1	- ¹⁾	Rotating electrical machines Part 1: Rating and performance	-	-
IEC 60034-22	1996	Part 22: AC generators for reciprocating internal combustion (RIC) engine driven generating sets	EN 60034-22	1997
IEC 60417 database	-	Graphical symbols for use on equipment	-	-
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
IEC 61000	Series	Electromagnetic compatibility (EMC)	EN 61000	Series
ISO 3046-1	2002	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 7000	- ²⁾	Graphical symbols for use on equipment - Index and synopsis	-	-
ISO 8178-1	- ²⁾	Reciprocating internal combustion engines - Exhaust emission measurement Part 1: Test-bed measurement of gaseous and particulate exhaust emissions	EN ISO 8178-1	1996 ³⁾
ISO 8528-1	- ²⁾	Reciprocating internal combustion engine driven alternating current generating sets Part 1: Application, ratings and performance	-	-
ISO 8528-6	- ²⁾	Part 6: Test methods	-	-

¹⁾ To be published.

²⁾ Undated reference.

³⁾ Valid edition at date of issue.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 8528-9	- ²⁾	Part 9: Measurement and evaluation of mechanical vibrations	-	-
ISO 8528-10	- ²⁾	Part 10: Measurement of airborne noise by the enveloping surface method	-	-

CONTENTS

1	Scope.....	7
2	Normative references	7
3	Terms and definitions	8
	3.1 General	8
	3.2 Performance of systems and components	9
	3.3 Specified values	10
	3.4 Input values.....	11
	3.5 Output values	12
4	Symbols and abbreviations.....	12
5	Selection criteria	12
6	General description	13
	6.1 Rotary UPS	13
	6.2 Types of rotary UPS	13
	6.2.1 Series connected rotary UPS.....	13
	6.2.2 Line interactive rotary UPS	14
	6.3 Parallel operation of a rotary UPS installation.....	15
	6.3.1 General	15
	6.3.2 Parallel operation	15
	6.3.3 Redundant operation	15
	6.4 Power system changeover with rotary UPS installations (bypass).....	16
	6.5 Enclosure protection.....	16
7	Modes of operation.....	16
	7.1 Power conditioning mode	17
	7.2 Independent mode.....	17
	7.3 Bypass mode	18
	7.4 Off mode	18
	7.5 Transitions	18
	7.5.1 Transition 1, starting the system with mains voltage present.....	18
	7.5.2 Transition 2, start-up without mains voltage (black start)	18
	7.5.3 Transition 3, disconnect from grid.....	19
	7.5.4 Transition 4, connect to grid	19
	7.5.5 Transition 6, transfer	19
	7.5.6 Transition 7, 8, retransfer	19
8	Service conditions	19
	8.1 Normal service conditions	19
	8.2 Operation at extended ambient.....	19
	8.2.1 Ambient service temperature	19
	8.2.2 Ambient storage and transportation conditions	19
	8.3 Engines.....	20
	8.4 Rotating electrical machines.....	20
	8.5 Control logic.....	20

9	Electrical service conditions and performance	20
9.1	General – all rotary UPS.....	20
9.2	Performance.....	21
10	Manufacturer technical declarations	22
10.1	General	22
10.2	Purchaser specification guidelines.....	22
10.2.1	Type of rotary UPS, additional features, and system requirements	23
10.2.2	Rotary UPS input.....	23
10.2.3	Load to be supplied from a rotary UPS	23
10.2.4	Rotary UPS output.....	24
10.2.5	Battery (where applicable).....	24
10.2.6	General application requirements and special service conditions.....	25
10.2.7	Multi-module system configurations	25
10.2.8	Electromagnetic compatibility	26
11	Testing	27
11.1	Static output voltage and frequency deviations	27
11.2	Dynamic output voltage and frequency deviations	28
11.3	Input current characteristics	28
11.4	Measurement of filter properties	28
11.4.1	From mains to output.....	28
11.4.2	From output to mains.....	30
11.5	System performance	30
11.5.1	Efficiency.....	30
11.5.2	Stored energy times	30
11.5.3	Multi-module rotary UPS performance	30
11.6	Black start test	31
11.7	Environmental tests.....	31
11.8	Audible noise	31
11.9	Testing.....	31
12	Maintenance and product marking	33
12.1	Nameplate markings.....	33
12.2	Label requirements.....	34
12.3	Name plate marker.....	34
12.4	Decals – labelling	35
12.4.1	Safety instructions and documentation	35
12.5	Maintenance.....	35
	Annex A (informative) Typical energy storage devices	36
	Annex B (normative) Reference non-linear load – Single-phase	40
	Annex C (normative) Reference non-linear load – Three-phase	42
	Annex D (normative) Input mains failure – Test method	43
	Annex E (informative) Types of uninterruptible power systems (UPS) configurations	44
	Figure 1 – Types of UPS systems	13
	Figure 2 – Typical example series connected rotary UPS.....	13
	Figure 3 – Typical example of a line interactive rotary UPS.....	14
	Figure 4 – Parallel operation of a rotary UPS	15

Figure 5 – Bypass operation	16
Figure 6 – Illustration of rotary UPS operation	17
Figure 7 – Operating modes.....	18
Figure 8 – Surge test	29
Figure 9 – Warning label.....	34
Figure A.1 – Dual conversion – direct-coupled flywheel	37
Figure A.2 – Line interactive – direct-coupled flywheel.....	37
Figure A.3 – Dual conversion – indirect coupled flywheel.....	37
Figure A.4 – Line interactive – indirect coupled flywheel.....	38
Figure A.5 – Double fed a.c. machine	38
Figure A.6 – Dual conversion with battery.....	38
Figure A.7 – Line interactive with battery	39
Figure B.1 – Single-phase non-linear load	40
Figure C.1 – Three-phase non-linear load.....	42
Figure D.1 – Input mains failure test method.....	43
Figure E.1 – Series connected type 1	44
Figure E.2 – Series connected type 2	45
Figure E.3 – Line interactive	45
Figure E.4 – Typical UPS.....	46
Figure E.5 – Typical switchless dual feed UPS	47
Table 1 – Compatibility levels for individual harmonic voltages in mains power	21
Table 2 – Operating steady-state limit values for performance classes	21
Table 3 – Operating dynamic limit values for performance classes (note 1).....	22
Table 4 – Technical data sheets – Manufacturers declaration	26
Table 5 – Test methods for rotary UPS performance characteristics	32

RECIPROCATING INTERNAL COMBUSTION ENGINE DRIVEN ALTERNATING CURRENT GENERATING SETS –

Part 11: Rotary uninterruptible power systems – Performance requirements and test methods

1 Scope

This International Standard, which forms part of the ISO 8528 series, specifies criteria, including performance and test methods, for rotary uninterruptible power systems (UPS) arising out of a combination of mechanical and electrical rotating machines. This standard applies to power supplies primarily designed for supplying uninterrupted a.c. power to the consumer. When operated without input mains feed, the power is provided by stored energy and/or reciprocating internal combustion (RIC) engine and the output power is provided by one or more rotating electrical machines.

This part 11 applies to a.c. power supplies primarily designed for supplying uninterruptible electrical power for stationary land and marine use, excluding supplies for aircraft, land vehicles or locomotives. It also excludes power supplies where the output power is generated by static converters. (See IEC 62040-3.)

The use of a rotary UPS installation to improve the quality of a.c. power supply, to provide voltage and/or frequency conversion, and to provide peak shaving is also described.

For some specific applications (for example, essential hospital supplies, offshore, non-stationary applications, high rise buildings, nuclear, etc.) supplementary requirements may be necessary. The provisions of this part of ISO 8528 should be used as a basis.

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.

IEC 60034-1:2003, *Rotating Electrical Machines – Part 1: Rating and performance*

IEC 60034-22:1996, *Rotating Electrical Machines – Part 22: AC generators for reciprocating internal combustion (RIC) engine driven generating sets*

IEC 60417 (all parts), *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets*

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

IEC 61000, *Electromagnetic compatibility (EMC)*

ISO 3046-1:2003, *Reciprocating internal combustion engines*

ISO 7000, *Graphical symbols for use on equipment*

ISO 8178-1, *Reciprocating internal combustion engines – Exhaust emission measurement – Part 1: Test-bed measurement of gaseous and particulate exhaust emissions*

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