

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

Elektrisk fordonsdrift – Elmaskiner för räls- och vägfordon – Del 1: Maskiner andra än växelströmsmotorer för omriktardrift

Electric traction –

Rotating electrical machines for rail and road vehicles –

Part 1: Machines other than electronic convertor-fed alternating current motors

Som svensk standard gäller europastandarden EN 60349-1:2010. Den svenska standarden innehåller den officiella engelska språkversionen av EN 60349-1:2010.

Nationellt förord

Europastandarden EN 60349-1:2010

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 60349-1, Second edition, 2010 - Electric traction - Rotating electrical machines for rail and road vehicles - Part 1: Machines other than electronic convertor-fed alternating current motors**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 60349-1, utgåva 1, 2000 och SS-EN 60349-1/A1, utgåva 1, 2003, gäller ej fr o m 2013-11-01.

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

SEK Svensk Elstandard 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 Svensk Elstandard

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

English version

**Electric traction -
Rotating electrical machines for rail and road vehicles -
Part 1: Machines other than electronic converter-fed alternating current
motors
(IEC 60349-1:2010)**

Traction électrique -
Machines électriques tournantes des
véhicules ferroviaires et routiers -
Partie 1: Machines autres que les moteurs
à courant alternatif alimentés par
convertisseur électronique
(CEI 60349-1:2010)

Elektrische Zugförderung -
Drehende elektrische Maschinen für
Bahn- und Straßenfahrzeuge -
Teil 1: Elektrische Maschinen
ausgenommen umrichter gespeiste
Wechselstrommotoren
(IEC 60349-1:2010)

This European Standard was approved by CENELEC on 2010-11-01. 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, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 9/1415/FDIS, future edition 2 of IEC 60349-1, prepared by IEC TC 9, Electrical equipment and systems for railways, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60349-1 on 2010-11-01.

This European Standard supersedes EN 60349-1:2000 + A1:2002.

The main technical changes with regard to EN 60349-1:2000 + A1:2002 are as follows:

- As the limits of vibration velocities have been changed in EN 60034-14, the limits valid for traction motors are now directly stated in this standard.
- In addition to the existing method for measuring and calculating the sound power level, the methods described in EN ISO 3741, EN ISO 3743 (all parts), EN ISO 3744, EN ISO 3745 and EN ISO 9614 (all parts) are also allowed. However the maximum sound power levels and the correction for pure tones remain unchanged in C.7 and C.8.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

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) 2011-08-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2013-11-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60349-1:2010 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60034-2-1	NOTE	Harmonized as EN 60034-2-1.
IEC 60034-9	NOTE	Harmonized as EN 60034-9.
IEC 60034-14	NOTE	Harmonized as EN 60034-14.
IEC 61260	NOTE	Harmonized as EN 61260.
IEC 61287 series	NOTE	Harmonized in EN 61287 series (not modified).
IEC 61373	NOTE	Harmonized as EN 61373.
IEC 61377-2	NOTE	Harmonized as EN 61377-2.
IEC 61672	NOTE	Harmonized as EN 61672.
ISO 3741	NOTE	Harmonized as EN ISO 3741.
ISO 3743-1	NOTE	Harmonized as EN ISO 3743-1.
ISO 3743-2	NOTE	Harmonized as EN ISO 3743-2.

ISO 3744	NOTE Harmonized as EN ISO 3744.
ISO 3745	NOTE Harmonized as EN ISO 3745.
ISO 3746	NOTE Harmonized as EN ISO 3746.
ISO 3747	NOTE Harmonized as EN ISO 3747.
ISO 9614-1	NOTE Harmonized as EN ISO 9614-1.
ISO 9614-2	NOTE Harmonized as EN ISO 9614-2.

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 When 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 (mod)	-	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1	-
IEC 60034-8	-	Rotating electrical machines - Part 8: Terminal markings and direction of rotation	EN 60034-8	-
IEC 60085	-	Electrical insulation - Thermal evaluation and designation	EN 60085	-
IEC 60638	-	Criteria for assessing and coding of the commutation of rotating electrical machines for traction	-	-
IEC 62498-1	-	Railway applications - Environmental conditions for equipment - Part 1: Equipment on board rolling stock	-	-

CONTENTS

1	Scope and object.....	7
2	Normative references	8
3	Terms and definitions	8
4	Environmental conditions.....	13
5	Characteristics	13
5.1	General.....	13
5.2	Reference temperature.....	13
5.3	Efficiency characteristics	14
5.4	Commutator type traction motor characteristics	14
5.5	Main generator characteristics.....	14
5.6	Auxiliary motor characteristics.....	15
5.7	Auxiliary generator characteristics.....	15
5.8	Auxiliary motor-generator set and rotary converter characteristics	15
6	Marking	15
6.1	Nameplate.....	15
6.2	Terminal and lead markings	16
7	Test categories and summary of tests	16
7.1	Test categories	16
7.1.1	General	16
7.1.2	Type tests	16
7.1.3	Routine tests	16
7.1.4	Investigation tests	16
7.2	Summary of tests	17
8	Type tests	19
8.1	Temperature-rise tests	19
8.1.1	General	19
8.1.2	Ventilation during temperature-rise tests	19
8.1.3	Judgement of results	19
8.1.4	Limits of temperature rise	20
8.1.5	Short-time overload temperature-rise test.....	20
8.2	Characteristic tests and tolerances.....	21
8.2.1	General	21
8.2.2	Commutator type traction motors	21
8.2.3	Main generators (refer to Figure 2)	22
8.2.4	Auxiliary motors.....	23
8.2.5	Auxiliary generators.....	23
8.2.6	Auxiliary motor-generator sets and rotary converters	23
8.3	Commutation tests	24
8.3.1	General	24
8.3.2	Traction motors (refer to Figure 1)	24
8.3.3	Main generators (refer to Figure 2)	25
8.3.4	Auxiliary motors and generators and motor-generator sets	25
8.4	Transient tests	26
8.4.1	General	26

8.4.2	Traction motors and motors of main motor-generator sets	26
8.4.3	Auxiliary motors, auxiliary motor-generator sets and auxiliary rotary converters	26
8.4.4	Voltage jump test on auxiliary motors, auxiliary motor-generator sets and auxiliary rotary converters.....	27
8.5	Short-circuit tests on main and auxiliary alternators.....	27
8.6	Starting tests	27
8.6.1	General	27
8.6.2	Single-phase a.c. locomotive motors	28
8.6.3	Main motor-generator sets.....	28
8.6.4	Auxiliary motors, auxiliary motor-generator sets and auxiliary rotary converters	28
8.7	Overspeed tests	28
8.8	Vibration tests	28
8.8.1	Internally generated vibration characteristics	28
9	Routine tests	29
9.1	Short-time soundness test.....	29
9.1.1	General	29
9.1.2	Test conditions	29
9.1.3	Plotting of heating and cooling curves	29
9.1.4	Judgement of results	30
9.2	Characteristic tests and tolerances.....	30
9.2.1	General	30
9.2.2	Commutator type traction motors (see Figure 1)	30
9.2.3	Main generators (refer to Figure 2)	30
9.2.4	Alternative tests for alternators	31
9.2.5	Auxiliary motors.....	31
9.2.6	Auxiliary generators.....	31
9.2.7	Auxiliary motor-generator sets and converters	31
9.3	Commutation routine tests.....	32
9.3.1	General	32
9.3.2	Traction motors (refer to Figure 1)	32
9.3.3	Main generators (refer to Figure 2)	32
9.3.4	Auxiliary motors and generators and motor-generator sets	32
9.4	Overspeed tests	32
9.4.1	General	32
9.4.2	Traction motors	32
9.4.3	Main or auxiliary engine-driven generators	32
9.4.4	Generators driven by a vehicle axle	33
9.4.5	Main or auxiliary motor-generator sets, auxiliary converters and auxiliary motors	33
9.5	Dielectric tests	33
9.6	Vibration tests (imbalance)	34
9.7	Commutator radial run-out measurement.....	34
Annex A	(normative) Measurement of temperature	37
Annex B	(informative) Methods of determining losses and efficiency.....	40
Annex C	(informative) Noise measurement and limits	50
Annex D	(normative) Supply voltages of traction systems	59
Annex E	(informative) Agreement between user and manufacturer	60

Bibliography.....	62
Figure 1 – Commutator type traction motor test points	35
Figure 2 – Main generator test points.....	36
Figure B.1 – Circuit for determining loss and efficiency by the regenerative method with the machines connected in parallel.....	42
Figure B.2 – Circuit for determining loss and efficiency by the regenerative method with the machines connected in series	43
Figure B.3 – Circuit for determining loss and efficiency by the regenerative method with the machines connected in series and with mechanical drive	44
Figure B.4 – Circuit for determining loss and efficiency of single-phase a.c. commutator motors by the regenerative method with the machines connected in series.....	44
Figure B.5 – Circuit for determining loss and efficiency of pulsating current motors by the regenerative method with the machines connected in series	45
Figure B.6 – Circuit for determining loss and efficiency of pulsating current motors by the regenerative method with the machines connected in parallel	46
Figure B.7 – Circuit for the measurement of the a.c. losses of pulsating current motors	46
Figure B.8 – Correction factor for additional load loss of uncompensated d.c machines	48
Figure B.9 – Correction factor for pulsating current I^2R loss.....	48
Figure B.10 – Conventional values of traction motor transmission losses.....	48
Figure C.1 – Limiting mean sound power level for airborne noise emitted by traction motors	56
Figure C.2 – Location of measuring points and prescribed paths for horizontal machines	57
Figure C.3 – Location of measuring points and prescribed paths for vertical machines	58
Table 1 – Summary of tests	18
Table 2 – Limits of temperature rise for continuous or other ratings	20
Table 3 – Temperature rise for short-time overload rating	21
Table 4 – Tolerances on the speed of commutator type traction motors	22
Table 5 – Dielectric test voltages	33
Table 6 – Limits of commutator radial run-out	34
Table C.1 – Corrections	52
Table C.2 – Corrections	55
Table C.3 – Correction for pure tones	56

ELECTRIC TRACTION – ROTATING ELECTRICAL MACHINES FOR RAIL AND ROAD VEHICLES –

Part 1: Machines other than electronic converter-fed alternating current motors

1 Scope and object

This part of IEC 60349 is applicable to rotating electrical machines, other than electronic converter-fed alternating current motors, forming part of the equipment of electrically propelled rail and road vehicles. The vehicles may obtain power either from an external supply or from an internal source.

The object of this standard is to enable the performance of a machine to be confirmed by tests and to provide a basis for assessment of its suitability for a specified duty and for comparison with other machines.

Where further testing is to be undertaken in accordance with IEC 61377-2, it may be preferable, to avoid duplication, that some type and investigation tests be carried out on the combined test bed.

NOTE 1 This standard also applies to machines installed on trailers hauled by electrically propelled vehicles.

NOTE 2 The basic requirements of this standard may be applied to rotating electrical machines for special purpose vehicles such as mine locomotives, but it does not cover flameproof or other special features that may be required.

NOTE 3 It is not intended that this standard should apply to machines on small road vehicles such as battery-fed delivery vehicles, works trucks, etc. Neither does it apply to minor machines such as windscreen wiper motors, etc. that may be used on all types of vehicles.

NOTE 4 Industrial type machines complying with the IEC 60034 series may be suitable for certain auxiliary applications.

Electrical inputs or outputs of machines covered by this standard may be as follows:

- a) direct current (including rectified polyphase alternating current);
- b) pulsating current (rectified single-phase alternating current);
- c) unidirectional chopper-controlled current;
- d) single-phase alternating current;
- e) polyphase alternating current (in general three-phase).

In this standard, the electrical machines concerned are classified as follows.

- 1) Traction motors – Motors for propelling rail or road vehicles.
- 2) Engine-driven main generators – Generators for supplying power to traction motors on the same vehicle or train.
- 3) Main motor-generator sets – Machines obtaining power from a line or battery, and supplying power to traction motors on the same vehicle or train.
- 4) Auxiliary motors – Motors for driving compressors, fans, auxiliary generators or other auxiliary machines.
- 5) Auxiliary generators – Generators for supplying power for auxiliary services such as air conditioning, heating, lighting, battery charging, etc.

- 6) Auxiliary motor-generator sets and auxiliary rotary converters – Machines which obtain their power from the line or other source to provide an electrical supply for auxiliary services.

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, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60034-8, *Rotating electrical machines – Part 8: Terminal markings and direction of rotation*

IEC 60085, *Thermal evaluation and designation*

IEC 60638, *Criteria for assessing and coding of the commutation of rotating electrical machines for traction*

IEC 62498-1, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*