



# SLOVENSKI STANDARD

## SIST EN 60310:2016

01-julij-2016

Nadomešča:  
SIST EN 60310:2004

---

**Železniške naprave - Transformatorji in dušilke vlečnih tokokrogov na vozniških sredstvih**

Railway applications - Traction transformers and inductors on board rolling stock

Bahnanwendungen - Transformatoren und Drosselspulen auf Bahnfahrzeugen

Applications ferroviaires - Transformateurs de traction et bobines d'inductance à bord du matériel roulant

[SIST EN 60310:2016](https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-22256c18456a/sist-en-60310-2016)

<https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-22256c18456a/sist-en-60310-2016>

**Ta slovenski standard je istoveten z EN 60310:2016**

---

**ICS:**

29.180	Transformatorji. Dušilke	Transformers. Reactors
45.060.10	Vlečna vozila	Tractive stock

**SIST EN 60310:2016**

**en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 60310:2016

<https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-c4bd24056c18/sist-en-60310-2016>

EUROPEAN STANDARD

**EN 60310**

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2016

ICS 45.060

Supersedes EN 60310:2004

English Version

## Railway applications - Traction transformers and inductors on board rolling Stock (IEC 60310:2016)

Applications ferroviaires - Transformateurs de traction et bobines d'inductance à bord du matériel roulant  
(IEC 60310:2016)

Bahnanwendungen - Transformatoren und Drosselspulen auf Bahnfahrzeugen  
(IEC 60310:2016)

This European Standard was approved by CENELEC on 2016-03-02. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre 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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

**EN 60310:2016****European foreword**

The text of document 9/2080/FDIS, future edition 4 of IEC 60310, prepared by IEC/TC 9 "Electrical equipment and systems for railways" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60310:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-12-02
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-03-02

This document supersedes EN 60310:2004.

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

**Endorsement notice**

The text of the International Standard IEC 60310:2016 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 60216-1	NOTE	Harmonized as EN 60216-1.
IEC 60216-5	NOTE	Harmonized as EN 60216-5.
IEC 60505	NOTE	Harmonized as EN 60505.
IEC 61287-1	NOTE	Harmonized as EN 61287-1.

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-811	-	International electrotechnical vocabulary (IEV) - Chapter 811: Electric traction	-	-
IEC 60060-1	-	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	-
IEC 60060-2	-	High-voltage test techniques - Part 2: Measuring systems	EN 60060-2	-
IEC 60076-1	2011	Power transformers - Part 1: General	EN 60076-1	2011
IEC 60076-2	-	Power transformers - Part 2: Temperature rise for liquid-immersed transformers	EN 60076-2	-
IEC 60076-3	-	Power transformers - Part 3: Insulation levels, dielectric tests and external clearances in air	EN 60076-3	-
IEC 60076-4	-	Power transformers - Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors	EN 60076-4	-
IEC 60076-5	-	Power transformers - Part 5: Ability to withstand short circuit	EN 60076-5	-
IEC 60076-6	2007	Power transformers - Part 6: Reactors	EN 60076-6	2008
IEC 60076-7	-	Power transformers - Part 7: Loading guide for oil-immersed power transformers	-	-
IEC 60076-10	-	Power transformers - Part 10: Determination of sound levels	EN 60076-10	-
IEC 60076-11	-	Power transformers - Part 11: Dry-type transformers	EN 60076-11	-
IEC 60076-12	2008	Power transformers - Part 12: Loading guide for dry-type power transformers	-	-
IEC 60076-14	-	Power transformers - Part 14: Liquid-immersed power transformers using high-temperature insulation materials	EN 60076-14	-

## EN 60310:2016

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60076-18	-	Power transformers - Part 18: Measurement of frequency response	EN 60076-18	-
IEC 60077-1	-	Railway applications - Electric equipment for rolling stock - Part 1: General service conditions and general rules	EN 60077-1	-
IEC 60085	-	Electrical insulation - Thermal evaluation and designation	EN 60085	-
IEC 60270	-	High-voltage test techniques - Partial discharge measurements	EN 60270	-
IEC 60296	-	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear	EN 60296	-
IEC 60836	-	Specifications for unused silicone insulating liquids for electrotechnical purposes	EN 60836	-
IEC 60850	-	Railway applications - Supply voltages of traction systems	-	-
IEC 61039	-	Classification of insulating liquids	EN 61039	-
IEC 61099	-	Insulating liquids - Specifications for unused synthetic organic esters for electrical purposes	EN 61099	-
IEC 61373	2010	Railway applications - Rolling stock equipment - Shock and vibration tests	EN 61373	2010
IEC 61378-1	2011	Converter transformers - Part 1: Transformers for industrial applications	EN 61378-1	2011
IEC 62497-1	-	Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment	-	-
IEC 62498-1	-	Railway applications - Environmental conditions for equipment - Part 1: Equipment on board rolling stock	-	-
ISO 3746	-	Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane	EN ISO 3746	-
ISO 9614-1	-	Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 1: Measurement at discrete points	EN ISO 9614-1	-
ISO 9614-2	-	Acoustics - Determination of sound power levels of noise sources using sound intensity - Part-2: Measurement by scanning	EN ISO 9614-2	-



IEC 60310

Edition 4.0 2016-01

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Railway applications – Traction transformers and inductors on board rolling stock**

(standards.iteh.ai)

**Applications ferroviaires – Transformateurs de traction et bobines d'inductance à bord du matériel roulant**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 45.060

ISBN 978-2-8322-3107-4

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references.....	8
3 Terms and definitions .....	9
3.1 General definitions .....	10
3.2 Definitions for transformers .....	11
3.3 Definitions for inductors.....	11
4 Classification.....	12
4.1 Classification of transformers .....	12
4.2 Classification of inductors.....	12
5 Service conditions .....	12
6 Rated current and load profile.....	13
6.1 Load profile.....	13
6.2 Rated current.....	13
7 Rated voltage and power of transformer windings.....	13
7.1 Rated line-side voltage.....	13
7.2 Rated secondary voltage.....	13
7.3 Rated power of transformer.....	14
8 Transformer tapplings.....	14
9 Cooling.....	14
9.1 Identification of transformers and inductors according to cooling method.....	14
9.2 Arrangement of symbols.....	15
9.2.1 Enclosed transformers and inductors.....	15
9.2.2 Non-enclosed transformers and inductors .....	15
9.2.3 Air cooling .....	15
10 Temperature limits.....	15
10.1 Classification of insulating materials .....	15
10.2 Temperature limits of solid insulation.....	16
10.3 Temperature limits for liquid .....	16
10.4 Temperature limits for other parts.....	17
11 Mechanical design.....	17
12 Rating plates .....	17
13 Tests.....	18
13.1 Categories of tests .....	18
13.1.1 General .....	18
13.1.2 Type tests.....	18
13.1.3 Routine tests.....	18
13.1.4 Investigation tests.....	18
13.2 Tests on transformers .....	18
13.2.1 General – List of tests.....	18
13.2.2 Tolerances.....	20
13.2.3 Visual checks (type, routine test) and functional tests (optional type and routine test) .....	20
13.2.4 Mass (type and optional routine test).....	20
13.2.5 Measurement of winding resistance (type and routine tests).....	21



13.2.6	Measurement of voltage ratio, polarities and vector groups (type and routine tests).....	21
13.2.7	Measurement of no-load primary current and losses (type and routine tests).....	22
13.2.8	Measurement of impedance voltages or short-circuit impedances (type and routine tests).....	22
13.2.9	Measurement of fundamental load losses (type and routine tests).....	23
13.2.10	Determination of total losses (type test).....	24
13.2.11	Temperature-rise test (type test).....	24
13.2.12	Insulation resistance test (optional type and routine test).....	28
13.2.13	Dielectric tests (type and routine tests).....	28
13.2.14	Partial discharge test (type or optional routine test for dry-type, investigation test for immersed type).....	34
13.2.15	Short-circuit withstand test (optional type test).....	36
13.2.16	Shock and vibration test (optional type test).....	38
13.2.17	Voltage transmission ratio – VTR (optional type test).....	40
13.2.18	Noise measurement (type test).....	41
13.2.19	Leakage magnetic flux density measurement (optional type test).....	41
13.2.20	Electrical Frequency Response Analysis FRA (investigation test).....	42
13.2.21	Inrush current measurement (optional type test).....	42
13.3	Tests on inductors.....	43
13.3.1	List of tests.....	43
13.3.2	Tolerances.....	43
13.3.3	Visual checks (type and routine test).....	44
13.3.4	Mass (type and optional routine test).....	44
13.3.5	Measurement of winding resistance (type and routine test).....	44
13.3.6	Determination of losses (type test).....	44
13.3.7	Measurement of inductance (type and routine tests).....	45
13.3.8	Temperature-rise test (type tests).....	48
13.3.9	Insulation resistance test (optional type and routine test).....	48
13.3.10	Dielectric tests (type and routine tests).....	48
13.3.11	Partial discharge test (type or optional routine test for the dry-type).....	49
13.3.12	Short-circuit withstand test (optional type test).....	49
13.3.13	Shock and vibration test (optional type test).....	50
13.3.14	Vibration test with current flowing (investigation test).....	50
13.3.15	Noise measurement (type test).....	50
13.3.16	Leakage magnetic flux density measurement (optional type test).....	50
Annex A	(informative) List of items for which an agreement between purchaser and manufacturer is needed or for which further information or specifications shall be given by the purchaser or by the manufacturer.....	51
A.1	Items subject to agreement between purchaser and manufacturer.....	51
A.1.1	Transformer and inductors.....	51
A.1.2	Transformers.....	52
A.1.3	Inductors.....	53
A.2	Information to be given by purchaser to manufacturer.....	54
A.2.1	Transformers and inductors.....	54
A.2.2	Transformers.....	55
A.2.3	Inductors.....	55
A.3	Information to be given by manufacturer to purchaser.....	56
A.3.1	Transformers and inductors.....	56

A.3.2	Transformers .....	56
A.3.3	Inductors .....	56
Annex B (informative)	Thermal ageing and insulation life time .....	57
B.1	Insulation life time and thermal ageing .....	57
B.2	Definitions of thermal endurance .....	57
B.3	Thermal endurance calculations .....	58
B.4	Special considerations for thermal design and test .....	59
B.4.1	General .....	59
B.4.2	Cooling medium temperature at the external interface .....	59
B.4.3	Rated current .....	60
B.4.4	Temperature rise test of a dry-type transformer/inductor .....	60
B.5	Thermal conformity of the insulation system .....	60
B.6	End of life criterion .....	60
Annex C (informative)	Example of thermal endurance calculation to demonstrate the suitability of an insulation system for a specified application .....	61
C.1	Preliminary .....	61
C.2	Example 1 – Temperature limits for a dry-type transformer/inductor .....	61
C.3	Example 2 – Thermal endurance calculation .....	61
C.3.1	General .....	61
C.3.2	Operating conditions to be provided by the purchaser .....	62
C.3.3	Thermal endurance characteristics to be provided by the manufacturer .....	62
C.3.4	Temperature rise test results .....	62
C.3.5	Calculations .....	63
Annex D (informative)	Wet dielectric tests for dry-type transformers and inductors .....	65
D.1	General .....	65
D.2	Wet test 1 (optional type test or optional routine test): short soaking .....	65
D.3	Wet test 2 (investigation test or optional type test): misting .....	66
D.4	Wet test 3 (investigation test): thermal shock – long soaking – misting .....	66
D.4.1	General .....	66
D.4.2	Temperature conditioning .....	66
D.4.3	Thermal shock .....	66
D.4.4	Dielectric test .....	66
D.5	Common test procedure and criteria for wet dielectric tests .....	66
Annex E (informative)	Load profiles .....	68
Bibliography	.....	69
Figure 1	– Examples of set up for induced voltage withstanding tests .....	31
Figure 2	– Examples of set up for separate source voltage withstanding tests .....	32
Figure 3	– Examples of impulse test connections for traction, inductor and auxiliary transformers .....	33
Figure 4	– Partial discharge test: voltage versus time .....	35
Figure 5	– Configurations for VTR test .....	41
Figure 6	– Example of test circuit .....	42
Table 1	– Letter symbols for cooling method .....	14
Table 2	– Order of symbols .....	15
Table 3	– Temperature limits of solid insulation .....	16

Table 4 – Temperature limits for liquid.....	16
Table 5 – List of checks and tests to be made on traction transformers .....	19
Table 6 – Tolerances .....	20
Table 7 – Reference temperatures .....	21
Table 8 – Dielectric test voltage .....	30
Table 9 – Partial discharge measurements .....	35
Table 10 – List of checks and tests to be made on inductors.....	43
Table 11 – Tolerances .....	44
Table 12 – Test method of voltage between terminals withstand test.....	49
Table C.1 – Temperature limits and expected lifetime for a dry-type transformer or inductor (examples) .....	61
Table C.2 – Load cycle histogram .....	62
Table C.3 – Temperature histogram .....	62
Table C.4 – Temperature rise test results .....	63
Table C.5 – Thermal endurance calculation .....	63
Table C.6 – Equivalent current and temperatures .....	64

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 60310:2016](#)

<https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-c4bd24056c18/sist-en-60310-2016>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS –  
TRACTION TRANSFORMERS AND  
INDUCTORS ON BOARD ROLLING STOCK**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60310 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This fourth edition cancels and replaces the third edition issued in 2004 and constitutes a technical revision.

This edition takes into account the new generic railway standards, more specifically general service conditions referring to IEC 62498-1 and shock and vibration considerations referring to IEC 61373. It also includes the following significant technical changes with regard to the previous edition:

- temperature limits;
- temperature-rise test;
- dielectric tests;
- partial discharge test;

- inductance measurement methods;
- voltage between terminals withstand test;
- thermal ageing and insulation lifetime (informative);
- examples of thermal endurance calculation (informative);
- wet dielectric tests (informative);
- load profiles (informative).

The text of this standard is based on the following documents:

FDIS	Report on voting
9/2080/FDIS	9/2117/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

[SIST EN 60310:2016](https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-c4bd24056c18/sist-en-60310-2016)

[https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-](https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-c4bd24056c18/sist-en-60310-2016)

[c4bd24056c18/sist-en-60310-2016](https://standards.iteh.ai/catalog/standards/sist/6304b6db-dd22-4ce6-85c7-c4bd24056c18/sist-en-60310-2016)

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

# RAILWAY APPLICATIONS – TRACTION TRANSFORMERS AND INDUCTORS ON BOARD ROLLING STOCK

## 1 Scope

This International Standard applies to traction and auxiliary power transformers installed on board rolling stock and to the various types of power inductors inserted in the traction and auxiliary circuits of rolling stock, of dry or liquid-immersed design.

NOTE The requirements of IEC 60076 (all parts) are applicable to transformers and inductors where they do not conflict with this standard, or with the specialized IEC publications dealing with traction applications.

This standard can also be applied, after agreement between purchaser and manufacturer, to the traction transformers of three-phase a.c. line-side powered vehicles and to the transformers inserted in the single-phase or poly-phase auxiliary circuits of vehicles, except instrument transformers and transformers of a rated output below 1 kVA single-phase or 5 kVA poly-phase.

This standard does not cover accessories such as tap changers, resistors, heat exchangers, fans, etc., intended for mounting on the transformers or inductors, which are tested separately according to relevant rules.

## 2 Normative references

[SIST EN 60310:2016](#)

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.

IEC 60050-811, *International Electrotechnical Vocabulary (IEV) – Chapter 811: Electric traction*

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60076-1:2011, *Power transformers – Part 1: General*

IEC 60076-2, *Power transformers – Part 2: Temperature rise for liquid-immersed transformers*

IEC 60076-3, *Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air*

IEC 60076-4, *Power transformers – Part 4: Guide to the lightning impulse and switching impulse testing – Power transformers and reactors*

IEC 60076-5, *Power transformers – Part 5: Ability to withstand short circuit*

IEC 60076-6:2007, *Power transformers – Part 6: Reactors*

IEC 60076-7, *Power transformers – Part 7: Loading guide for oil-immersed power transformers*

IEC 60310:2016 © IEC 2016

– 9 –

IEC 60076-10, *Power transformers – Part 10: Determination of sound levels*IEC 60076-11, *Power transformers – Part 11: Dry-type transformers*IEC 60076-12:2008, *Power transformers – Part 12: Loading guide for dry-type transformers*IEC 60076-14, *Power transformers – Part 14: Liquid-immersed power transformers using high-temperature insulation materials*IEC 60076-18, *Power transformers – Part 18: Measurement of frequency response*IEC 60077-1, *Railway applications – Electric equipment for rolling stock – Part 1: General service conditions and general rules*IEC 60085, *Electrical insulation – Thermal evaluation and designation*IEC 60270, *High-voltage test techniques – Partial discharge measurements*IEC 60296, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*IEC 60836, *Specifications for unused silicone insulating liquids for electrotechnical purposes*IEC 60850, *Railway applications – Supply voltage of traction systems*IEC 61039, *Classification of insulating liquids*IEC 61099, *Insulating liquids – Specifications for unused synthetic organic esters for electrical purposes*IEC 61373:2010, *Railway applications – Rolling stock equipment – Shock and vibration tests*IEC 61378-1:2011, *Convertor transformers – Part 1: Transformers for industrial applications*IEC 62497-1, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*IEC 62498-1, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*ISO 3746, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Survey method using an enveloping measurement surface over a reflecting plane*ISO 9614-1, *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 1: Measurement at discrete points*ISO 9614-2, *Acoustics – Determination of sound power levels of noise sources using sound intensity – Part 2: Measurement by scanning*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60076-1 and IEC 60050-811 together with the following apply.