

Railway applications - Rolling stock - Combined test
method for traction Systems

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 61377:2016 sisaldab Euroopa standardi EN 61377:2016 ingliskeelset teksti.	This Estonian standard EVS-EN 61377:2016 consists of the English text of the European standard EN 61377:2016.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 22.04.2016.	Date of Availability of the European standard is 22.04.2016.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 45.060

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:

Aru 10, 10317 Tallinn, Eesti; koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Aru 10, 10317 Tallinn, Estonia; homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

**Railway applications - Rolling stock - Combined test method for
traction Systems
(IEC 61377:2016)**

Applications ferroviaires - Matériel roulant - Méthode
d'essais combinés pour systèmes de traction
(IEC 61377:2016)

Bahnanwendungen - Bahnfahrzeuge - Kombiniertes
Prüfverfahren für Traktionssysteme
(IEC 61377:2016)

This European Standard was approved by CENELEC on 2016-02-23. 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

European foreword

The text of document 9/2078/FDIS, future edition 2 of IEC 61377, 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 61377:2016.

The following dates are fixed:

- latest date by which the document has to be (dop) 2016-11-23
implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2019-02-23
standards conflicting with the
document have to be withdrawn

This document supersedes EN 61377-1:2006, EN 61377-2:2002 and EN 61377-3:2002.

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 61377:2016 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 60077-3	NOTE	Harmonized as EN 60077-3.
IEC 60077-4	NOTE	Harmonized as EN 60077-4.
IEC 60310	NOTE	Harmonized as EN 60310.
IEC 60322	NOTE	Harmonized as EN 60322.
ISO 14253-2	NOTE	Harmonized as EN ISO 14253-2.
ISO/IEC 17025	NOTE	Harmonized as EN ISO/IEC 17025.

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	Series	International Electrotechnical Vocabulary	-	-
IEC 60349-1	-	Electric traction - Rotating electrical machines for rail and road vehicles - Part 1: Machines other than electronic converter-fed alternating current motors	EN 60349-1	-
IEC 60349-2	-	Electric traction - Rotating electrical machines for rail and road vehicles - Part 2: Electronic converter-fed alternating current motors	EN 60349-2	-
IEC/TS 60349-3	-	Electric traction - Rotating electrical machines for rail and road vehicles - Part 3: Determination of the total losses of converter-fed alternating current motors by summation of the component losses	-	-
IEC 60349-4	-	Electric traction - Rotating electrical machines for rail and road vehicles - Part 4: Permanent magnet synchronous electrical machines connected to an electronic converter	EN 60349-4	-
IEC 60850	-	Railway applications - Supply voltages of traction systems	-	-
IEC 61133	-	Railway applications - Rolling stock - Testing of rolling stock on completion of construction and before entry into service	-	-
IEC 61287-1	-	Railway applications - Power converters installed on board rolling stock - Part 1: Characteristics and test methods	EN 61287-1	-
IEC 62313	-	Railway applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock	-	-

CONTENTS

FOREWORD.....	6
1 Scope.....	8
2 Normative references	10
3 Terms and definitions	10
4 Traction system characteristics.....	12
5 General requirements	13
6 General test conditions.....	14
6.1 Test setup.....	14
6.1.1 Setup of traction system under test.....	14
6.1.2 Test bench architecture	15
6.2 Cooling during the test.....	17
6.3 Mechanical output measurement.....	18
6.3.1 General	18
6.3.2 Summation of losses method.....	18
6.3.3 Comparison of power method	19
6.3.4 Comparison of current method.....	20
6.3.5 Back to back method	21
6.4 Tolerances and measuring accuracy	21
6.5 Environmental conditions	21
7 Torque characteristic test	22
7.1 General.....	22
7.2 Torque characteristics test at motor hot.....	22
7.2.1 Test objective	22
7.2.2 Test conditions	22
7.2.3 Test procedure	23
7.2.4 Acceptance criteria	23
7.3 Torque characteristics test at motor cold.....	23
7.3.1 Test objective	23
7.3.2 Test conditions	23
7.3.3 Test procedure	24
7.3.4 Acceptance criteria	24
7.4 Starting torque at zero speed	24
7.4.1 Test objective	24
7.4.2 Test conditions	24
7.4.3 Test procedure	24
7.4.4 Acceptance criteria	24
8 Efficiency and energy consumption test.....	24
8.1 General.....	24
8.2 Efficiency characteristics	25
8.2.1 Test objective	25
8.2.2 Test conditions	25
8.2.3 Test procedure	25
8.2.4 Acceptance criteria	25
8.3 Energy consumption on route profile	26
8.3.1 Test objective	26

8.3.2	Test conditions	26
8.3.3	Test procedure	26
8.3.4	Acceptance criteria	26
9	Temperature rise test	27
9.1	General.....	27
9.2	Temperature rise test at constant load	27
9.2.1	Test objective	27
9.2.2	Test conditions	27
9.2.3	Test procedure	27
9.2.4	Acceptance criteria	28
9.3	Temperature rise on route profile	28
9.3.1	Test objective	28
9.3.2	Test conditions	28
9.3.3	Test procedure	28
9.3.4	Acceptance criteria	28
9.4	Test with wheel diameter differences for paralleled asynchronous motors	29
9.4.1	General	29
9.4.2	Test objective	29
9.4.3	Test conditions	29
9.4.4	Test procedure	30
10	System function test	31
10.1	Start from backward/reverse motion.....	31
10.1.1	Test objective	31
10.1.2	Test conditions	31
10.1.3	Test procedure	31
10.1.4	Acceptance criteria	31
10.2	Motoring-braking transition.....	31
10.2.1	Test objective	31
10.2.2	Test conditions	31
10.2.3	Test procedure	32
10.2.4	Acceptance criteria	32
11	Variation of line voltage	32
11.1	Test objective	32
11.2	Test conditions	32
11.3	Test procedure.....	33
11.4	Acceptance criteria	34
12	System protection test	34
12.1	General.....	34
12.2	Rapid voltage changes test.....	34
12.2.1	Test objective	34
12.2.2	Test conditions	34
12.2.3	Test procedure	35
12.2.4	Acceptance criteria	36
12.3	Traction supply voltage interruption	36
12.3.1	Test objective	36
12.3.2	Test conditions	36
12.3.3	Test procedure	36
12.3.4	Acceptance criteria	36

12.4	Traction supply contact loss	36
12.4.1	Test objective	36
12.4.2	Test conditions	36
12.4.3	Test procedure	37
12.4.4	Acceptance criteria	37
12.5	Sudden loss of regeneration capability	37
12.5.1	Test objective	37
12.5.2	Test conditions	37
12.5.3	Test procedure	38
12.5.4	Acceptance criteria	38
12.6	Traction inverter stop	38
12.6.1	Test objective	38
12.6.2	Test conditions	38
12.6.3	Test procedure	38
12.6.4	Acceptance criteria	38
12.7	Temperature calculation functions	39
12.7.1	General	39
12.7.2	Test objective	39
12.7.3	Test conditions	39
12.7.4	Test procedure	39
12.7.5	Acceptance criteria	39
12.8	Over-current and over-voltage protection	39
12.9	Control battery supply interruption	39
12.9.1	Test objective	39
12.9.2	Test conditions	39
12.9.3	Test procedure	39
12.9.4	Acceptance criteria	40
13	Fault management test	40
13.1	General	40
13.2	Loss of sensor function	40
13.3	Loss of command and feedback signals	40
13.4	Fault in cooling systems	40
13.5	Earth and short-circuit faults	41
Annex A (normative)	List of combined tests	42
Annex B (informative)	List of clauses with agreements between the user and manufacturer	43
Annex C (normative)	Special test items and conditions for DC motors	44
C.1	General	44
C.2	Test bench architecture	44
C.2.1	Test setup	44
C.2.2	Load system	44
C.3	Commutation test	45
Bibliography	46
Figure 1	– Overview of traction system architecture	8
Figure 2	– Example of relationship between the “traction system under test” and the “traction system”	9
Figure 3	– Traction system – relationship between user, suppliers and manufacturer	11

Figure 4 – Example of peak temperatures on route profile	13
Figure 5 – Example of test bench architecture with speed controlled load system	15
Figure 6 – Example of test bench architecture with back to back method	16
Figure 7 – Examples of simulating auxiliary load and traction load power supply	17
Figure 8 – Example of measurement using summation of losses method	18
Figure 9 – Example of measurement using comparison of power method	20
Figure 10 – Example of measurement using comparison of current method	21
Figure 11 – Example of measurement using back to back method	21
Figure 12 – Torque characteristics of a traction system	23
Figure 13 – Effect of wheel diameter mismatch on the torque characteristic of asynchronous motor	29
Figure 14 – Test conditions for motoring-braking transition	32
Figure 15 – Test conditions in traction system range of voltage	33
Figure 16 – Test conditions for variation of the voltage	33
Figure 17 – Rapid voltage change with DC line voltage	35
Figure 18 – Rapid voltage change with AC line voltage	35
Figure 19 – Example of method to create a rapid voltage change	36
Figure 20 – Example of method to simulate the traction supply contact loss	37
Figure 21 – Example of method to create loss of regenerative capability	38
Figure C.1 – Example of braking configuration for a traction system under test with separately excited DC motor	44
Figure C.2 – Test bench arrangement for back to back test of the traction system under test with a DC motor	45
Table A.1 – List of combined tests	42
Table B.1 – List of subclauses including agreements between the user and manufacturer	43

RAILWAY APPLICATIONS – ROLLING STOCK – COMBINED TEST METHOD FOR TRACTION SYSTEMS

1 Scope

This International Standard applies to the traction system consisting (when it applies) of traction motor(s), converter(s), traction control equipment including software, transformer, input filters, brake resistors, main circuit-breaker, cooling equipment, transducers, contactors, etc.

Figure 1 is just an overview and is not representative of all traction system architectures.

Current collector, mechanical braking systems and gearbox are not in the scope of this standard.

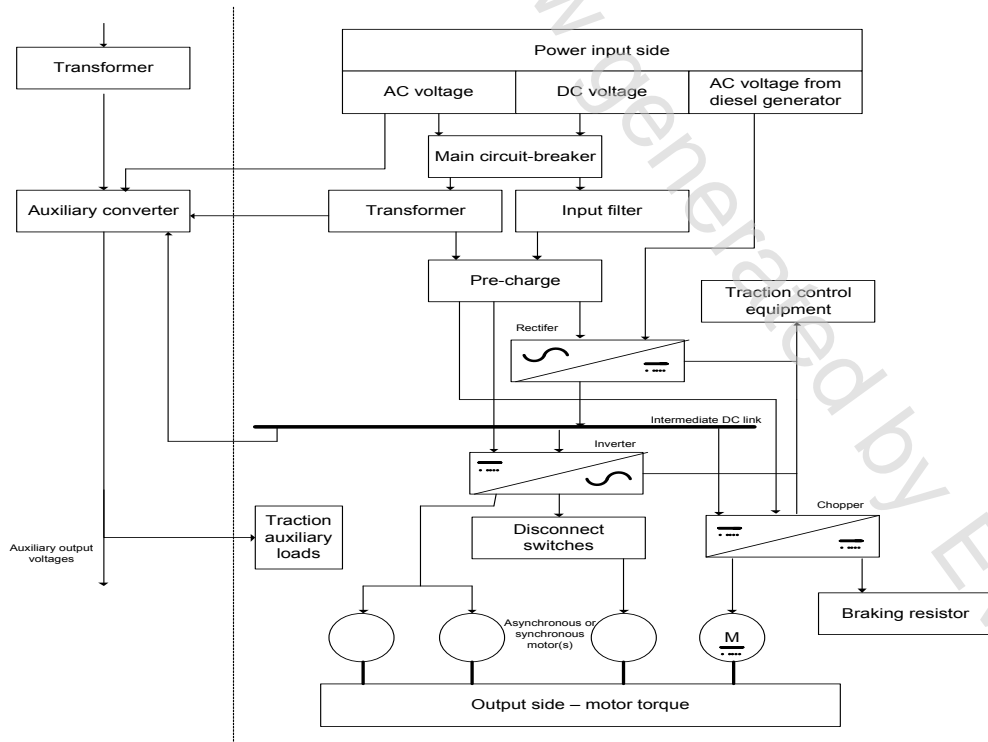
Types of motors applicable in this standard are asynchronous, or synchronous including permanent magnet (PMM), or direct current (DC).

The auxiliary converter(s) is (are) part of the scope when the auxiliary converter is enclosed within the traction converter. Otherwise, when the traction system feeds an auxiliary system outside the traction converter, the auxiliary system can be replaced by an equivalent load.

NOTE 1 Energy storage system is not considered in this standard since there is no specific type test standard for energy storage system.

NOTE 2 Auxiliary loads validation is not part of this standard.

NOTE 3 The gearbox can be part of test set-up, but it is not a part of traction system.



IEC

Figure 1 – Overview of traction system architecture

The objective of this standard is to specify the type test of a traction system, mainly comprising of:

- test of performance characteristics;
- test methods of verifying these performance characteristics.

This standard does not specify the type test of each individual component.

The traction system under test incorporates at least one complete traction conversion line (at least one traction converter and its related loads, one transformer in the case of AC supply or input filter in the case of DC supply). The representativeness of the traction system under test versus the actual traction system is agreed between the user and manufacturer.

Figure 2 gives one example of the relationship between the traction system under test and the whole traction system.

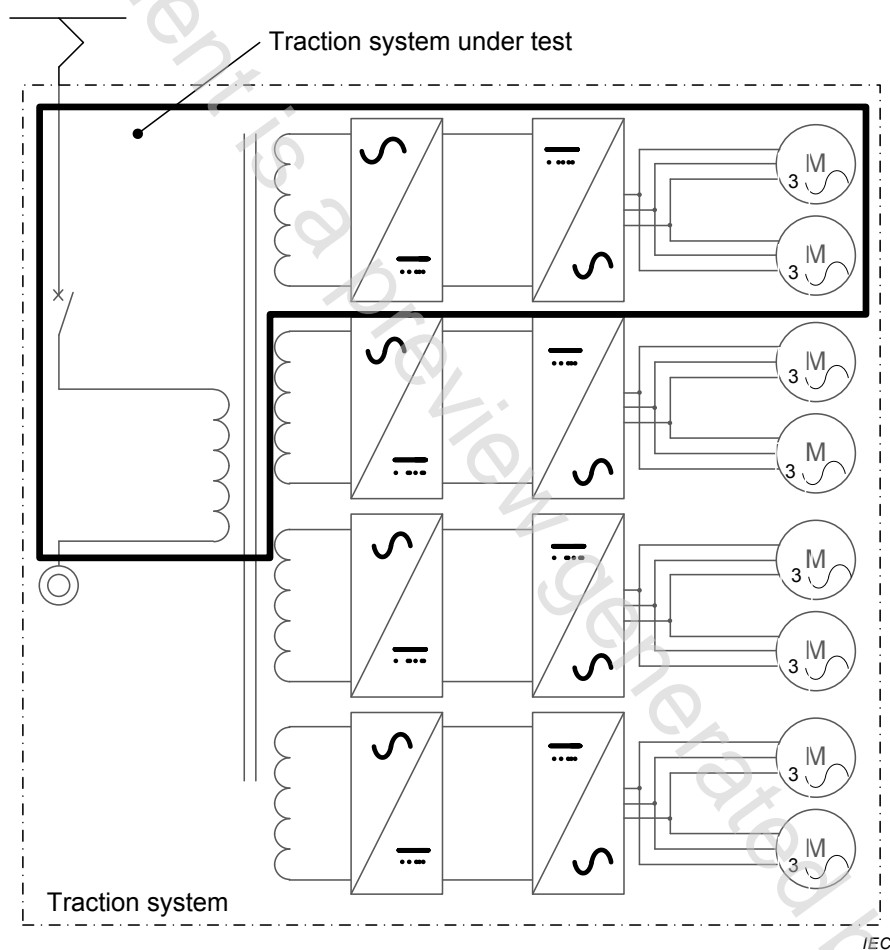


Figure 2 – Example of relationship between the “traction system under test” and the “traction system”

The traction system under test is equipped with components that are representative of the production series.

Deviations may be permitted by agreement between user and manufacturer, and are justified from an impact stand point in advance of the test. Using equivalent components or parts is permitted if no significant influence on the test result is expected.