
**Electrically propelled road vehicles —
Test specification for electric
propulsion components —**

**Part 7:
Operating load testing of the DC/DC
converter**

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*Véhicules à propulsion électrique — Spécification d'essai pour les
composants de propulsion électrique —*

Partie 7: Test de charge de fonctionnement du convertisseur DC/DC

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	1
5 Operation endurance test and requirements	1
5.1 General	1
5.2 Test diagram	1
5.3 Test conditions	2
5.4 Test procedure	3
5.5 Test requirements	5
5.5.1 General	5
5.5.2 Energizing	5
5.5.3 Disassembling	5
6 Test report	5
Annex A (informative) Test report	6

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 37, *Electrically propelled vehicles*.

A list of all parts in the ISO 21782 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Electrically propelled road vehicles — Test specification for electric propulsion components —

Part 7: Operating load testing of the DC/DC converter

1 Scope

This document specifies the operating load test and test criteria for the DC/DC converter designed as a voltage class B electric propulsion system of electrically propelled road vehicles.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 21782-1:2019, *Electrically propelled road vehicles — Test specification for electric propulsion components — Part 1: General test conditions and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21782-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 21782-1 apply.

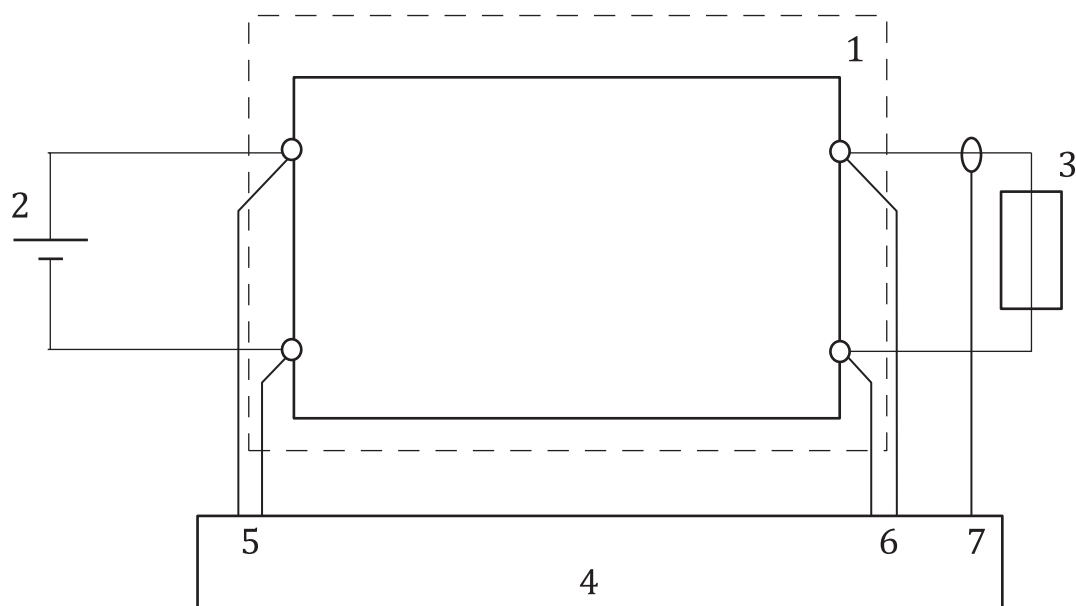
5 Operation endurance test and requirements

5.1 General

The operation endurance test method may be conducted depending on an agreement between the supplier and customer. The test methods take into account repeated operations with a representative current output pattern of the DC/DC converter. The test, including test objectives and time, aims to prevent failures in main power conversion parts.

5.2 Test diagram

The test diagram is shown in [Figure 1](#).

**Key**

- 1 DUT
- 2 DC power supply
- 3 load
- 4 power meter
- 5 DC/DC converter input voltage (in V)
- 6 DC/DC converter output voltage (in V)
- 7 DC/DC converter output current (in A)

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Figure 1 — Diagram for operation endurance test of the DC/DC converter

5.3 Test conditions

Temperature conditions of the DC/DC converter are shown in Table 1. Unless otherwise specified, the conditions shall be decided by an agreement between the supplier and customer. If an accelerated test with raised temperature conditions is conducted, it shall be agreed between the supplier and customer.

Table 1 — Conditions for operation endurance test of the DC/DC converter

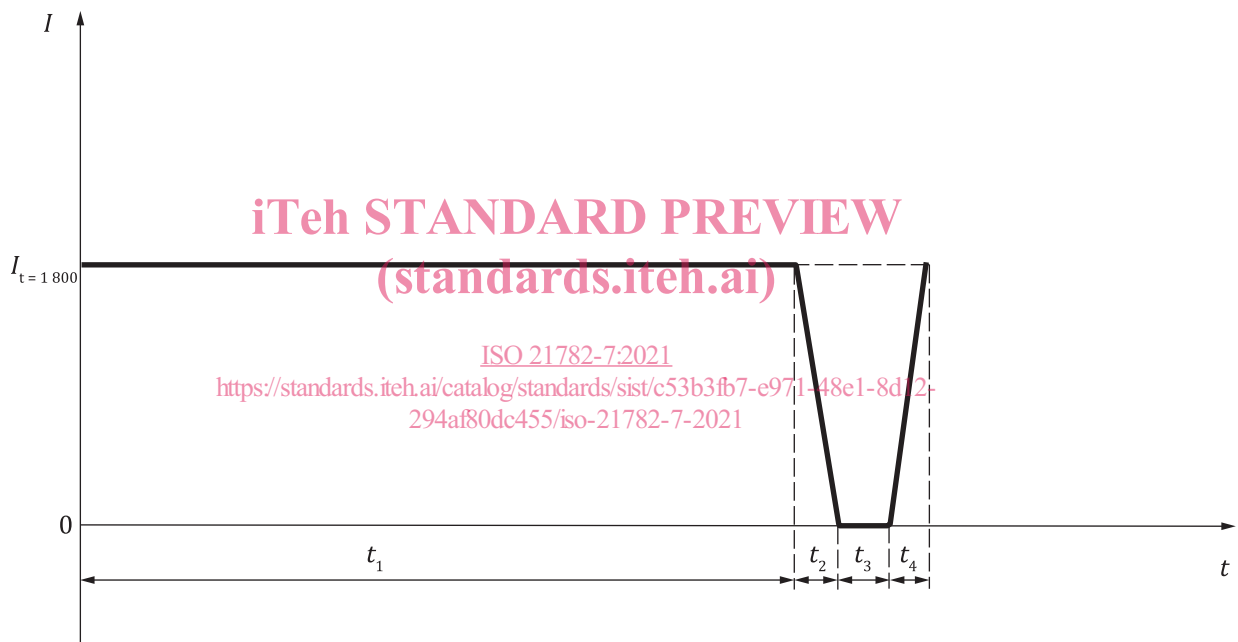
Test conditions		Value	Remarks
DC/DC converter input voltage		Rated voltage as defined in ISO 21782-1:2019, 3.22	DC/DC converter input voltage tolerance, see ISO 21782-1:2019, 5.3
DC/DC converter output voltage		Design value	
DC/DC converter output current		Defined in Figures 2 and 3	
Ambient conditions		— Maximum temperature for unlimited operating capability — Humidity as defined in ISO 21782-1:2019, 5.4	
Coolant temperature	Liquid	Maximum temperature for unlimited operating capability	
	Air	Maximum temperature for unlimited operating capability	

Table 1 (continued)

Test conditions		Value	Remarks
Coolant flow rate	Liquid	Minimum flow rate for unlimited operating capability	
	Air	Minimum flow rate for unlimited operating capability	
Operating time		1 800 000 s	

5.4 Test procedure

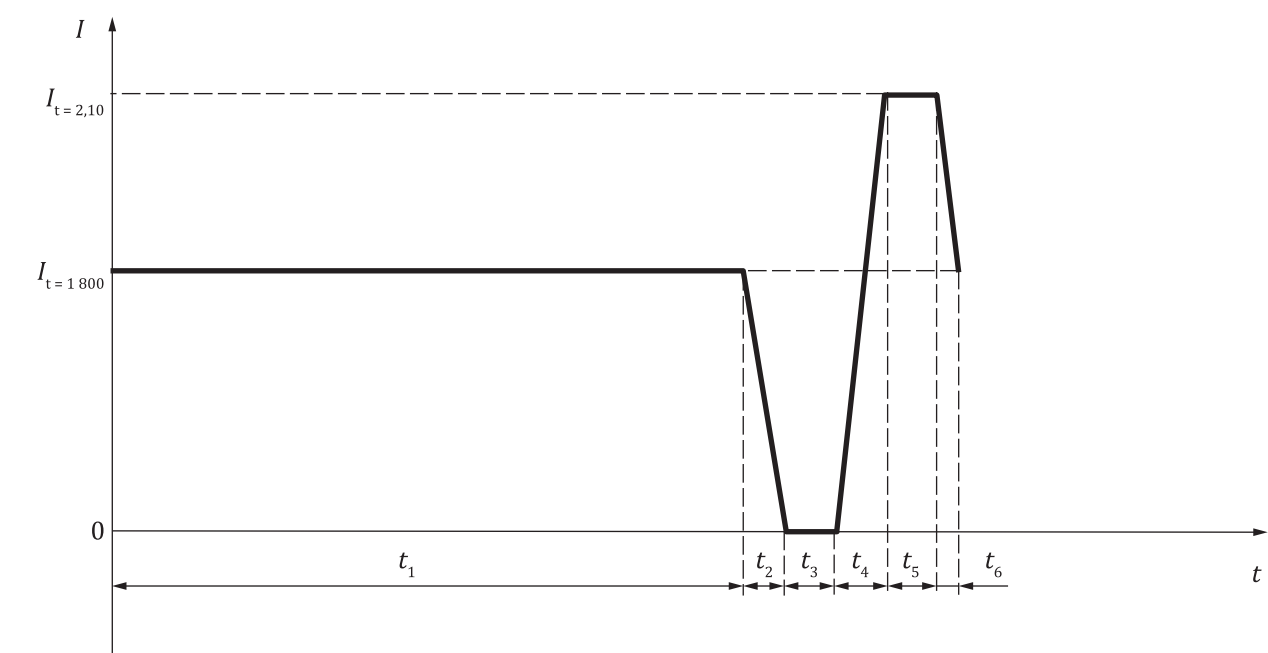
The DC/DC converter shall be tested with an equivalent load (e.g. electrical load). The load shall be applied according to the conditions defined in Table 1 and the test pattern defined in Figures 2 and 3. When the output current specification of DUT has no $I_{t=2,10}$, the test pattern shown in Figure 2 with the time parameters shown in Table 2 shall be applied. On the other hand, the output current specification of DUT has $I_{t=2,10}$, the test pattern shown in Figure 3 with the time parameters shown in Table 3 shall be applied.



Key

- t time (in s)
 I DC/DC converter output current (in A)
 t_1, t_2, t_3, t_4 time parameter (in s)

Figure 2 — Operation endurance test pattern without $I_{t=2,10}$



Key

- t time (in s)
- I DC/DC converter output current (in A)
- $t_1, t_2, t_3, t_4, t_5, t_6$ time parameter (in s)

Figure 3 — Operation endurance test pattern with $I_{t=2,10}$

Table 2 — Description of time parameter in Figure 2

Time parameters	Requirements
t_1	$1\,800\text{ s} - (t_2 + t_3 + t_4)$
t_2	$<1\text{ s}$
t_3	$<2\text{ s}$
t_4	$<1\text{ s}$
NOTE t_2, t_3, t_4 can be set to 0 s by an agreement between the supplier and customer.	

Table 3 — Description of time parameter in Figure 3

Time parameters	Requirements
t_1	$1\,800\text{ s} - (t_2 + t_3 + t_4 + t_5 + t_6)$
t_2	$<1\text{ s}$
t_3	This shall be controlled so that the temperature of DC/DC converter does not exceed the maximum temperature for unlimited operating capability.
t_4	$<2\text{ s}$
t_5	2 s or 10 s
t_6	$<1\text{ s}$

5.5 Test requirements

5.5.1 General

The rank listed in [Table 4](#) classifies the time before physical and/or functional deterioration is observed on the DC/DC converter by percentage of operating time. To confirm the time before physical and/or functional deterioration, energizing and/or disassembling shall be conducted.

Table 4 — Capital letter indicating operation endurance test of the DC/DC converter

Ranks	Time before physical and/or functional deterioration
S	>220 % of the operating time
A	200 % of the operating time
B	180 % of the operating time
C	160 % of the operating time
D	140 % of the operating time
E	120 % of the operating time
F	100 % of the operating time

5.5.2 Energizing

To investigate the functional deterioration, the data listed in [Table 5](#) shall be obtained before the operation endurance test in order to compare the data before and after this test. Additional measurement items can be added by agreement between supplier and customer.

Table 5 — Criteria of energizing

Measurement items	Conditions	Criteria
DC/DC converter output voltage	Conditions defined in Table 1 $I_{t=1\ 800}$ ($I_{t=2,10}$ optional)	Within ± 5 % difference before and after the test
Efficiency of DC/DC converter	Conditions defined in Table 1 $I_{t=1\ 800}$ ($I_{t=2,10}$ optional)	Within ± 7 % difference before and after the test

5.5.3 Disassembling

To investigate the physical deterioration, the power semiconductor and DC bus capacitor shall be disassembled and investigated according to [Table 6](#). The investigation items and/or criteria may be decided by agreement between the supplier and customer.

Table 6 — Investigation items of the DC/DC converter

Items/places	Details of investigation
Power semiconductor chip	No physical and/or functional deterioration
DC bus capacitor	No physical and/or functional capacitor film deterioration
Transformer	No physical and/or functional deterioration
Choke coil	No physical and/or functional deterioration

6 Test report

Each test shall be reported with a test report, containing information on test conditions and results.

An example for a test report on conditions and results is given in [Table A.1](#).

Annex A (informative)

Test report

A.1 Operation endurance test

Table A.1 — Operation endurance test of the DC/DC converter

1 Common conditions			
	Items	Value	Remark
Ambient conditions	Temperature (in °C)		
	Humidity (in %)		
Cooling type		Liquid / Air	
Coolant temperature (in °C)			
Coolant flow rate (in l/min)			
DC/DC converter input voltage (in V)			
DC/DC converter output voltage (in V)			
Test pattern		Figure 2 / Figure 3	
2 Results			
	Items	Value	Remark
Rank		S / A / B / C / D / E / F	
	operating time (in s)		
3 Test requirements — Energizing			
	Items	Value	Remark
DC / DC converter output voltage		Pass / Fail	
	Efficiency of DC / DC converter	Pass / Fail	
4 Test requirements — Disassembling			
	Items	Value	Remark
Power semiconductor chip		Pass / Fail	
	DC bus capacitor	Pass / Fail	
Transformer		Pass / Fail	
	Choke coil	Pass / Fail	