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

Part 4: Performance testing of the DC/DC converter

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

Partie 4: Essais de performance pour le convertisseur DC/DC

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Foreword

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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 4:
Performance testing of the DC/DC converter

1 Scope

This document specifies performance tests and each evaluation for the DC/DC converter in the 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*

ISO 21498-1, *Electrically propelled road vehicles — Specification of voltage sub-classes for voltage class B*

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 Tests

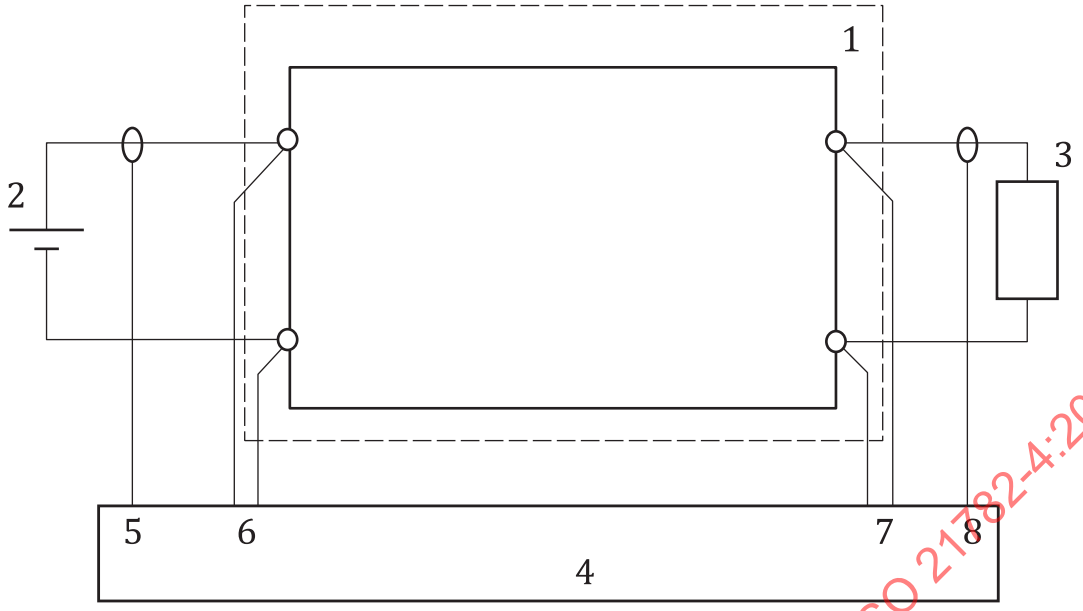
5.1 Measurement of loss and efficiency

5.1.1 General

The purpose of this test is to operate the DC/DC converter under the specified conditions and to measure the loss and the efficiency of the DC/DC converter in order to ensure the performance is as designed.

5.1.2 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 current (in A)
6 DC/DC converter input voltage (in V)
7 DC/DC converter output voltage (in V)
8 DC/DC converter output current (in A)

Figure 1 — Diagram for loss and efficiency test of the DC/DC converter

5.1.3 Test conditions

Test conditions are shown in Table 1.

Table 1 — Conditions for loss and efficiency test of the DC/DC converter

Test conditions	Value	Remark
DC/DC converter input voltage	— Maximum voltage for unlimited operating capability as specified in ISO 21498-1 — Minimum voltage for unlimited operating capability as specified in ISO 21498-1 — Rated voltage as defined in ISO 21782-1:2019, 3.22	For DC/DC converter input voltage tolerance, see ISO 21782-1:2019, 5.3.
Operating points	Test points as defined in Figure B.1 — "p_1" to "p_{18}"	
Ambient conditions	Room temperature (RT) and humidity as defined in ISO 21782-1:2019, 5.4	

Table 1 *(continued)*

Test conditions		Value	Remark
Coolant temperature	Liquid	Maximum temperature for unlimited operating capability	— Ethylene glycol and propylene glycol as examples of coolant — If technically feasible, the tests shall be performed at coolant temperature of 65 °C. Otherwise the deviation shall be documented in the test report.
	Air	Maximum temperature for unlimited operating capability	
Coolant flow rate	Liquid	Minimum flow rate for unlimited operating capability	
	Air	Minimum flow rate for unlimited operating capability	
Operating time	"p_1" to "P_{15}"	1 800 s	
	"p_{16}" to "p_{18}"	2 s or 10 s (Optional 30 s, 60 s)	

5.1.4 Test procedure

The test shall be carried out as follows.

a) The test DC/DC converter shall be operated at specified operating points for the operating time defined in Table 1. Averages of the input power and output power during the last 1 s of the operating time shall be recorded.

b) The loss and efficiency shall be calculated by the following formulae.

$$P_{dl} = P_{di} - P_{do} \tag{1}$$

$$\eta_d = \frac{P_{do}}{P_{di}} \times 100 \tag{2}$$

where

P_{dl} is loss of DC/DC converter (in W);

P_{do} is DC/DC converter output power (in W);

P_{di} is DC/DC converter input power (in W);

η_d is efficiency of DC/DC converter (in %).

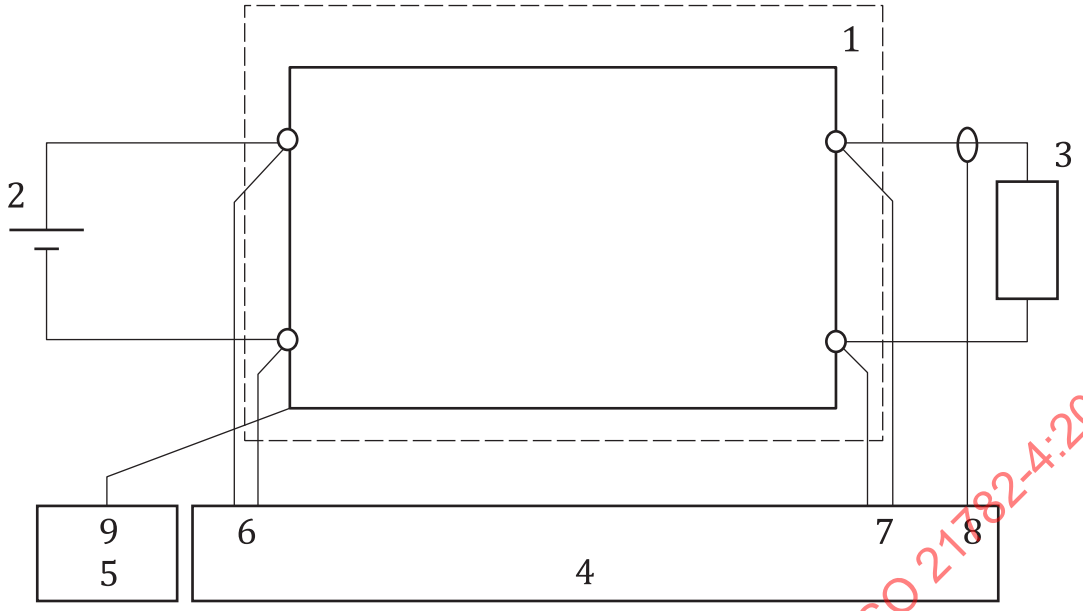
5.2 Temperature rise test

5.2.1 General

This test is to operate the DC/DC converter under the specified conditions and to measure the temperature rise in the DC/DC converter in order to ensure the thermal performance is as designed.

5.2.2 Test diagram

The test diagram is shown in Figure 2.



Key

1 DUT
2 DC power supply
3 load
4 power meter
5 thermometer
6 DC/DC converter input voltage (in V)
7 DC/DC converter output voltage (in V)
8 DC/DC converter output current (in A)
9 measurement points temperatures (in °C)

Figure 2 — Diagram for temperature rise test of the DC/DC converter

5.2.3 Test conditions

The test conditions are shown in Table 2.

Table 2 — Conditions for temperature rise test of the DC/DC converter

Test conditions		Value	Remark
DC/DC converter input voltage		Maximum and minimum voltage for unlimited operating capability as specified in ISO 21498-1 Rated voltage as defined in ISO 21782-1:2019, 3.22	For 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		The points as defined in Figure B.1 — "p_5", "p_{16}"	
Ambient conditions		RT and humidity as defined in ISO 21782-1:2019, 5.4	
Coolant temperature	Liquid	Maximum temperature for unlimited operating capability	— Ethylene glycol and propylene glycol as examples of coolant — If technically feasible the tests shall be performed at coolant temperature of 65 °C. Otherwise the deviation shall be documented in the test report
	Air	Maximum temperature for unlimited operating capability	
Coolant flow rate	Liquid	Minimum flow rate for unlimited operating capability	
	Air	Minimum flow rate for unlimited operating capability	
Operating time		— The operating point "p_5": 1 800 s — The operating point "p_{16}": 2 s or 10 s (optional 30 s, 60 s)	

5.2.4 Test procedure

a) The DC/DC converter shall be operated by the $I_{t=t0}$, and the temperature of each part of the DC/DC converter shall be recorded after specified time (t_o) passes.

b) The temperature shall be measured by the thermometer method. The temperature measurement points are shown below:

— electrode part of power semiconductor or specified point of the cooling components closely connected to these parts;

— inlet and outlet of coolant (in case of liquid cooling);

— inlet and outlet of air (in case of air cooling).

Some points may be added by the agreement between the supplier and customer.

6 Test report

Each test shall be reported with a test report, containing information on test conditions and results. Examples for test reports on conditions and results are given in Tables A.1 and A.2.

Annex A
(informative)

Test report

A.1 Measurement of loss and efficiency

Table A.1 — Loss and efficiency 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)			
2 Results and individual conditions				
	Items		**Value**	**Remark**
	Operating point			
	Operating time (in s)			
	DC/DC converter input current (in A)			
	DC/DC converter input voltage (in V)	Target		
		Measured		
	Power (in W)			
	DC/DC converter output current (in A)	Target		
		Measured		
	DC/DC converter output voltage (in V)			
	DC/DC converter output power (in W)			
	Calculated results	Loss (in W)		
		Efficiency (in %)		

A.2 Temperature rise test

Table A.2 — Temperature rise 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)			
2 Results and individual conditions				
	Items		**Value**	**Remark**
	Operating time (in s)			
	DC/DC converter input voltage (in V)	Target		
		Measured		
	DC/DC converter output current (in A)	Target		
		Measured		
	DC/DC converter output voltage (in V)			
	Measurement point temperatures (in °C)	Point 1		
		Point 2		
		Point 3		
		Point 4		
		Point 5		
		.....		