SVENSK STANDARD
SS-ISO 21782-2:2019

Fastställd/Approved: 2019-09-02
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 43.120

SWEDISH STANDARDS INSTITUTE

Eldrivna vägfordon – Provningsspecifikation för elektriska drivkomponenter –
Del 2: Prestanprovning av motorsystem (ISO 21782-2:2019, IDT)

Electrically propelled road vehicles – Test specification for electric propulsion components –
Part 2: Performance testing of the motor system
(ISO 21782-2:2019, IDT)

Standarder får världen att fungera

SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.

Delta och påverka
Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

Ta del av det färdiga arbetet
Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standard-paket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

Utveckla din kompetens och lyckas bättre i ditt arbete
Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på www.sis.se eller ta kontakt med oss på tel 08-555 523 00.

Standards make the world go round

SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.

Take part and have influence
As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

Get to know the finished work
We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

Increase understanding and improve perception
With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

If you want to know more about SIS, or how standards can streamline your organisation, please visit www.sis.se or contact us on phone +46 (0)8-555 523 00

Den internationella standarden ISO 21782-2:2019 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 21782-2:2019.

The International Standard ISO 21782-2:2019 has the status of a Swedish Standard. This document contains the official English version of ISO 21782-2:2019.

Upplysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS som även lämnar allmänna upplysningar om svensk och utländsk standard.

Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS, who can also provide general information about Swedish and foreign standards.

Denna standard är framtagen av kommittén för El- och hybridfordon, SIS/TK 517.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

Contents

Page

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 2: Performance testing of the motor system

1 Scope

This document specifies the performance tests for the motor system designed as a voltage class B electric propulsion system for 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, *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 Abbreviated terms

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

5 Tests

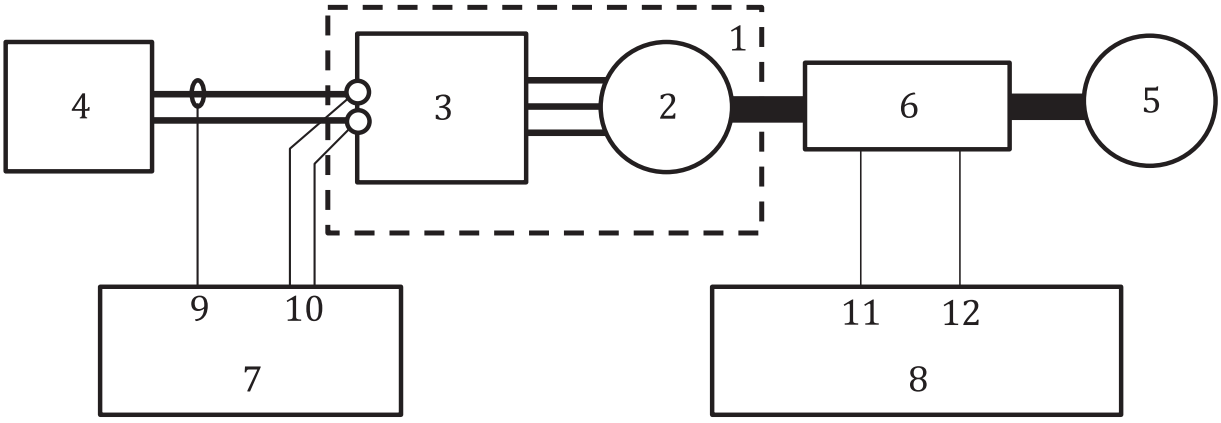
5.1 Measurement of total loss and total efficiency

5.1.1 General

Under the conditions of the paired inverter and motor combination, this test measures total loss and total efficiency between the input power of the inverter and the output power of the motor in order to ensure that the performance of the motor system is as designed.

5.1.2 Test diagram

The test diagram is shown in Figure 1.



Key

1 DUT
2 test motor
3 test inverter
4 DC power supply
5 load
6 torque/speed detector
7 spectrum analyser/power meter
8 torque/speed meter
9 inverter input current (in A)
10 inverter input voltage (in V)
11 motor torque (in Nm)
12 motor speed (in min^{-1})

Figure 1 — Diagram for total loss and total efficiency test of the motor system

5.1.3 Test conditions

The test conditions are shown in Table 1.

Table 1 — Conditions for total loss and total efficiency test of the motor system

Test conditions	Value	Remark
DC input voltage	Rated voltage as defined in ISO 21782-1:2019, 3.22.	For the DC input voltage tolerance, see ISO 21782-1:2019, 5.3.
Ambient conditions	Room temperature (RT) and humidity as defined in ISO 21782-1:2019, 5.4.	
Coolant temperature	Maximum temperature for unlimited operating capability	— In case of liquid cooling — 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.
Coolant flow rate	Minimum flow rate for unlimited operating capability	In case of liquid cooling

Table 1 *(continued)*

Test conditions	Value	Remark
Cooling air flow rate	Minimum flow rate for unlimited operating capability	In case of air cooling
Operating point	Test points as defined in ISO 21782-1:2019, Figure 1 — "a", "a'", "b", "p_1" to "p_{10}" (optional "e", "e'", "f", "p_1'" to "p_{10}'")	
Operating time	— The operating points "a", "a'", "p_1", "p_3", "p_5", "p_7", "p_9", "p_{10}": 2 s, 10 s (optional 30 s, 60 s) — The operating point "b": 1 800 s — The operating points "p_2", "p_4", "p_6", "p_8": 1 800 s or maximum allowable time for temperature protection	For regenerative operating points, the same operating time applies as for corresponding motoring operating points.
Measuring time	Average of the last one second	

5.1.4 Test procedure

If technically feasible the cooling flow path should be connected between inverter and motor and the coolant should flow from inverter to motor and the tests shall be performed at coolant temperature of 65 °C. Otherwise the cooling configuration and/or temperature deviation shall be documented in the test report.

Under specified operating points, the input power and the output torque and speed of motor shall be measured. Inverter input power, motor output torque and speed shall be recorded. Each average of the last one second of the records shall be used.

The total loss and total efficiency shall be calculated by using Formulae (1) and (2):

$$P_{sl} = P_{ii} - P_{mo} \tag{1}$$

$$\eta_s = \frac{P_{mo}}{P_{ii}} \times 100 \tag{2}$$

where

P_{sl} is the total loss of the motor system (in W);

P_{ii} is the inverter input power (in W);

P_{mo} is the motor output power (in W);

η_s is the total efficiency of the motor system (in %).

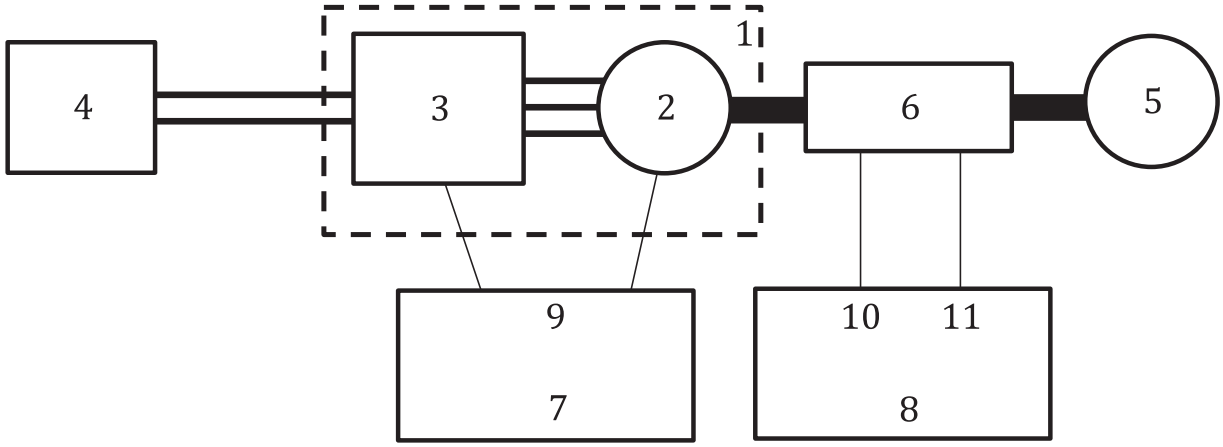
5.2 Temperature rise test

5.2.1 General

Under the conditions of the paired inverter and motor combination, this test investigates the temperature rise characteristics of each part of the motor system within the specified range in order to ensure that the performance of the motor system is as designed.

5.2.2 Test diagram

The test diagram is shown in Figure 2.



Key

1 DUT
2 test motor
3 test inverter
4 DC power supply
5 load
6 torque/speed detector
7 thermometer
8 torque/speed meter
9 measurement point of temperature (in °C)
10 motor torque (in Nm)
11 motor speed (in min^{-1})

Figure 2 — Diagram for temperature rise test of the motor system

5.2.3 Test conditions

The test conditions are shown in Table 2.

Table 2 — Conditions for temperature rise test of the motor system

Test conditions	Value	Remark
DC input voltage	Rated voltage as defined in ISO 21782-1:2019, 3.22.	For the DC input voltage tolerance, see ISO 21782-1:2019, 5.3.
Ambient conditions	RT and humidity as defined in ISO 21782-1:2019, 5.4.	
Coolant temperature	Maximum temperature for unlimited operating capability	— In case of liquid cooling — 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.
Coolant flow rate	Minimum flow rate for unlimited operating capability	In case of liquid cooling
Cooling air flow rate	Minimum flow rate for unlimited operating capability	In case of air cooling

Table 2 *(continued)*

Test conditions	Value	Remark
Operating point	Test points as defined in ISO 21782-1:2019, Figure 1 —"a", "b"	Can be set after consultation with the customer.
Operating time	—The operating point "a": 2 s, 10 s (optional 30 s, 60 s) —The operating point "b": 1 800 s	
Measuring time	Average of the last one second	

5.2.4 Test procedure

If technically feasible the cooling flow path should be connected between inverter and motor, the coolant should flow from inverter to motor and the tests shall be performed at a coolant temperature of 65 °C. Otherwise the cooling configuration and/or temperature deviation shall be documented in the test report.

The test motor system shall be operated at specified operating points, and the temperature at the measurement points shall be recorded. At each operating point, after the specified time passes, the temperature shall be recorded.

The temperature of coil of test motor shall be measured at the points assumed as the highest. The measurement points in the coil and other measurement points can be added by the agreement between the supplier and customer.

The temperature of test inverter shall be measured at the measurement points shown below:

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

— inlet and outlet of coolant.

Additional measurement points can be added by the agreement between the supplier and customer.

5.3 Torque characteristic test

5.3.1 General

Under the conditions of the paired inverter and motor combination, this test measures the torque characteristics specified in the specifications of the motor system in order to ensure that the performance of the motor system is as designed.

5.3.2 Test diagram

The test diagram is shown in Figure 3.