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# GB/T 25123.4-2015

# Electric traction - Rotating electrical machines for rail and road vehicles - Part 4: Permanent magnet synchronous electrical machines connected to an electronic converter

电力牵引轨道机车车辆和公路车辆用旋转电机 第 4 部分:与电子变流器相连的永磁同步电机

(IEC 60349-4:2012, MOD)

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**Standardization Administration of the People's Republic of China.**

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# Foreword

GB/T 25123 "Electric traction - Rotating electrical machines for rail and road vehicles" consists of the following parts:

- Part 1: Machines others than electronic convertor-fed alternating current motors;
- Part 2: Electronic convertor-fed alternating current motors;
- Part 3: Determination of the total losses of convertor-fed alternating current motors by summation of the component losses;
- Part 4: Permanent magnet synchronous electrical machines connected to an electronic converter.

This Part is Part 4 of GB/T 25123.

This Part was drafted in accordance with the rules given in GB/T 1.1-2009.

This Part uses redrafting method to modify and adopt IEC 60349-4:2012 "Electric traction - Rotating electrical machines for rail and road vehicles - Part 4: Permanent magnet synchronous electrical machines connected to an electronic converter".

Compared with IEC 60349-4:2012, this Part has certain adjustments in structure. Annex F lists the comparison on Clause numbers between this Part and IEC 60349-4:2012.

There are technical differences between this Part and IEC 60349-4:2012. The margins of the clauses covered by these differences are marked with a single vertical line ( | ). The technical differences between this Part and IEC 60349-4:2012 and their reasons are as follows:

- Regarding the normative references, this Part has adjusted with technical differences to adapt to the technical conditions of China. The adjustments are reflected in Clause 2 "Normative references". The specific adjustments are as follows:
  - Use GB/T 755 that identically adopts IEC 60034-1 to replace IEC 60034-1 (see Clause 1 and Clause 4);
  - Use GB/T 1402 that modifies IEC 60850 to replace IEC 60850 (see Annex D);
  - Use GB/T 1971 that identically adopts IEC 60034-8 to replace IEC 60034-8 (see 6.2, Annex E);
  - Use GB/T 2900.25 that identically adopts IEC 60050-411 to replace IEC 60050-411 (see Clause 3);
  - Use GB/T 2900.36 that modifies IEC 60050-811 to replace IEC 60050-811 (see

Clause 3);

• Use GB/T 2900.74 that modifies IEC 60050-131 to replace IEC 60050-131 (see Clause 3);

• Use GB/T 2900.83 that identically adopts IEC 60050-151 to replace IEC 60050-151 (see Clause 3);

• Use GB/T 9637 that not identically adopts IEC 60050-211 to replace IEC 60050-211 (see Clause 3);

• Use GB 10068 that identically adopts IEC 60034-14 to replace IEC 60034-14 (see 8.5);

• Use GB 10069.3 that identically adopts IEC 60034-9 to replace IEC 60034-9 and move it into the Bibliography, because Annex C of this document is cited as an informative appendix (see C.8);

• Use GB/T 11021 that identically adopts IEC 60085 to replace IEC 60085 (see 8.1.5);

• Add GB/T 22715 as a reference document (see 9.4.3);

• Delete IEC 62498-1, because it is not directly cited in the text (see Clause 2 and Clause 4 of IEC 60349-4:2010).

- Modify the requirements for altitude to meet the altitude requirements for traction equipment in China (see Clause 4 of this document, Clause 4 of IEC 60349-4:2010);

- Add nameplates to increase important parameters (see 6.1 of this document, 6.1 of IEC 60349-4:2010);

- Delete the additional temperature rise test of the converter power supply in the simplified type inspection, so as to improve the inspection requirements (see 7.3.2 of IEC 60349-4:2010);

- Add assessment test of anti-demagnetization ability to improve the reliability of the permanent magnet motor (see 8.2);

- Modify the loss tolerance requirements so as to be consistent with the loss tolerance of GB/T 25123.2 (see 8.3.2 of this document, 8.2.2 of IEC 60349-4:2010);

- Modify "9.4 Withstanding voltage test" and change it to "9.4 Insulation test". Add "9.4.1 Insulation resistance measurement of stator windings" and "9.4.3 Impulse withstand voltage level of stator coil" to improve product quality (see 9.4 of this document, 9.4 of IEC 60349-4:2010).

# Electric traction - Rotating electrical machines for rail and road vehicles - Part 4: Permanent magnet synchronous electrical machines connected to an electronic converter

## 1 Scope

This Part of GB/T 25123 applies to permanent magnet synchronous electrical machines (motors or generators) connected to an electronic converter used for electric traction of rotating electrical machines for rail and road vehicles, including the following four types of electrical machines:

a) Traction motors: motors for propelling rail or road vehicles.

b) Main generators: generators for supplying power to traction motors on the same vehicle or train.

c) Auxiliary motors: electric motors for driving compressors, fans, auxiliary generators or other auxiliary machinery not involved by GB 755;

d) Auxiliary generators: generators that supply power to auxiliary equipment such as air conditioners, heating, lighting, and storage batteries not involved by GB 755.

The object of this Part is to enable the performance of a machine to be confirmed by tests and to provide a basis for assessment of its suitability for a specified duty and for comparison with other machines.

**NOTE 1:** This Part also applies to machines installed on trailers hauled by powered vehicles.

**NOTE 2:** The basic requirements of this Part may be applied to machines for special purpose vehicles (such as mine locomotives) but this Part does not cover flameproof or other special features that may be required.

**NOTE 3:** It is not intended that this Part should apply to machines on small road vehicles, such as battery-fed delivery vehicles, factory trucks, etc. This Part also does not apply to minor machines such as windscreen wiper motors, etc. that may be used on all types of vehicles.

**NOTE 4:** Industrial type machines complying with GB 755 may be suitable for some auxiliary drives, provided that it is demonstrated that operation on a converter supply will meet the requirements of the particular application.

The electrical input to motors covered by this Part is from an electronic converter.

Generators may be connected to a rectifier or a converter.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

GB 755, *Rotating electrical machines - Rating and performance* (GB 755-2008, IEC 60034-1:2004, IDT)

GB/T 1402, *Railway applications - Supply voltages of traction systems* (GB/T 1402-2010, IEC 60850:2007, MOD)

GB 1971, *Rotating electrical machines - Terminal markings and direction of rotation* (GB 1971-2006, IEC 60034-8:2002, IDT)

GB/T 2900.25, *Electrotechnical terminology - Rotating electrical machines* (GB/T 2900.25-2008, IEC 60050-411:1996, IDT)

GB/T 2900.36, *Electrotechnical terminology - Electric traction* [GB/T 2900.36-2003, 60050 (811):1991, MOD]

GB/T 2900.74, *Electrotechnical terminology - Circuit theory* (GB/T 2900.74-2008, IEC 60050-131:2002, MOD)

GB/T 2900.83, *Electrotechnical terminology - Electrical and magnetic devices* (GB/T 2900.83-2008, IEC 60050-151:2001, IDT)

GB/T 9637, *Electrotechnical terminology - Magnetic materials and components* (GB/T 9637-2001, eqv IEC 60050-221:1990)

GB 10068, *Mechanical vibration of certain machines with shaft heights 56 mm and higher-measurement, evaluation and limits of vibration severity* (IEC 60034-14:2007, IDT)

GB/T 11021, *Electrical insulation - Thermal evaluation and designation* (GB/T 11021-2014, IEC 60085:2007, IDT)

GB/T 22715, *Impulse voltage withstand levels of form-wound stator coils for rotating a.c. machines* (GB/T 22715-2008, IEC 60034-15:1995, IDT)

## 3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 2900.25, GB/T 2900.36, GB/T 2900.74, GB/T 2900.83 and GB/T 9637 as well as the followings

characteristics or parameters of the machine, part or all of the test should be performed;

c) When the exit-factory inspection result has an impermissible deviation from the previous inspection result;

d) When the production is transferred to another plant or production is resumed after it is stopped for 2 years or more;

e) In every 4 years of continuous production.

Unless otherwise agreed, the machines to be tested shall be selected from the first batch of 10 machines manufactured.

The manufacturer and user can also negotiate to determine the specific type inspection.

The machine used for type inspection should have passed the exit-factory inspection (see Clause 9).

Before testing commences, the manufacturer shall provide the user with a test specification outlining the tests to be undertaken to demonstrate compliance with this Part. Following completion of the type inspections, the manufacturer shall supply the user with a full test report.

**7.2.2 Type inspections on converter supply**

The type inspection shall be carried out using the converter and control to be applied in service, but, as an alternative, a supply which closely resembles the supply from the vehicle converter in control principle, waveform and harmonics may be employed.

**NOTE 1:** Many working points of a permanent magnet synchronous machine can be operated stable only with the converter and its control.

**NOTE 2:** In case of a permanent magnet generator with rectifier a similar diode bridge can be used instead of a converter.

If agreed, the manufacturer shall demonstrate the similarity of the test and service supplies and shall state the likely effect on the performance of the machine of any difference between them.

Unless otherwise agreed, the type inspection may be repeated if the electrical output characteristics of the converter are changed.

**7.3 Exit-factory inspection**

Exit-factory inspection is used to verify that each machine has been correctly assembled, has withstood the appropriate insulation tests, and is in good working order both

The specific test method shall be carried out according to GB/T 22715.

**NOTE:** This test is completed before the machine is assembled.

#### 9.4.3.2 Impulse withstand voltage level of stator coil to ground

In the ground impact resistance test of the stator coil, a voltage should be applied between the coil terminal and the ground.

The ground insulation test voltage is provided by the impulse voltage generator. The wave front time of its impulse voltage is 1.2 μs. The number of shock waves is 5 times.

The peak value of the ground impulse voltage of the main insulation of the stator coil is (4U +5000) V.

The specific test method shall be carried out according to GB/T 22715.

**NOTE:** This test is completed before the machine is assembled.

### 9.5 Vibration tests (imbalance)

Each machine shall be checked for vibrations associated with machine imbalance. It shall normally be adequate to demonstrate that a machine runs smoothly when mounted on the test bed. For machines with integrated gearboxes or generators, if installed in place, vibration tests can be carried out together.

In applications where machine vibration is considered critical, if agreed between user and manufacturer, the tests detailed in 8.5 can be carried out on each machine.

## 10 Investigation tests

### 10.1 Measurement of cogging torque

The torque of the machine is measured with open terminals. Details have to be agreed between user and manufacturer.

### 10.2 Temperature rise test of the machine in high speed with open terminals

The machine is driven by a motor to the defined speed with open terminals. The test time and speed and cooling conditions should be agreed between user and manufacturer.

The temperature shall be measured in accordance with Annex A. The temperature rises of windings at the commencement of cooling as defined in A.4 shall not exceed the values given in Table 2.

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