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Road vehicles — Spark-plugs — Test methods and requirements

Véhicules routiers — Bougies d'allumage — Méthodes d'essai et exigences

ISO 11565:1998(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11565 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 1, *Ignition equipment*.

Annex A of this International Standard is for information only.

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Road vehicles — Spark-plugs — Test methods and requirements

1 Scope

This International Standard specifies the test methods and requirements for the mechanical and electrical performance of spark-plugs for use with spark ignition engines.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1919:1998, *Road vehicles — M14 × 1,25 spark-plugs with flat seating and their cylinder head housings.*

ISO 2344:—[1]), *Road vehicles — M14 × 1,25 spark-plugs with conical seating and their cylinder head housings*.

ISO 2345:1994, *Road vehicles — M18 × 1,25 spark-plugs with conical seating and their cylinder head housing*.

ISO 2346:1991, *Road vehicles — M14 × 1,25 compact spark-plugs with flat seating and their cylinder head housing*.

ISO 2347:1994, *Road vehicles — M14 × 1,25 compact spark-plugs with conical seating and their cylinder head housing*.

ISO 2704:1993, *Road vehicles — M10 × 1 spark-plugs with flat seating and their cylinder head housings*.

ISO 2705:—[2]), *Road vehicles — M12 × 1,25 spark-plugs with flat seating and their cylinder head housings*.

ISO 8470:—[3]), *Road vehicles — M14 × 1,25 spark-plugs with flat seating and 16 mm hexagon and their cylinder head housings*.

IEC 60051-1:1997, *Direct acting indicating analogue electrical measuring instruments and their accessories — Part 1: Definitions and general requirements common to all parts*.

IEC 60068-2-6:1995, *Environmental testing — Part 2: Tests — Test Fc: Vibration (sinusoidal)*.

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[1]) To be published. (Revision of ISO 2344:1992)

[2]) To be published. (Revision of ISO 2705:1991)

[3]) To be published. (Revision of ISO 8470:1990)

3 Test methods and requirements

3.1 General

The tests shall be carried out at an ambient temperature of (23 ± 5) °C and a relative humidity of (65 ± 20) % unless otherwise specified.

For each test sample in table 1, the test sequence is indicated by x's from top to bottom.

Each test sequence shall be started with unused samples.

Table 1 — Test sequences

Characteristic to be checked	In accordance with subclause	Test sample						
		A	B	C	D	E	F	G
General characteristics by visual examination	3.2	X	X	X	X	X		
Dimensions	3.3	X	X	X	X	X	X	X
Resistance of incorporated element for RF suppression	3.7.1	X						X
Loading life of incorporated resistor	3.8	X						
Mechanical shell performance	3.4.1	X						
HT terminal tear off resistance	3.4.2		X					
Bending resistance	3.4.3			X				
Gas tightness	3.5				X			
Dielectric strength of the insulator	3.7.2				X			
Vibration resistance	3.4.4				X			
Gas tightness	3.5				X			
Dielectric strength of the insulator	3.7.2				X			
Thermal shock, thermal resistance	3.6					X		
Insulation resistance at ambient temperature	3.7.3						X	
Insulation resistance at high temperature	3.7.4						X	
Thermal stability of incorporated resistor	3.9							X
General characteristics by visual examination	3.2				X		X	X

3.2 General characteristics

3.2.1 Test

Check the following characteristics specified in 3.2.2 by visual examination. This visual examination shall be carried out with naked eye (normal strength of vision and normal colour perception) at the most favourable viewing distance and with suitable illumination.

3.2.2 Requirements

3.2.2.1 The external **gasket**, if any, shall be in accordance with the relevant International Standard.

3.2.22 The **scavenging area** shall be clean and without any foreign body.

3.2.23 The **electrodes** shall be fixed in position.

3.2.2.4 The **shell** shall be properly fixed to the insulator. No visible sign of corrosion is allowed. The thread shall be free from burrs or damage.

3.2.2.5 The **insulator** shall be smooth and uniform without abnormal appearance. The insulator shall not show chips, cracks or signs of shock damage.

3.2.2.6 The **marking** shall be in accordance with the manufacturer's specification.

3.3 Dimensional characteristics

3.3.1 Test

The dimensions are checked in accordance with the relevant International Standard, using random samples.

3.3.2 Requirement

All dimensions shall conform to the relevant International spark-plug Standard.

3.4 Mechanical performance

3.4.1 Mechanical performance of the shell

3.4.1.1 Test fixture

The test fixture shall have the thread and the seat according to the relevant International spark-plug Standard and have a surface finish of 1,6 µm (R_a = 1,6).

3.4.1.2 Test

Install the fully assembled spark-plug on the test fixture specified in 3.4.1.1 using a torque wrench, or a corresponding measuring device, until the shell breaks.

3.4.1.3 Requirement

The measured maximum value of torque shall not be less than

60 N·m for M14 gasket seat spark-plugs and for M18 conical seat spark-plugs;

40 N·m for M14 conical seat spark-plugs;

35 N·m for M12 spark-plugs;

25 N·m for M10 spark-plugs.

3.4.2 Tear-off resistance of the high tension terminal

3.4.2.1 Test

The test shall be non-destructive.

Mount the spark-plug on a tensile test bench using a suitable device. Apply a force linearly increasing from zero to (400 ± 10) N with a rate of less than 500 N/s to the high tension terminal in the axial direction.

3.4.2.2 Requirement

After the test, the spark-plug shall be intact.

3.4.3 Bending resistance

3.4.3.1 Test

Mount the spark-plug on a suitable test block at the maximum installation torque specified in the relevant International Standard. Apply a force perpendicular to the insulator axis and within 5 mm of the insulator's end. The touch down velocity of the force applied shall be less than 10 mm/min to avoid impact damage.

3.4.3.2 Requirement

The minimum bending moment shall be 15 N·m.

3.4.4 Vibration, sinusoidal

3.4.4.1 Test

Subject the spark-plug, mounted and tightened as specified, to a vibration test Fc in accordance with IEC 60068-2-6:

— frequency range: 50 Hz to 500 Hz;

— sweep rate: 1 octave/min;

— acceleration: 30 g (294 m/s^2);

— vibration directions: spark-plug axis and perpendicular;

— duration: 8 h in each direction.

3.4.4.2 Requirement

After this test the spark-plug shall show no abnormalities and fulfil all of the following tests (see table 1).

3.5 Gas tightness

3.5.1 Test

Mount the spark-plug on a test device which represents the configuration given for mounting the spark-plug to the cylinder head and tighten it with maximum installation torque as specified in the relevant International Standard. The test fixture seat shall have a hardness of HRC 20 or greater, and a surface roughness transverse to the seating surface of 3,2 μm (R_a = 3,2) for spark-plugs with conical seating and of 32 μm (R_a = 32) for spark-plugs with flat seat. All threads shall be free of lubricants.

Ensure the spark-plug temperature, measured close to the seat as shown in figure 1, has reached (200 ± 10) °C. Apply a pressure of (2 ± 0,2) MPa [(20 ± 2) bar] (air, nitrogen, carbon dioxide or any other detection gas) to the spark-plug face for a duration of 5 min. Then determine the leakage rate between

— shell and cylinder head,

— shell and insulator,

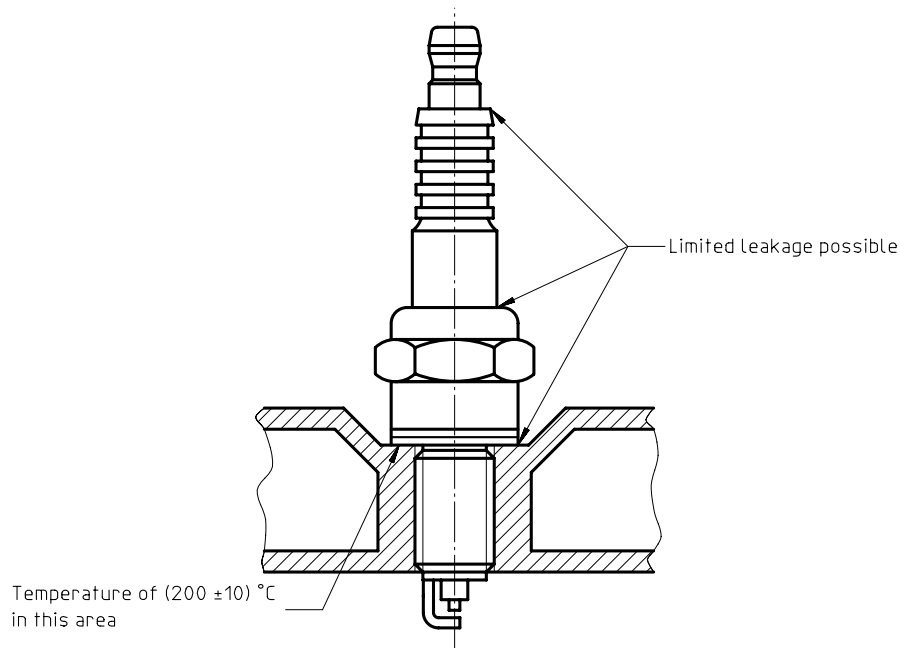— insulator and high tension terminal.

Figure 1 — Leakage

3.5.2 Requirement

The measured total leakage rate shall not exceed 2 cm³/min. If air or nitrogen are not used, convert the leakage rate to that of air using the specific volume of the detection gas.

3.6 Thermal shock, thermal resistance

3.6.1 Test

Cut off the shell to expose the insulator nose, without damaging the insulator nose. The insulator nose shall be immersed to a soldering bath, the soldering material having a temperature of (500_{-20}^{+50}) °C for a duration of 30 s to a depth not less than 3 mm.

Following immersion, allow the insulator to cool to ambient temperature, without forced cooling.

The use of a flow detecting penetrant is recommended for visual examination. The same method shall be used for examination before and after the test.

3.6.2 Requirement

There shall be no ruptures, cracks or deformations.

3.7 Electrical performance

3.7.1 Resistance of the incorporated element for RF suppression

3.7.1.1 Test

Apply a pulsed voltage of 1 kV to 5 kV between the centre electrode and the terminal of the resistor plug.

For those plugs whose resistors are not voltage sensitive, a d.c. voltage of up to 12 V may be used.

3.7.1.2 Requirement

The resistance of suppression spark-plugs shall be as agreed between the spark-plug manufacturer and the engine manufacturer.

NOTE — Typical resistance values are in the range 1 kΩ to 20 kΩ.

3.7.2 Dielectric strength of the insulator

3.7.2.1 Test

Mount the spark-plug on a suitable pressure chamber and tighten with the torque specified in the relevant International Standard. Apply pressure (air, nitrogen or carbon dioxide) in the pressure chamber to the firing end of the spark-plug to ensure that no spark occurs between the electrodes during this test.

Apply ignition voltage pulses, with the voltage rising at a rate of > 600 V/μs up to a peak value as given in table 2, between shell and high voltage terminal of the spark-plug.

A spark-plug boot may be used to avoid surface flash-over.

Table 2 — Test voltages

Test voltage (peak value) kV	Spark-plug in accordance with
	ISO 2347
	ISO 1919
	ISO 2344
20	ISO 2345
	ISO 2704
	ISO 2705
	ISO 8470
	ISO 2346

3.7.2.2 Requirement

No breakdown shall occur.

3.7.3 Insulation resistance at ambient temperature

3.7.3.1 Test

Measure the insulation resistance between the centre electrode of the plug and the grounded part by using an insulation tester.

The insulation resistance tester used for testing shall have an accuracy according to IEC 60051.

3.7.3.2 Requirement

Insulation resistance shall be 100 MΩ or higher.

3.7.4 Insulation resistance at high temperature

3.7.4.1 Test

Install the test spark-plug onto a metallic fixture to which one lead of an insulation tester is attached. Attach the second lead of the insulation tester (mechanical or welded) to the centre electrode of the test spark-plug. Insert the entire assembly into a heatable test chamber. Pass the insulation tester leads through the door of the test chamber using a high temperature insulating material and attach them to the insulation tester. Heat the chamber to 400 °C and record the insulation resistance after 30 min at this temperature.

3.7.4.2 Requirement

The insulation resistance at high temperature shall be 10 MΩ or higher.

3.8 Loading life of the incorporated resistor

3.8.1 Test

After measuring the resistance values of the resistor plugs in accordance with 3.7.1, subject the plugs to $1,3 \times 10^7$ sparks of the following parameters:

— spark voltage: 20 kV;

— spark energy: 16 mJ;

— spark rate: 50 Hz or 60 Hz;

— coil output voltage: 35 kV.

Afterwards, measure the resistance values again and examine the change in the values before testing.

NOTE — The wiring diagram of a test bench is shown as an example in annex A.

3.8.2 Requirement

The resistance shall be as agreed between the spark-plug manufacturer and the engine manufacturer.

3.9 Thermal stability of the incorporated resistor

3.9.1 Test

Measure the resistance values of the resistor plugs in accordance with 3.7.1. Then maintain the plug in air at 150 °C for 2 h, and after measuring the resistance value at this time, promptly return the plug into air of room temperature, and measure the resistance value again after the restoration at room temperature.

Then, after maintaining the plug in air at 300 °C for 20 min, promptly return it to air of room temperature, measure the resistance value after returning to room temperature, and examine the changes of the respective resistance values from that before testing.

3.9.2 Requirement

The resistance shall be as agreed between the spark-plug manufacturer and the engine manufacturer.

NOTE — Typical resistance values are in the range of 1 kΩ to 20 kΩ.