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Automotive parts —
Ignition coils — Test methods

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Foreword

This Standard has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently, **JIS D 5121 : 1980** is replaced with **JIS D 5121 : 1998**. This revision has been modified to test methods of ignition coils based on **ISO/DIS 13476**, *Road vehicles — Ignition coils — Electrical characteristics and test methods*, and specifications of the ignition coils in the former Standard were deleted.

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Automotive parts—Ignition coils — Test methods

Introduction This Standard is the Japanese Industrial Standard prepared based on ISO/DIS 13476, *Road vehicles — Ignition coils — Electrical characteristics and test methods* which was passed in the international vote as ISO/DIS in September, 1996, without modifying its technical content, and the Annex specifies the test items (except those specified in the draft International Standard) which have been conventionally specified in Japanese Industrial Standard.

The parts underlined with dots in this Standard show the matters not given in the original International Standard.

1 Scope This Standard applies to ignition coils (hereafter referred to as “coils”) of the induced energy accumulation type. The test methods are specified for the coils to be used in the ignition device using the semi-conductor switching structure of the spark ignition internal combustion engine.

Remarks : The International Standard corresponding to this Standard (draft) is as follows.

ISO/DIS 13476 Road vehicles — Ignition coils — Electrical characteristics and test methods

2 Definitions and symbols (parameters) The performance of the coils are influenced by the following major 3 sets of parameters.

- a) Parameters specific to the coils
- b) Parameter associated with the external condition to influence the primary side of the coils
- c) Parameter to influence the output or secondary side of the coils

The coil characteristics on the low voltage terminal side shall be informed the supplier of the interruption mechanism. Similarly, the output of the high voltage terminal shall be informed those to decide the specifications of required ignition plugs and high voltage output circuit. Some parameters are related to each other; but shall be given in a complete set.

The parameters in 2.1 to 2.3 include no temperature rise caused by the operation of the coils.

2.1 Structural parameters of coil

- a) Primary resistance (R_p)
- b) Primary inductance (L_p) (only as informative reference)
- c) Turns ratio (only as informative reference)
- d) Secondary resistance (R_s) (only as informative reference)
- e) Primary current rise reference time (t_{ref})
- f) Primary leakage inductance (L_{pl})

2.2 Primary parameters (switching)

- a) Nominal primary interruption current (I_{Np})
- b) Primary clamp voltage (U_{plim})

2.3 Output parameters to be controlled by coil structure and switching

- a) Maximum secondary output voltage (U_{sm})
- b) Ignition limiting load resistance (R_{15kV})
- c) Secondary voltage rise time (t_{sur})
- d) Zener discharge energy (E_{zd})
- e) Zener discharge duration (t_{1zd})
- f) Maximum Zener discharge current (I_{zdm})

3 Test condition Every test shall be carried out under the conditions that the ambient temperature is $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, and the relative humidity is from 45 % to 75 %. It shall be confirmed that the temperature of the coils is constant before measuring the resistance.

Every equipment shall be calibrated before starting the measurement.

4 Test apparatus The coils shall be connected as indicated in Fig. 1 and Fig. 2 according to the purpose of the test. In a case of the simultaneous ignition coil, the high voltage terminal shall be grounded through a 0.5 kV Zener diode so as to simulate the discharge in the exhaust stroke.

4.1 DC power supply The DC power supply shall be 50 μs or under in return time of from 10 % to 90 % for the load range under service, and shall be 50 mV or under in fluctuation of the mean voltage, and 100 mV or under in peak-to-peak ripple for the range from the no load to the whole load of the ignition device. In supplying the power, the wiring to the system to be tested shall be arranged as short as possible.

The DC power supply shall be regulated as follows :

- $13.5 \text{ V} \pm 0.1 \text{ V}$ for 12 V system
- $27 \text{ V} \pm 0.2 \text{ V}$ for 24 V system

4.2 Oscilloscope The oscilloscope to be used shall be 35 ns in maximum rise time, and its minimum band pass of 10 MHz shall be used (P1, P2, P3 and P4). The total error of measurement shall be below the following values, taking into consideration the correction and calibration voltage, and the voltage and current probes (see 4.3 and 4.4).

- 1 % for the voltage up to 1500 V
- 3 % for the voltage exceeding 1500 V
- 1 % for the measured value of current

4.3 Voltage probe

4.3.1 The high voltage probe P2 to be used shall be 5 pF or under in the input capacity, and 100 M Ω or over in input resistance.

4.3.2 The voltage probes P3 and P4 to be used shall be 10 MHz in the minimum band pass.

4.4 Current probe The current probe P1 shall be applied to both the direct current to the alternating current of up to 10 MHz.

4.5 Interruption system The current interruption frequency shall be set to $50 \text{ Hz} \pm 0.5 \text{ Hz}$.

4.6 Test apparatus A Only the high voltage wires without resistance and low voltage wires for automobiles shall be used.

4.6.1 The capacitance C_{total} shall be the value equivalent to the capacitance which is normally generated in the wires and ignition plugs in the engine. The capacitance consists of the cable capacity (3 % or under for 1 kHz) of the low dielectric loss (low dissipation factor) and those of the capacitor C1 and the high voltage probe P2, and the total capacitance shall be as follows.

- Normally 50 pF to 55 pF
- 25 pF to 30 pF for the ignition device without any high voltage wires

Remarks 1 Other capacitance value may be used according to the application.

- 2 An example of the measurement of the total capacitance by the cut-frequency method using the test apparatus A is as follows. (This does not specify the dielectric loss of the capacitance.)

In the cut-frequency method, the power is supplied from the sinusoidal wave generator through a DC resistor such as $R = 10 \text{ k}\Omega$ to the load. In particular, attention shall be paid to the value of C1 (V_0) voltage at lower frequency, and then, increase the frequency and measure the frequency at which the voltage is equal to $V_0 = 0.7$ (−0.3 dB). The capacitance shall be calculated by the following formula.

$$C_{\text{total}} = 1 / (2 \times \pi \times f_{\text{3dB}} \times R)$$

The output voltage of the sinusoidal wave generator shall be kept constant during the measurement.

4.6.2 The resistance R1 simulates the pollution of the ignition plug with carbon. Each resistor to be used is low in voltage factor ($0.0005 \% / V_{\text{max}}$), non-dielectric, and approximately 10 W and $1 \text{ M}\Omega \pm 5 \%$ at 20 kV, respectively. The resistors shall be connected in parallel to the ballast capacitor C1, and used for the measurement of the ignition limit load resistance $R_{15\text{kV}}$ (see 5.5).

4.7 Test apparatus B

4.7.1 A Zener diode of 1 kV shall be used for the ignition coil in Fig. 1, while two Zener diodes of 1 kV and 0.5 kV shall be used for the simultaneous ignition coil in Fig. 2, and these diodes shall be used with the Zener voltage tolerance of $\pm 5 \%$ under any test condition.

4.7.2 The high voltage diode D2 of at least 5 kV shall be used.

4.7.3 The components shall be as follows as an example to evaluate the energy.

4.7.3.1 The DC voltmeter P5 shall have the input resistance of at least $10 \text{ M}\Omega$, and capable of measuring the voltage of 1 mV.

4.7.3.2 The filter circuit shall have the resistance $R2 = 10 \text{ k}\Omega$ (nominal) and the capacity ($C2 = 47 \mu\text{F}$ (nominal)), and shall have the leakage characteristic of less than $1 \mu\text{A/V}$.

4.7.3.3 The non-dielectric resistor R3 (a shunt resistor) shall be $100 \Omega \pm 1 \%$.

Remarks 3 The components specified in 4.7.1 and 4.7.2 shall be essential. The components specified in 4.7.3 are arbitrary, and show an example for evaluating the energy. (See 5.6, Fig. 1 and Fig. 2.)