International Standard ISO 6518/2

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Ignition systems — Part 2 : Test methods

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6518/2 was developed by Technical Committee ISO/TC 22, *Road vehicles*, and was circulated to the member bodies in July 1981.

It has been approved by the member bodies of the following countries:

Austria	Hungary	Romania
Belgium	Italy	Spain
Bulgaria	Japan	Sweden
China	Korea, Dem. P. Rep. of	Switzerland
Czechoslovakia	Korea, Rep. of	United Kingdom
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France	New Zealand	USSR
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No member body expressed disapproval of the document.

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Ignition systems — Part 2 : Test methods

1 Scope and field of application

This part of ISO 6518 specifies the methods and test conditions of battery ignition systems for spark ignited internal combustion engines, which give reproducible test results.

It is intended for any technical person or group interested in ignition system design and/or evaluation.

NOTE — Part 1 of ISO 6518 defines the terms relating to ignition systems for spark ignited internal combustion engines.

2 DC source

The source of dc voltage to be used in ignition system measurements shall be a variable dc power supply having a 10 to 90 % transient recovery time of not more than 50 µs over the load range encountered in use. It shall have no more than 50 mV variation in average voltage from no load to full ignition system load and no more than 100 mV peak-to-peak ripple over the same load range. This power supply may be substituted by a battery and be positioned immediately adjacent to the test area.

3 Ignition system description

The ignition system as described for the tests specified in this part of ISO 6518 shall consist of :

3.1 A coil.

This can be the conventional induction coil or an air or magnetic core transformer.

3.2 A coil external resistor or resistors, if the coil being tested requires an external resistor, or any fixed or variable means to make the voltage and/or the current in the ignition circuit vary.

3.3 A distributor.

This is a device which distributes the ignition impulses to the spark plugs. It may also contain means of triggering and/or timing adjustment, all of which have a proper angular interrelationship to themselves and, through a mechanical drive, to the engine.

3.4 High voltage, non-resistive metal conductor ignition cables, coil to distributor is 455 mm long, distributor to spark gap is 610 mm long.

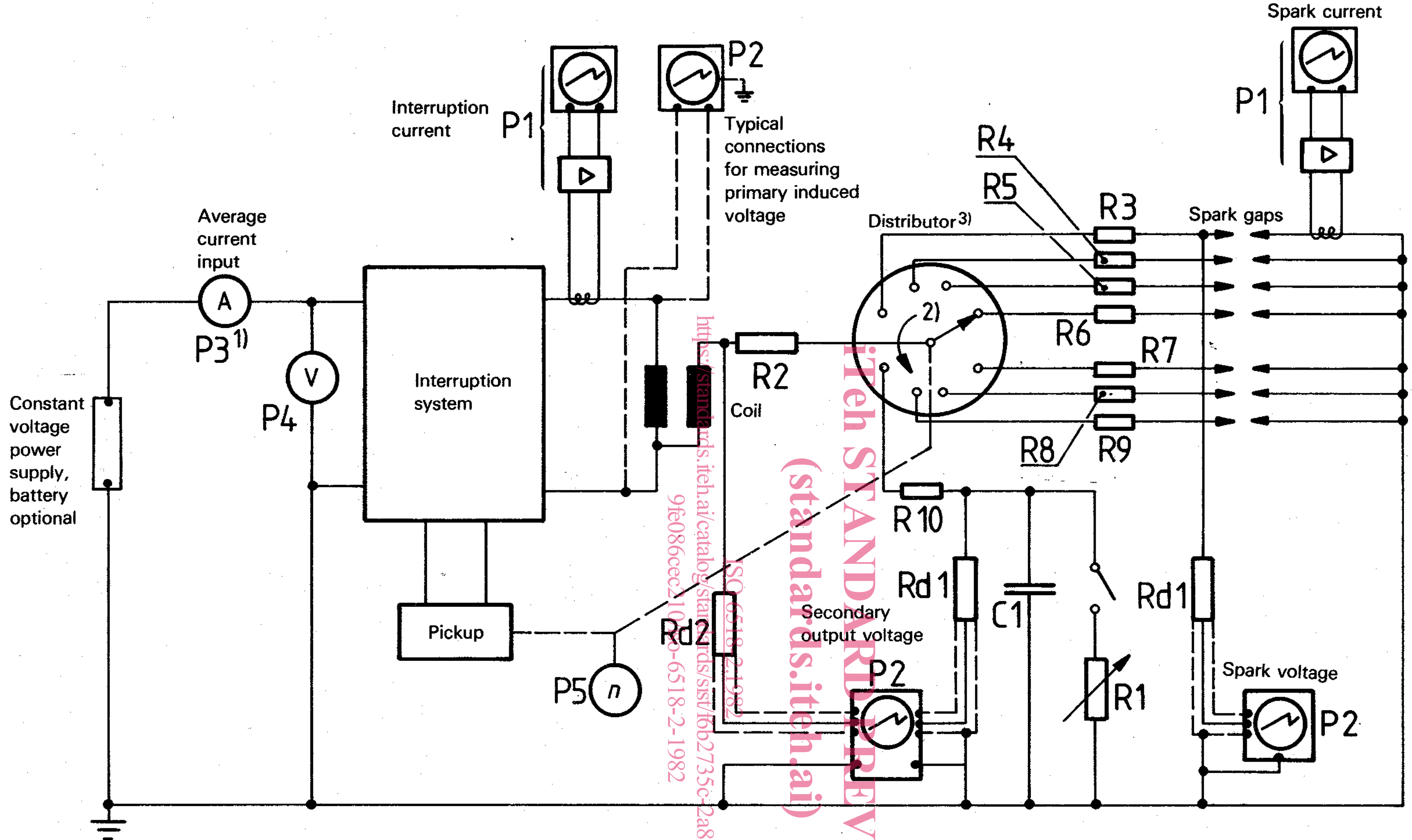
3.5 Any auxiliary switching means, implicit with the system being tested such as a transistorized control unit.

The above devices shall be interconnected as shown in figure 1 or in any other circuit which has proved to be equivalent.

4 System load

The load connected to the ignition system shall be a multi-point spark gap test stand, each gap being individually variable. The number of gaps used is one less than the number of towers on the distributor cap. Using an eight cylinder distributor as an example, seven gaps will be set to 5,5 ± 0,1 mm (corresponding approximately to 12 kV). The eighth tower shall be connected as shown in figure 1 by low dissipation factor (not greater than 3 % at 1 kHz), secondary ignition cable of length such that in conjunction with the capacitor the total capacitance is 50 to 55 pF (this can be a section of screened ignition cable) to simulate the capacitance of the cables and spark plugs as normally encountered on a vehicle, and at suitable times a low voltage coefficient (0,000 5 %/V max.), non-inductive approximately 10 W, 1 MΩ ± 5 % resistor.

The resistor simulates lead or carbon fouled spark plugs. For measuring the total capacitance, the distributor spark gaps and the impedances R2 to R10, if lumped resistors, shall be shunted and the ignition cable shall be removed from the ignition coil.



P1 = current probe, amplifier and oscilloscope

P2 = voltage measuring oscilloscope

P3 = dc ammeter

P4 = dc voltmeter

P5 = tachometer

C1 = load capacity

R1 = load resistor

R2 to R10 = suppression impedances lumped or distributed [practical implementation and values of these impedances (R1 to R10) to be agreed upon between manufacturer and user]

Rd1 = voltage divider

Rd2 = voltage divider

Figure 1 — Test circuit for ignition systems

1) P3 in positive supply rail to prevent shunting by case of interruption system. Maximum voltage drop across P3 : 100 mV.

2) The arrow shows the sequence of the sparks.

3) The distance between rotor electrode and cap electrode shall be maintained constant during spark duration or as agreed between user and supplier.

5 Measurements

5.1 Available voltage at spark plug

This measurement is fundamental to spark ignition. Comparing available voltage to voltage required to fire spark plugs (in a given engine) determines the adequacy of the ignition system (see figure 2A).

5.2 Interruption current

This measurement indicates energy into the coil and shall be verified to ensure adequate switching device life (see figure 2B).

5.3 Average current input

This measurement determines the average current draw of the system with respect to the dc source (alternator, generator, battery, etc.).

5.4 Spark voltage and spark current measurement

These measurements are necessary to calculate spark energy.

5.5 Spark duration measurement

Within limits, this measurement is indicative of the igniting capability of a spark under marginal fuel conditions. It also is an indication of the amount of erosion which will occur on spark plug electrodes due to electrical means[1] (see figure 2C).

5.6 Maximum inductance spark current measurement

This is the instantaneous current from the secondary winding of the ignition coil flowing through the spark gap after breakdown (see figure 2E).

5.7 Inductive spark energy computation

Spark energy is computed by integration of spark current times spark voltage over the spark duration interval. A time can be defined where the simple product of instantaneous values of spark current, spark voltage and spark duration gives the same result. This time shall be determined for particular systems and conditions.

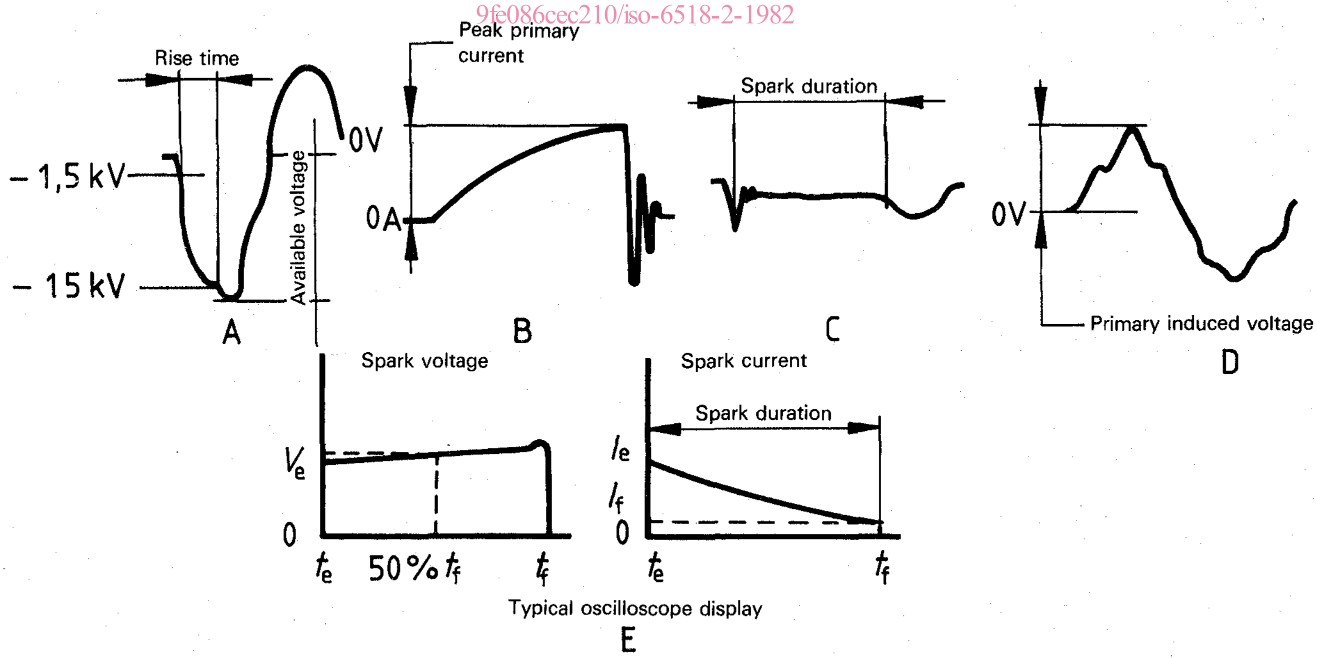
5.8 Coil secondary voltage rise time

This measurement is an indication of the ability of an ignition system to fire shunted (fouled) spark plugs. The shorter the rise time, the less system energy is lost across the fouled shunt and the more voltage is available to fire the plug (see figure 2A).

To facilitate comparison between systems, the rise time shall be determined between − 1,5 kV and − 15 kV or as agreed between user and manufacturer.

5.9 Coil primary induced voltage

This measurement is useful with respect to distributor contact life on conventional ignition systems and is a measure of the stress on a semiconductor power switch in inductive energy storage ignition systems (see figure 2D). If it is made, it may be



Abscissae in A, C, D and E : Time in microseconds.
Abscissa in B : Time in milliseconds.
Ordinates are as marked.

Figure 2 — Measurements effected on the ignition system

1) Because of the complexity of both of these areas, however, experience is required to use this information effectively.

necessary to use a measuring instrument with a differential input. This measurement is not applicable to capacitor discharge ignition systems.

NOTE — The primary induced voltage wave form will be preceded by a leakage induction spike. Usually this is ignored in calculations but if the area under the "spike" curve becomes significant then it is essential that it be taken into account, when considering the effect on solid state devices.

5.10 Ignition limiting load resistance

The shunt behaviour of an ignition system is also determined by its ignition limiting load resistance. It is the resistance at which the secondary available voltage falls to − 15 kV. The designation for it could be R_{15kV}. The parameters are C_{load} = 50 pF, U_{supply} = 13,5 V, n = 1 000 min⁻¹.

6 Test equipment

6.1 An oscilloscope with a maximum rise time of 35 ns, with a minimum band pass of 10 MHz and measuring incertitude of less than 3 % shall be used (P1 and P2).

6.2 A voltage divider with an input capacitance smaller than or equal to 5 pF and an input resistance of more than or equal to 100 MΩ and an oscilloscope shall be used to measure the available voltage rise time and spark duration (Rd1 and Rd2). For measuring the ignition current, a current probe shall be used as shown in figure 1.

6.3 A dc ammeter shall be used to measure average current input (P3).

6.4 The same oscilloscope as described in 6.1 may be used to measure primary induced voltage.

6.5 A dc voltmeter with an input resistance of at least 10 kΩ/V and with sufficient resolution to easily indicate differences of 0,1 V.

6.6 A distributor drive stand and attached tachometer conforming to the following :

6.6.1 Drive shaft and attached tachometer shall be concentric within 0,1 mm.

6.6.2 A continuous speed adjustment, variation between 10 to 4 000 min^{-1} possible.

6.6.3 Speed stability within 5 % between 10 and 750 min^{-1} and 2 % between 1 000 and 4 000 min^{-1}.

6.6.4 A tachometer accurate within 1 % of indicated speed.

7 Procedures

7.1 The conventional circuit arrangement as shown in figure 1 with instrumentation in place can be used to measure the parameters mentioned in clause 5 under the conditions listed in the table as appropriate.

The calculation described in 5.7 plus the procedure described here determines the inductive portion of the spark energy dissipated in a spark gap as shown in figure 3 under the conditions shown in the table. This procedure can be used in relating the effective amount of spark energy required to ignite a given fuel mixture.

Table — Test conditions

Distributor min^{-1}	Supply V	Environment temperature °C Comparative testing	 Operational testing	Operating condition
10 20 30 40	6,0	+ 23 ± 2	− 30 ± 3	Cold starting
50 60 70	10,0	+ 23 ± 2	+ 50 ± 2* + 80 ± 2**	Warm starting
250 500 750 1 000 1 250 1 500 1 750 2 000 2 250 2 500 2 750 3 000 3 250 3 500 3 750 4 000	13,5	+ 23 ± 2	+ 50 ± 2* + 80 ± 2**	Running

* This value applies for items mounted in vehicle cabin or similar environment.

** This value applies for items mounted on or near the engine.

7.2 If 6 V ignition systems are to be tested, divide the supply voltages listed in the table by two; for 24 V systems, multiply by two.

Allow the ignition system to soak at least 1 h at the temperatures listed in the table before beginning tests. Before any readings are recorded at any of the test points, the system should be allowed to come to a thermally stable operating condition to be agreed upon between manufacturer and user.

Output voltage amplitudes vary due to contact arcing and other small but accumulative factors. It is recommended that the minimum peak amplitude be recorded. This represents the level which can be guaranteed by the system under test.

The voltage divider lead shall be connected to a firing spark gap for spark duration measurements and this gap set to 5,5 mm. (See figure 3).

7.3 When environmental equipment is used to control ambient test temperatures, care must be taken that wire and/or cable lengths and, consequently, impedances do not affect test results.

7.4 During simulated starting tests, the system shall be operated under conditions simulating vehicle electrical conditions, for example, if a resistor in series with coil is normally bypassed during vehicle cranking, this resistor should be bypassed for this portion of bench tests.

7.5 The circuit arrangement shown in figure 1 is appropriate to measure the coil's primary induced voltage and secondary voltage. When the 1 MΩ resistor is connected, it is also appropriate to measure the rise time of the secondary voltage. Oscilloscope P2 is used to measure primary induced voltage in this case. These measurements should be made at an ambient temperature of 23 ± 2 °C, a distributor speed of 1 000 min^{-1} and a supply voltage of 13,5 V. Primary induced voltage test results are usually more meaningful if compared to secondary voltage values measured simultaneously. A satisfactory ratio of secondary voltage to primary induced voltage should be established by each group making these tests if they wish to ensure that neither contacts nor semiconductors are overstressed.

Dimensions in millimetres

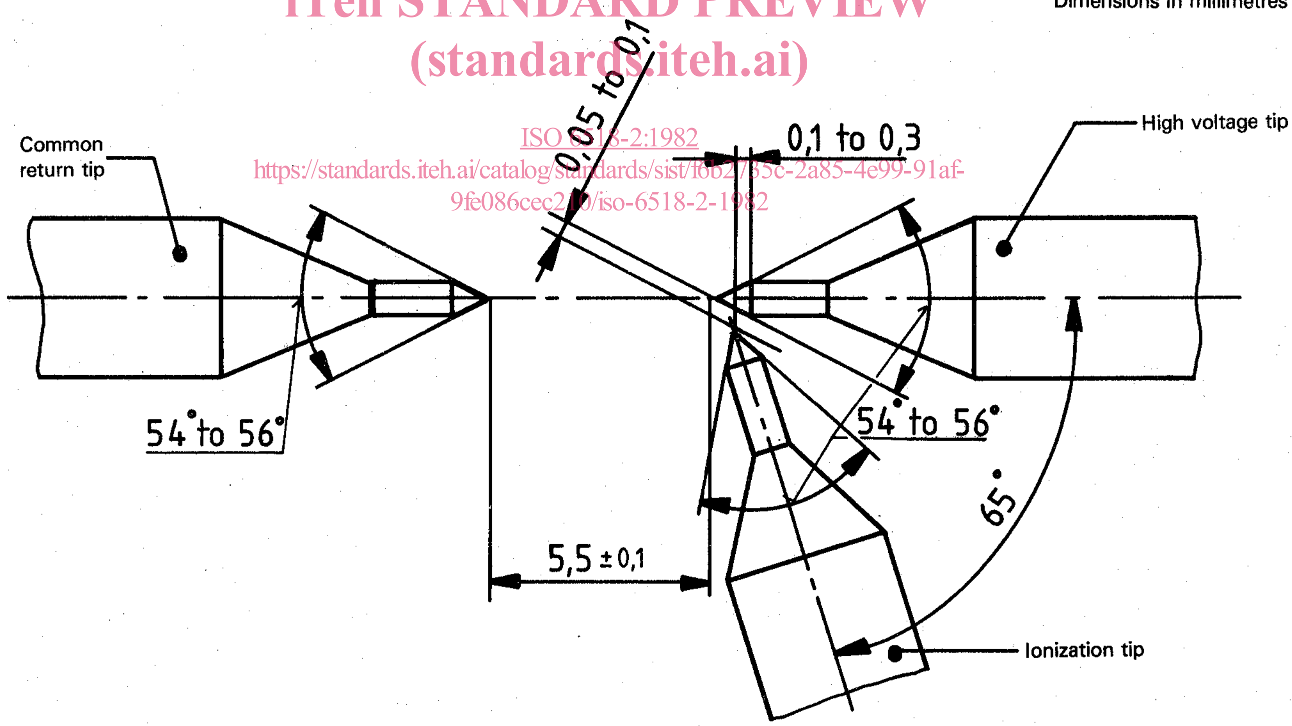


Figure 3 — Setting of the pointed spark gap