



**International
Standard**

ISO 6518-2

**Road vehicles — Ignition systems —
Part 2:
Electrical performance and function
test methods**

Véhicules routiers — Systèmes d'allumage —

*Partie 2: Performances électriques et méthodes d'essai de
fonctionnement*

**Third edition
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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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 document 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).

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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 32, *Electrical and electronic components and general system aspects*.

This third edition cancels and replaces the second edition (ISO 6518-2:1995), which has been technically revised. It also incorporates the Technical Corrigendum ISO 6518-2:1995/Cor. 1:1997.

The main changes compared are as follows:

- test description amended to reflect the state of the art in digital technology.

A list of all parts in the ISO 6518 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.

Introduction

The purpose of this document is to provide a compact and concise specification on ignition parameter measurements, the test equipment and the corresponding measurement procedures.

It is intended to specify equipment, conditions and methods to evaluate ignition systems for internal combustion engines.

ISO 6518-1 specifies the definitions.

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Road vehicles — Ignition systems —

Part 2: Electrical performance and function test methods

1 Scope

This document specifies the design and/or evaluation with the specific equipment, conditions and methods for distributorless battery ignition systems intended for use in various internal combustion engines including automotive, marine, motorcycle and utility engine applications. The test procedures listed in this document are limited to measurements performed on a test bench only and do not include measurements made directly on engines or vehicles. This document is not intended to supply information for battery ignition systems used in aircraft applications of any type.

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 6518-1, *Road vehicles — Ignition systems — Part 1: Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6518-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Ignition system description

This document applies to single ended coil on plug (COP) and coil near plug (CNP). This document does not propose methods to measure any advanced ignition technologies. Those advanced technologies may require advanced methodologies for collection of performance characteristics.

The ignition system as defined for the tests tabulated in this document shall consist of:

- a) A coil. This can be the conventional induction coil or an air or magnetic core transformer.
- b) High voltage, metal conductor ignition cables which are specified to eliminate the varying effects of the different kinds of cable with high impedance conductors. Resistance per foot, as well as inductance of spark plug cables built to suppress radiation, can be quite different from manufacturer to manufacturer.

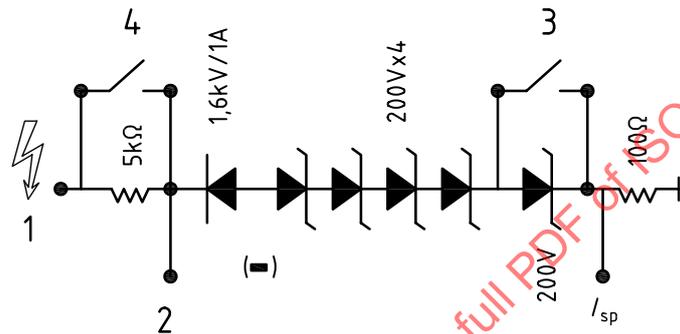
NOTE It is possible that some ignition systems do not function properly with metallic secondary cables due to EMI and can require low resistance inductance cables.

- c) The standard switching device used in modern systems is the insulated gate bipolar transistor (IGBT). Other transistorized switches can be utilized too.

The preceding devices shall be interconnected as the manufacturer recommends or similar to the conventional system see [Figure 15](#) in [7.7](#).

5 System load

For the purposes of this document, the assumed loads for the ignition coil are capacitance, resistance and a Zener diode string shown in [Figure 1](#). For certain tests, as designated in [Clause 6](#), the capacitive and resistive loads will be directly connected to the coil high voltage tower with the coil not firing. A high voltage load of 20 Picofarad (pF) or other as specified by OEM for coil-on-plug ignition system (this can be a section of shielded ignition cable) are used to simulate the capacitance of the cables and spark plugs as normally encountered on a vehicle. At suitable times, a low voltage coefficient (0,000 5 %/V max), non-inductive 1,0 MW resistor, with a power rating of approximately 10 W, should be used to represent the fouling accumulated onto the spark plug. The resistor simulates spark plug fouling due to carbon or other fuel additives. This is a standard condition, but if the user deviates from this, then it is to be documented in the test procedure. Load may vary according to customer requirements.



Key

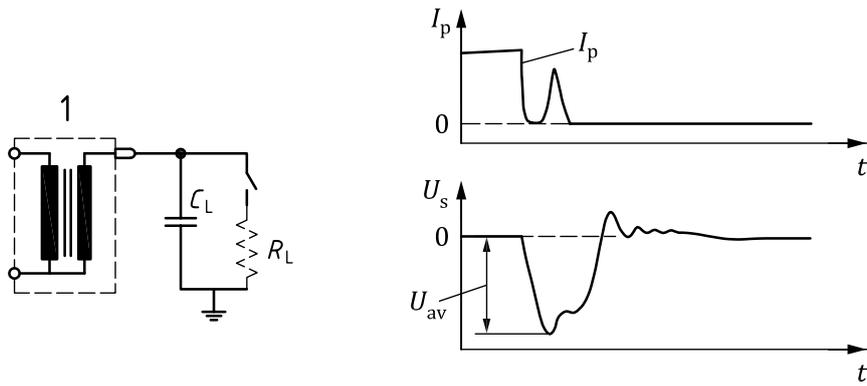
- 1 secondary output voltage
- 2 HV measurement point
- 3 800 V/1 000 V switch
- 4 5 kΩ bypass switch

Figure 1 — Representation of Zener diode string

6 Ignition parameter measurements

6.1 Available secondary (spark) voltage

The available secondary voltage is the minimum voltage at the spark plug terminal with the terminal connected to a load referenced to ground under specified conditions. This condition is usually a capacitive load representative of the engine environment around the coil and spark plug. This measurement is fundamental to spark ignition systems. Comparing available secondary voltage to the voltage that must be exceeded to fire spark plugs (in a given engine) determines the adequacy of the ignition system (see [Figure 2](#)).



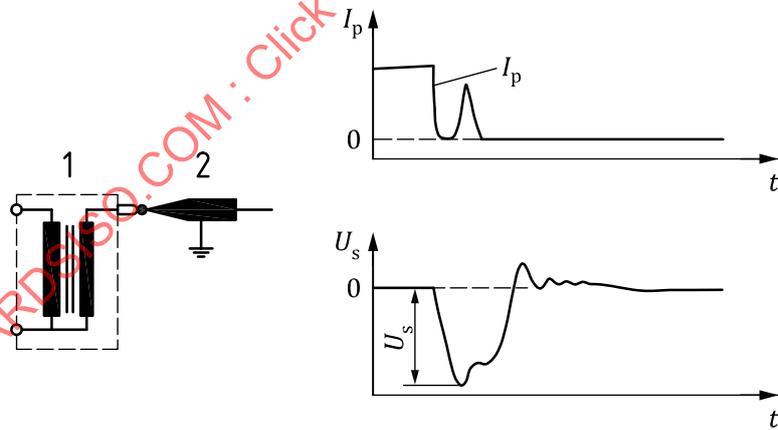
Key

- | | | | |
|----------|--|-------|------------------------------|
| 1 | ignition coil | t | time [μs (typ.)] |
| I_p | (reference) primary current [A (typ.)] | C_L | capacitive load |
| U_{av} | available voltage | R_L | resistance load |
| U_s | secondary voltage [kV (typ.)] | | |

Figure 2 — Example of secondary voltage waveform

6.2 Secondary output voltage (open circuit coil secondary voltage)

The secondary output voltage is the voltage measured at the coil output terminal without loading (see [Figure 3](#)). The coil is likely to be considered not installed or away from the installed capacitance due to the valve cover, the environment around the boot and the spark plug. A specified capacitance may also be placed from the high voltage terminal to ground to represent the installed system. This presents maximum voltage to the ignition coil and possible stress to IGBT clamping. This is due to the stress put upon the insulation around the windings and the stress to the driving element (IGBT) experiencing the reflected voltage from this event upon the collector. Typically, this voltage is measured with a very low capacitance HV probe.



Key

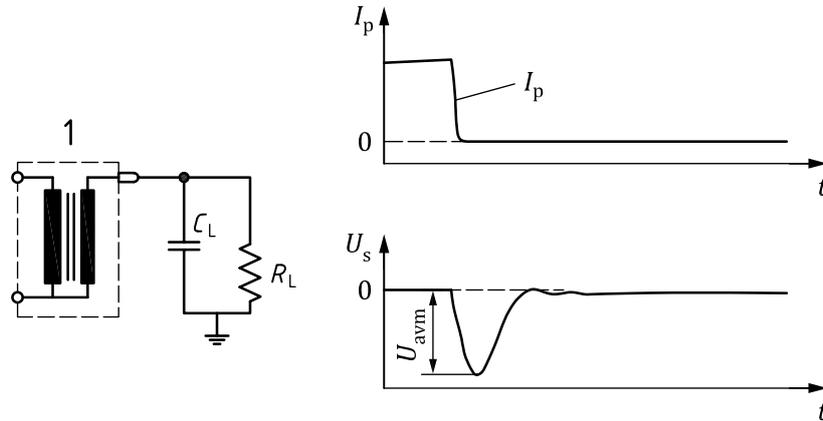
- | | | | |
|-------|----------------------------|-------|-------------------------------|
| 1 | ignition coil | t | time [μs (typ.)] |
| 2 | high voltage probe | U_s | secondary voltage [kV (typ.)] |
| I_p | primary current [A (typ.)] | | |

Figure 3 — Example of secondary voltage waveform

6.3 Minimum available voltage (loaded secondary voltage)

The minimum available voltage is the voltage measured at the spark plug terminal with a non-inductive (1 M Ω +/- 1 %, 10 W 0,000 5 %/V maximum voltage coefficient, dielectric strength that exceeds the system

voltage) load resistor connected to the cable spark plug terminal. This may also have a specified capacitance in parallel with the resistor. This is representative of available voltage when there is a severe plug fouling condition represented by [Figure 4](#). This may also be called minimum available voltage requirement.



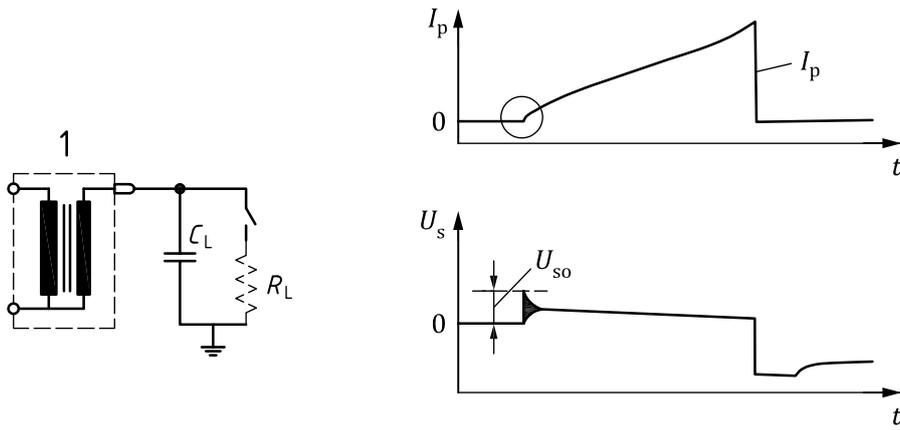
Key

1	ignition coil	t	time [μs (typ.)]
I_p	primary current [A (typ.)]	C_L	capacitive load
U_{avm}	minimum available voltage	R_L	resistance load
U_s	secondary voltage [kV (typ.)]		

Figure 4 — Example of secondary voltage waveform for a fouled spark plug with a low shunt resistance

6.4 Secondary voltage at primary current switch on (feed forward voltage)

This is the voltage induced in a secondary winding due to rate of change of the primary current at switch on (transformer effect) as shown in [Figure 5](#). This measurement occurs at the beginning of the current ramp of the primary coil. It is the voltage that appears on the secondary output as the current changes over time on the primary coil. This is most pronounced during the moment of turning on the ignitor. This turn on can produce a peak voltage that could produce a spark before it is expected. This is measured at a specified load and battery voltage condition.



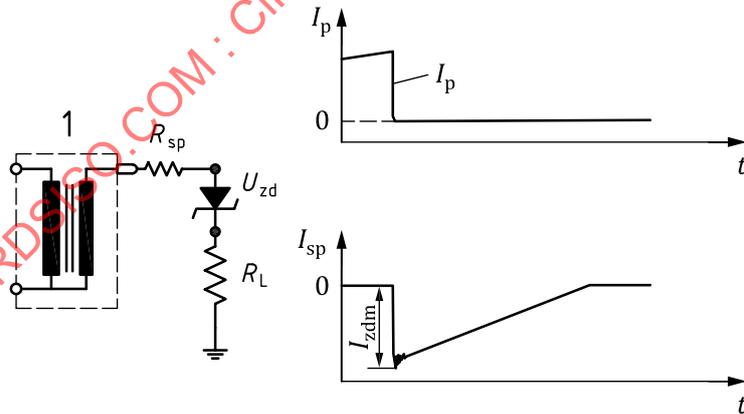
Key

- | | | | |
|----------|----------------------------|-------|------------------------------|
| 1 | ignition coil | U_s | secondary voltage [V (typ.)] |
| U_{so} | feed forward voltage | C_L | capacitive load |
| t | time [μ s (typ.)] | R_L | resistance load |
| I_p | primary current [A (typ.)] | | |

Figure 5 — Example of close-up of secondary voltage waveform illustrating voltage induced during turn on of primary current of ignition coil

6.5 Zener discharge current (peak spark current)

The Zener discharge current is the instantaneous current observed in the secondary circuit during discharge of the ignition coil passing through the spark gap electrodes during arcing (see Figure 6). This measurement describes the current flow through the electrode gap during the discharge. For an inductive ignition coil, this occurs at the beginning of discharge. The critical parameter is the peak inductive current (peak spark current) value. However, the instantaneous values over the duration of the spark event are useful in determining spark energy. This can also refer to the secondary current across a load R_L .



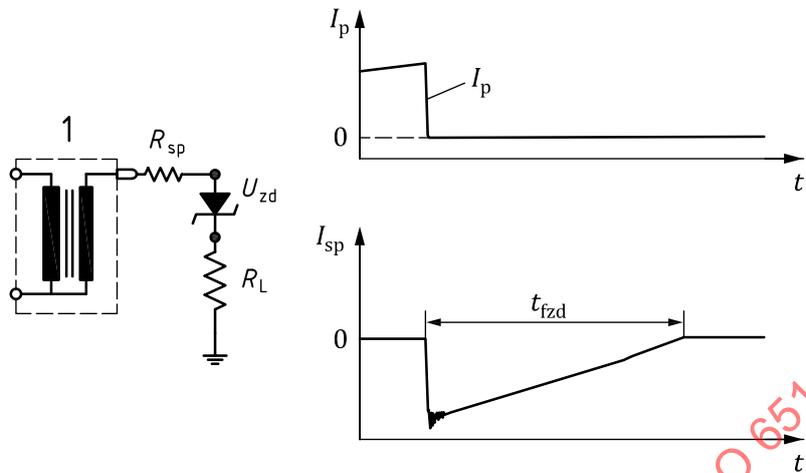
Key

- | | | | |
|-----------|----------------------------|----------|---------------------------|
| 1 | ignition coil | I_{sp} | spark current [mA (typ.)] |
| I_p | primary current [A (typ.)] | R_{sp} | spark plug resistor |
| I_{zdm} | peak spark current | R_L | resistance load |
| t | time [ms (typ.)] | U_{zd} | Zener discharge voltage |

Figure 6 — Example of secondary current waveform with a 1 000 V Zener load showing peak inductive secondary current

6.6 Zener discharge duration

The Zener discharge duration is the length of time the current is flowing in the secondary circuit during the coil discharge event under specified conditions. This measurement is indicative of the length of time when an arc is present in the electrode gap and the secondary current is non-zero (see [Figure 7](#)).



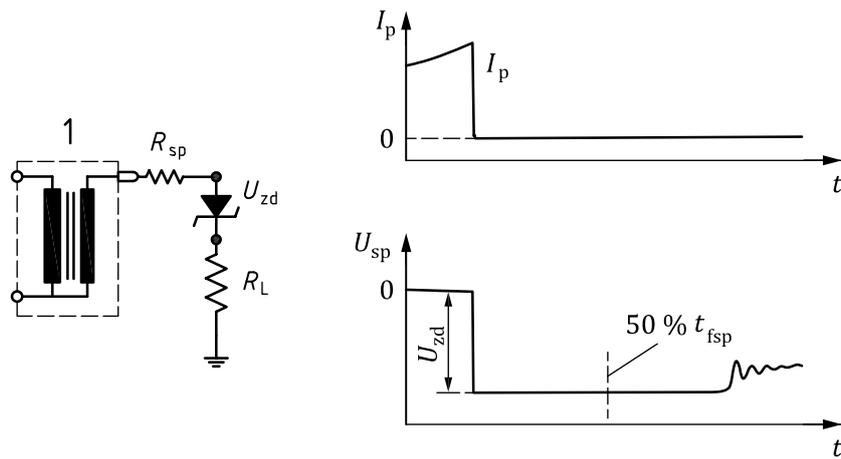
Key

- | | | | |
|-----------|-------------------------------|----------|-------------------------|
| 1 | ignition coil | t | time [ms (typ.)] |
| I_p | primary current [A (typ.)] | R_{sp} | spark plug resistor |
| t_{fzd} | Zener discharge duration time | R_L | resistance load |
| I_{sp} | spark current [mA (typ.)] | U_{zd} | Zener discharge voltage |

Figure 7 — Example of secondary current waveform with a 1 000 V Zener load showing duration of secondary current

6.7 Zener discharge voltage

This measurement is the potential difference between the HV secondary terminal and ground during coil discharge across the electrode gap during the coil discharge (see [Figure 8](#)). This value can be either positive or negative depending on the system polarity. The critical parameter of value is the peak voltage during the breakdown phase. The instantaneous values over the duration of the discharge event are useful in determining the output energy of the coil.



Key

- | | | | |
|-----------|-----------------------------|----------|----------------------------|
| 1 | ignition coil | I_p | primary current [A (typ.)] |
| t_{fsp} | time of 50 % spark duration | R_{sp} | spark plug resistor |
| U_{zd} | Zener discharge voltage | R_L | resistance load |
| U_{sp} | spark voltage [V (typ.)] | | |
| t | time [ms (typ.)] | | |

NOTE The voltage of the Zener voltage is measured at the 50 % spark duration mark.

Figure 8 — Example of secondary current waveform with a 1 000 V Zener load showing Zener voltage measurement

6.8 Zener discharge energy

This represents the measure of energy released from the coil during the discharge event (see [Figure 9](#)). The typical spark discharge is made of two components: capacitive and inductive. It is calculated as shown in [Formula \(1\)](#):

$$E_{zd} = E_b + E_{sp}$$

$$\text{where } E_b = \frac{1}{2} C_L U_{sm}^2 \text{ and } E_{sp} = \int_{t_i}^{t_f} U_S I_S dt \tag{1}$$

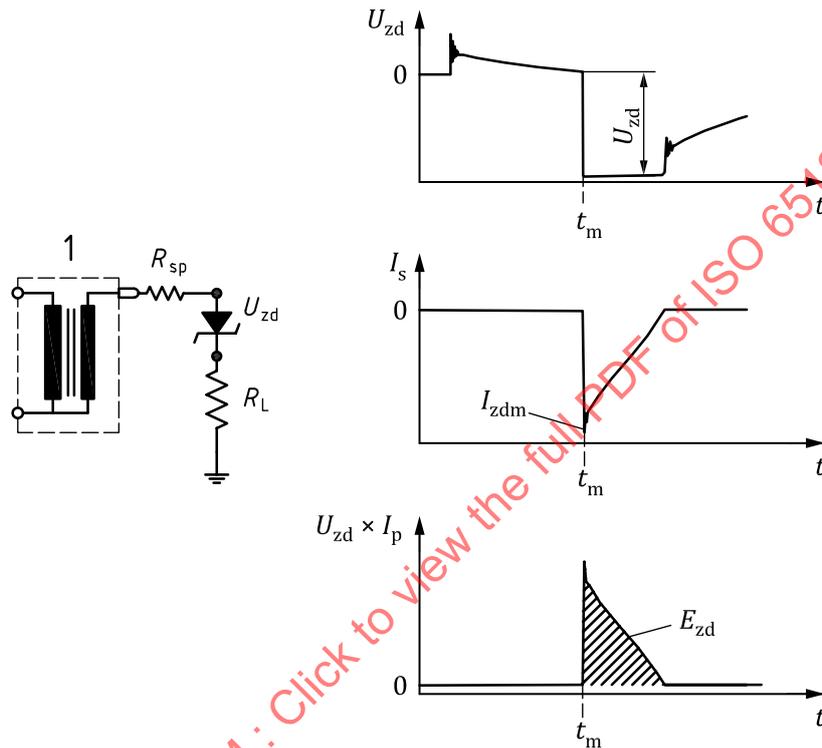
where

- E_{zd} is the Zener discharge energy;
- E_b is the secondary breakdown phase energy;
- C_L is the standard capacitive load (total secondary circuit capacitance);
- U_{sm} is the maximum secondary output voltage (peak breakdown voltage);
- E_{sp} is the secondary (inductive) discharge energy (secondary spark energy);
- t_i is the initial value of discharge time;
- t_f is the final value of discharge time;
- U_s is the secondary voltage after breakdown;
- I_s is the secondary current.

Capacitive energy is critical for a distributorless ignition system with both a firing and non-firing gap. The amount of capacitive energy dissipated is also a significant contributor to spark plug electrode wear. The inductive energy is of importance because it is the energy delivered to the spark plug gap after breakdown occurs. This parameter is important for combustion performance and spark plug wear considerations.

For bench measurements, because breakdown of the spark is condition dependent (gap size- pressure, mixture, etc.), the measurement depends on measuring only the inductive maximum energy at a voltage that is defined by a string of Zener diodes. Convenience is found by abstracting out the energy dedicated to the before arc voltage build-up (E_b).

The integration of the product of both the measured secondary voltage and current waveforms is the most accurate method to calculate this parameter.



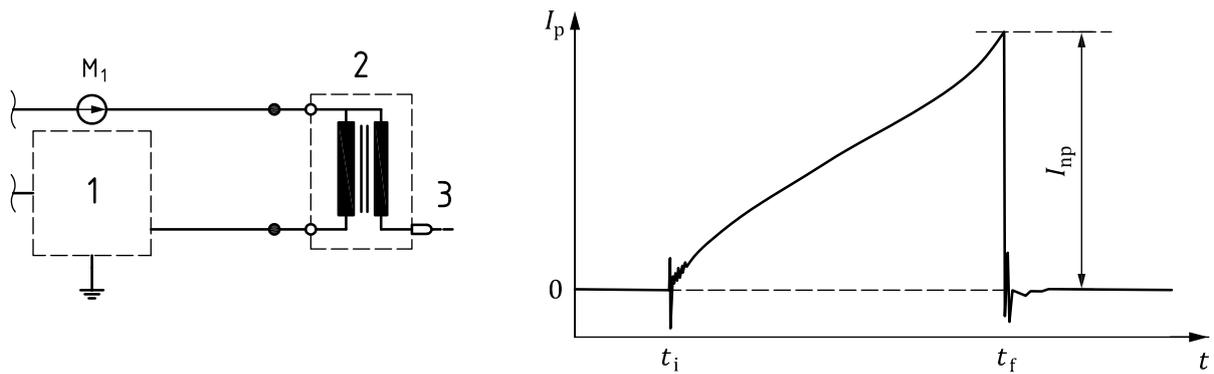
Key

- 1 ignition coil
- E_{zd} Zener discharge energy [V*mA (typ.)]
- I_{zdm} max. Zener discharge current = peak secondary current [mA (typ.)]
- R_L resistance load
- R_{sp} spark plug resistor
- t time [ms (typ.)]
- t_m point of time when discharge starts
- U_{zd} secondary Zener discharge voltage [V (typ.)]

Figure 9 — Secondary voltage, secondary current and calculated secondary power versus time for ignition system energy measurement across 1 000 V Zener load

6.9 Primary current (peak coil current)

The primary current is the peak current (see M_1) flowing through the coil primary winding under specified conditions (see [Figure 10](#)).



Key

- | | | | |
|----------|--|-------|---------------------------------|
| 1 | internal or external coil control unit (IGBT) | t | time [ms (typ.)] |
| 2 | ignition coil | t_f | final value of discharge time |
| 3 | high voltage output | t_i | initial value of discharge time |
| I_{np} | primary interruption current = peak primary current [A (typ.)] | | |

Figure 10 — Example of primary current waveform including peak coil current

6.10 Average current input

This measurement determines the average or RMS current draw of the system with respect to the DC source (alternator, generator, battery, etc.) under specified conditions, see [Formula \(2\)](#). Refer to [Figure 10](#) for a primary current waveform example.

$$I_{par} = \sqrt{\frac{1}{t_{wave}} \cdot \int_0^{t_{wave}} I_p(t)^2 \cdot dt} \quad (2)$$

where

I_{par} is the average current input;

t_{wave} is the period of the waveform;

I_p is the primary current;

t is the time.

6.11 Primary energy

This is a measure of energy that is input to the ignition coil [[Formulae \(3\)](#) and [\(4\)](#)]. This parameter is important when taking vehicle demand energy into account for fuel consumption and electrical system requirements. This value should be exclusive of the IGBT if that device is on the coil. This measurement indicates energy into the magnetic circuit per the general transformer physics equation; see [Formula \(3\)](#).

$$E_p = \frac{1}{2} L_p I_p^2 \quad (3)$$

where

E_p is the energy input to primary circuit;

L_p is the primary inductance;

I_{np} is the primary interruption current (peak primary current).

Alternatively, in practice one may use the following [Formula \(4\)](#) if the true inductance (L_p) is not known:

$$E_p = \int_{t_i}^{t_f} U_p I_p dt \quad (4)$$

where

E_p is the energy input to primary circuit;

t_i is the initial value of discharge time;

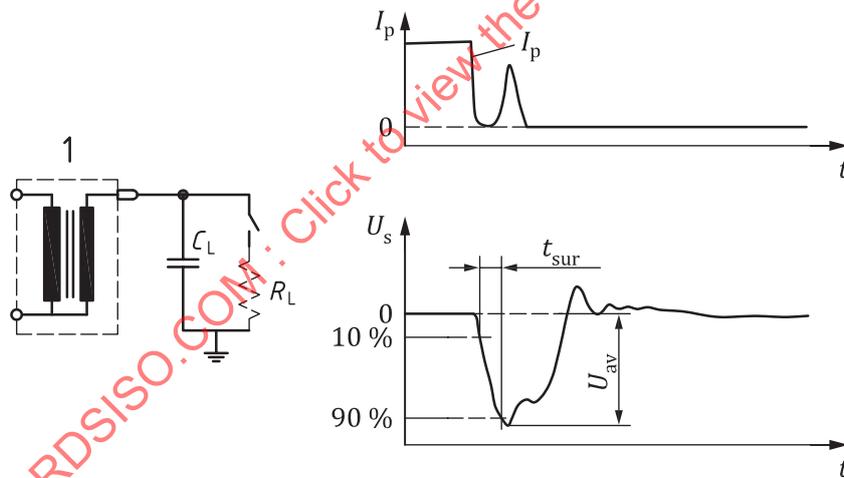
t_f is the final value of discharge time;

U_p is the primary voltage;

I_p is the primary current.

6.12 Coil secondary voltage risetime

The coil secondary voltage risetime, t_{sur} , is the time required in microseconds [μs] for the secondary available voltage, U_{av} , to rise from 10 % to 90 % (or other) of the peak voltage under specified conditions. This measurement is an indication of the ability of an ignition system to fire shunted (fouled) spark plugs. This is the time between two discrete points of available voltage as defined by the manufacturer. The shorter the risetime, the less system energy is lost across the fouled shunt and the more voltage is available to fire the plug (see [Figure 11](#)). This also can affect the measurement of dielectric strength of spark plug ceramic materials. This parameter could also be controlled to inhibit spark electrode wear and it can also be used in spark voltage diagnostics.



Key

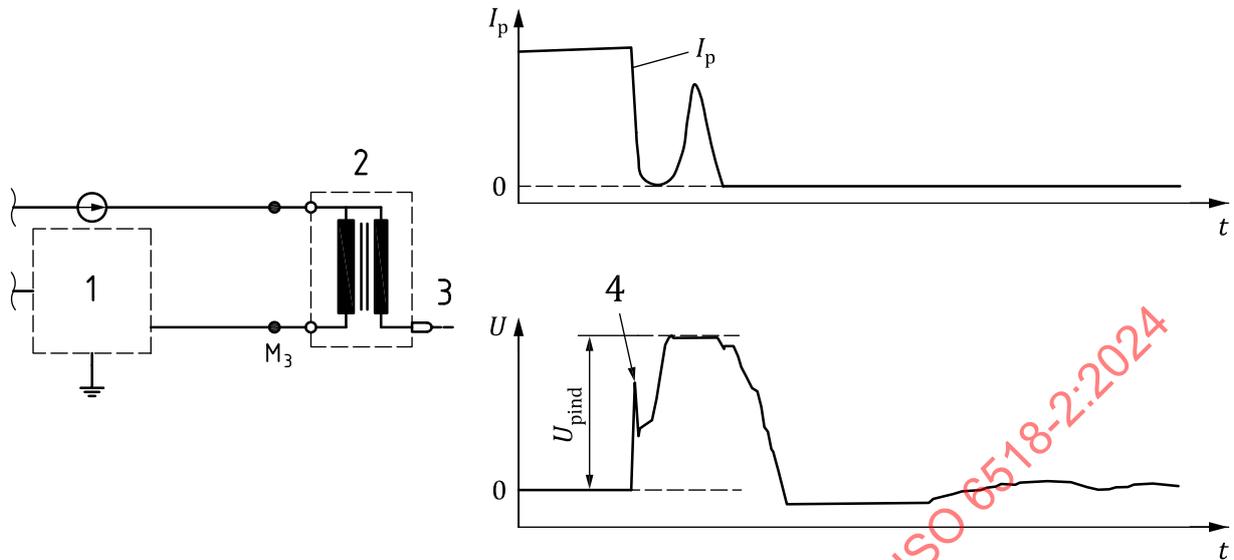
1	ignition coil	U_s	secondary voltage [kV (typ.)]
I_p	primary current [A (typ.)]	t	time [μs (typ.)]
t_{sur}	(coil) secondary voltage rise time	C_L	capacitive load
U_{av}	secondary available (spark) voltage	R_L	resistance load

Figure 11 — Example of secondary voltage waveform illustrating secondary voltage rise time for a normal spark plug with a high shunt resistance

6.13 Peak coil primary voltage

This measurement (see M_3) indicates the amount of flyback voltage produced by shutting off the primary current (see [Figure 12](#)). The voltage on the collector is a helpful indicator to determine maximum voltage on primary windings and semiconductor material in the IGBT/ignitor. Often in conventional inductive ignition

systems, the coil primary voltage begins with a voltage spike referred to as a leakage induction spike. The area under this waveform is a calculation of power dissipation, and usually the leakage spike is negligible, but can be useful for some calculations to determine effects on the switching element (IGBT).



Key

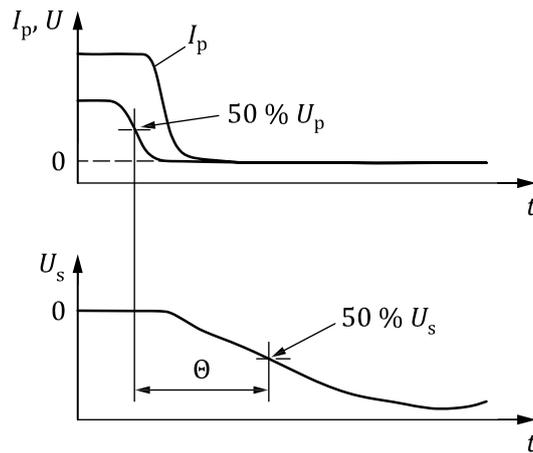
- | | | | |
|---|---|------------|------------------------------|
| 1 | internal or external coil control unit (IGBT) | U | collector voltage [V (typ.)] |
| 2 | ignition coil | t | time [μ s (typ.)] |
| 3 | high voltage output | I_p | primary current [A (typ.)] |
| 4 | leakage inductance spike | U_{pind} | peak coil primary voltage |

Figure 12 — Example of inducted collector voltage waveform

6.14 Spark timing delay (time lag/delay time)

The spark timing delay is the interval between a timing event and occurrence of a spark voltage under specified conditions (see [Figure 13](#)).

- It can be expressed in microseconds [μ s] or in engine crank angle degrees.
- It can be defined relative to timing event based upon level of primary current or signal.



Key

U	primary voltage [V (typ.)]	θ	time lag
I_p	primary current [A (typ.)]	t	time [μ s (typ.)]
U_s	secondary voltage [kV (typ.)]		

Figure 13 — Illustration of timing lag between signal and secondary voltage induced by actual spark discharge

6.15 Dwell time or dwell angle

The dwell time or dwell angle is the interval during which the primary winding of an inductive ignition coil is being charged (see [Figure 14](#)). It can be measured timewise (dwell time t_{igo}) or in rotating crank angle (dwell angle α_{igo}) as shown in [Formulae \(5\)](#) and [\(6\)](#):

$$t_{igo} = t_f - t_i \tag{5}$$

$$\alpha_{igo} = \alpha_f - \alpha_i \tag{6}$$

where

t_{igo} is the dwell time;

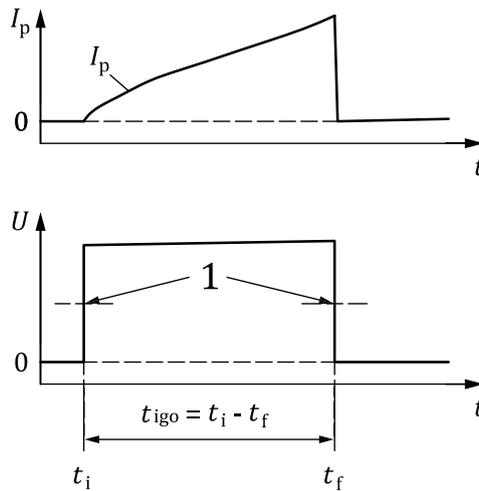
t_i is the initial time;

t_f is the final time;

α_{igo} is the dwell (crank) angle;

α_i is the initial (crank) angle;

α_f is the final (crank) angle.



Key

- | | | | |
|-------|--|------------------------------|--------------------------------|
| 1 | 50 % U_{signal} or $U_{\text{threshold}}$ | $t_{\text{igo}} = t_f - t_i$ | dwell time |
| I_p | primary current [A (typ.)] | t_i | initial time of signal voltage |
| U | signal voltage [V (typ.)] | t_f | final time of signal voltage |
| t | time [ms (typ.)] | | |

Figure 14 — Illustration of dwell time signal and actual spark discharge

7 Test equipment

7.1 Voltage probe (voltage divider)

A resistive divider or capacitive divider type voltage probe is necessary to measure the signals in the test procedures. High-impedance (Hi-Z) passive probes are the most commonly used oscilloscope probes and offer attenuation factors of 10:1 (X10) and/or 100:1 (X100). For direct secondary voltage measurements, a ratio of 1 000:1 and 10,000:1 capacitive probes with very low capacitance are utilised.

7.2 Oscilloscope

An oscilloscope for measuring voltages as defined in this document should be used to measure available primary and secondary voltages, risetimes and durations. A modern digitizing oscilloscope should be used. It is highly desirable to utilise an oscilloscope with basic measurement and mathematical functions that can support the measurements suggested in this document. The requirements for ignition testing are not typically easily handled by many commonly available oscilloscopes. The oscilloscope should have an adequate bandwidth in order not to filter out important characteristics of the signals and appropriate sampling time to resolve the fast edges of the signals containing higher frequency components. Commonly recommended sampling rate is ≥ 1 MS/s.

Because of the wide dynamic range of the measurements, be sure to choose an oscilloscope that can measure the signals with an appropriate vertical resolution to avoid large quantization error. Commonly recommended vertical resolutions for the typical bandwidths utilised for this testing is ≥ 12 bits. The OEM should recommend specific characteristics if applicable.

7.3 Current probe

A good current probe of the hall effect or transformer type is particularly effective in measuring the primary current. Typically, this is an active probe with adequate bandwidth to cover the minimum sampling requirement. Commonly this bandwidth ranges from 10 MHz to 30 MHz minimum.

7.4 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 μ s over the load range encountered in use. It shall have no more than 10 mV variation in average voltage from no load to full ignition system load and no more than 50 mV peak-to-peak ripple over the same load range. This power supply shall be shunted by a suitably tapped automotive-type lead acid battery and be positioned immediately adjacent to the test area so that the source impedance of a vehicle is simulated as closely as possible.

7.5 Signal generator (arbitrary waveform generator)

A signal generator is used to switch the coil's IGBT or switching circuit on and off to produce current flow through the coil. The signal generator should have adjustable voltage output, frequency and duty cycle (pulse width % is not ideal). The source voltage and impedance should mimic the actual ECU circuit accurately enough to determine proper switching thresholds and signal rise/fall rates.

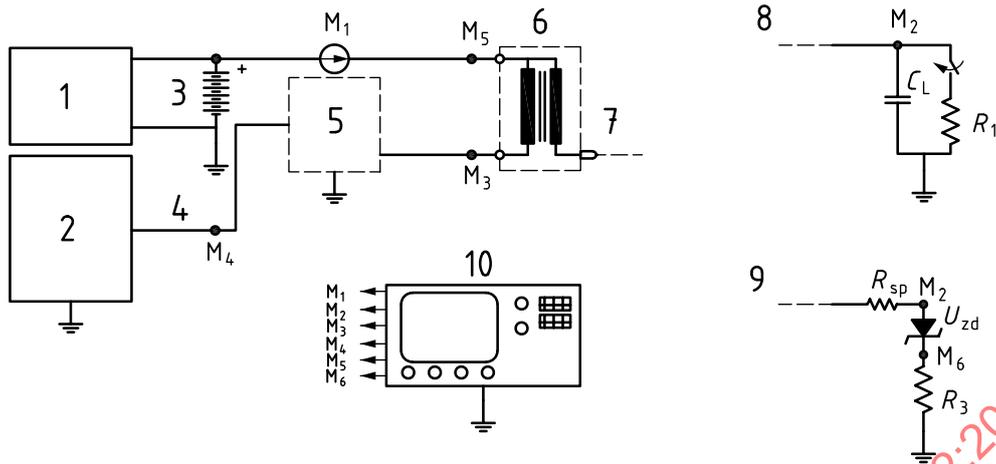
7.6 Secondary loading

The capacitance and resistance shall be able to withstand the full voltage output of the coil without allowing arcing between the ends of the capacitor (and resistors-if applicable) or breakdown occurring either through the dielectric material (punch through) or through the ionized air around the unit (flashover). Often the devices have several inches of distance between the applied high voltage end and any surface that the spark may be able to arc to during operation of the coil. Capacitance can be a single adjustable unit or values put in series to accommodate the voltage without breakdown.

7.7 Test bench setup

[Figure 15](#) shows a typical bench diagram. The connectivity functionally represents the coil in a vehicle system.

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Key

- | | | | |
|-------|--|----------|--|
| 1 | DC power supply | R_{sp} | 5 k Ω , optional (spark plug representative resistance) |
| 2 | waveform generator
(electronic spark timing [EST] signal) | C_L | capacitive load (carefully to be controlled) |
| 3 | automotive battery | R_3 | 100 Ω , 0,5 W non-inductive resistor |
| 4 | EST control/trigger | U_{zd} | Zener diodes voltage (in series to 1 000 V \pm 5 %) |
| 5 | internal or external coil control (IGBT) | M_1 | primary current measuring |
| 6 | ignition coil | M_2 | secondary voltage measuring |
| 7 | high voltage output | M_3 | collector voltage measuring |
| 8 | capacitance/fouling loading | M_4 | EST signal voltage measuring |
| 9 | Zener loading | M_5 | battery voltage measuring |
| 10 | oscilloscope | M_6 | Zener voltage measuring |
| R_1 | resistive load in parallel | | |

NOTE All measurements need not to be concurrent.

Figure 15 — Test circuit arrangement for all tests

The coil control unit should be representative of the manufacturer intent control unit and can be controlled by an external oscillator/waveform generator.

8 Test procedures for ignition system parameter measurements

8.1 General comments

Measurements shall be stabilized at defined conditions (e.g. temperature, battery voltage, wiring harness resistance consistent with usage or manufacturer's recommendations). The connection is made to the capacitance/fouling loading in a fixture that securely holds the coil. Probes from the measurement oscilloscope shall be secured to the measurement apparatus, being mindful of any grounds or capacitive structures that are near the HV output of the coil. Measurements at high voltages are sensitive to the area surrounding the conductors carrying the high voltage charge. Having a long or large conductor increases the opportunity of parasitic capacitance that will skew the voltage measurements. Likewise, extra parasitic inductances can affect the energy measurements, but to a lesser extent. Skilful measurement of the system load capacitance can be achieved to ensure all contributing parasitic losses are minimized.

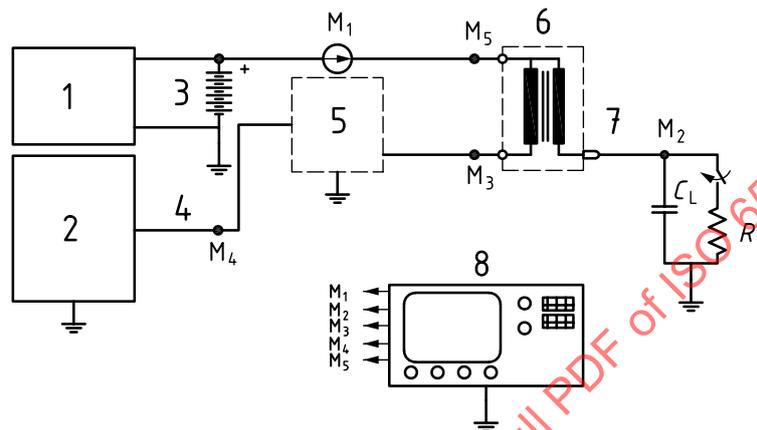
NOTE Spark gaps have been eliminated from these tests, as the waveform irregularities they introduce add no value to the results and make stabilized patterns on the oscilloscope difficult to achieve.

8.2 Secondary voltage measurements

Figure 16 shall be used as a reference for the secondary voltage measurements.

For use for the following measurements:

- 6.1 available secondary (spark) voltage
- 6.2 secondary output voltage
- 6.3 minimum available voltage
- 6.4 secondary voltage at primary current switch on (feed forward voltage)



Key

- | | | | |
|---|--|-------|--|
| 1 | DC power supply | R_1 | resistive load in parallel |
| 2 | waveform generator
(electronic spark timing [EST] signal) | C_L | capacitive load (carefully controlled) |
| 3 | automotive battery | M_1 | primary current measuring |
| 4 | EST control/trigger | M_2 | secondary voltage measuring |
| 5 | internal or external coil control (IGBT) | M_3 | collector voltage measuring |
| 6 | ignition coil | M_4 | EST signal voltage measuring |
| 7 | high voltage output | M_5 | battery voltage measuring probe |
| 8 | oscilloscope | | |

Figure 16 — Secondary voltage measurement setup diagram with capacitance/fouling loading

Procedural notes:

- a) Place the ignition coil to be tested in the circuit shown in Figure 16.
- b) Connect the coil to the driving circuitry portrayed on the left side of Figure 16.
- c) Normally a harness carrying the power and the signals to the coil has the appropriate resistance, this should be carefully considered for measurements relating to timing. Typically, the harness resistance for battery voltage and ground has a small loop resistance of (100-200) m Ω .
- d) Set up the oscilloscope with the appropriate timescale and vertical resolution for each probe. The minimum resolution should be in the range of 1 MS/s. It should be triggered upon a meaningful reference signal (choose the sharp edge of the signal [M_4] or falling edge of the primary current [M_1]). The measurement functions should be set up and gated on each channel to obtain the relevant measurements.
- e) Adjust the coil inputs (power supply and waveform generator according to conditions recommended by manufacturer) so that the primary break current is at the manufacturer's recommended coil