INTERNATIONAL STANDARD

ISO 6518-2

Second edition
1995-04-01

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

Reference number
ISO 6518-2:1995(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 6518-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 1, *Ignition equipment*.

This second edition cancels and replaces the first edition (ISO 6518-2:1982), which has been changed as follows:

— introduction of test methods A (spark gaps) and B (Zener diode string);

— detailed revision of the clauses on test equipment, measured parameters and test procedures.

ISO 6518 consists of the following parts, under the general title *Road vehicles — Ignition systems*:

— *Part 1: Vocabulary*

— *Part 2: Electrical performance and function test methods*

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Road vehicles — Ignition systems —

Part 2:
Electrical performance and function test methods

1 Scope

This part of ISO 6518 specifies the methods and test conditions for testing battery-supplied ignition systems for spark-ignited internal combustion engines.

Because of the difficulties in producing repeatable measurements with atmospheric spark gaps and different observers, two methods of obtaining the results necessary for calculating the system output energy are given.

Method A — using spark gaps for the energy measurement (test arrangement A).

The output energy obtained by this method is called spark energy, E_{sp}.

Method B — using a Zener diode string for the energy measurement (test arrangement B).

The output energy obtained by this method is called Zener discharge energy, E_{zd}.

This method is not suitable for systems giving alternating spark current.

Method B is also recommended for the comparative testing of ignition coils and current interruption systems.

2 Ignition system description

For the tests described in the following subclauses, the ignition system components used shall be as specified for the application being examined, i.e. to the original equipment specification.

2.1 Ignition system with mechanical distributor

The following components shall be interconnected as shown in figure 1 or in any other circuit which has been proved to be equivalent.

2.1.1 Single-ended coil which can be the conventional induction coil or an air or magnetic core transformer.

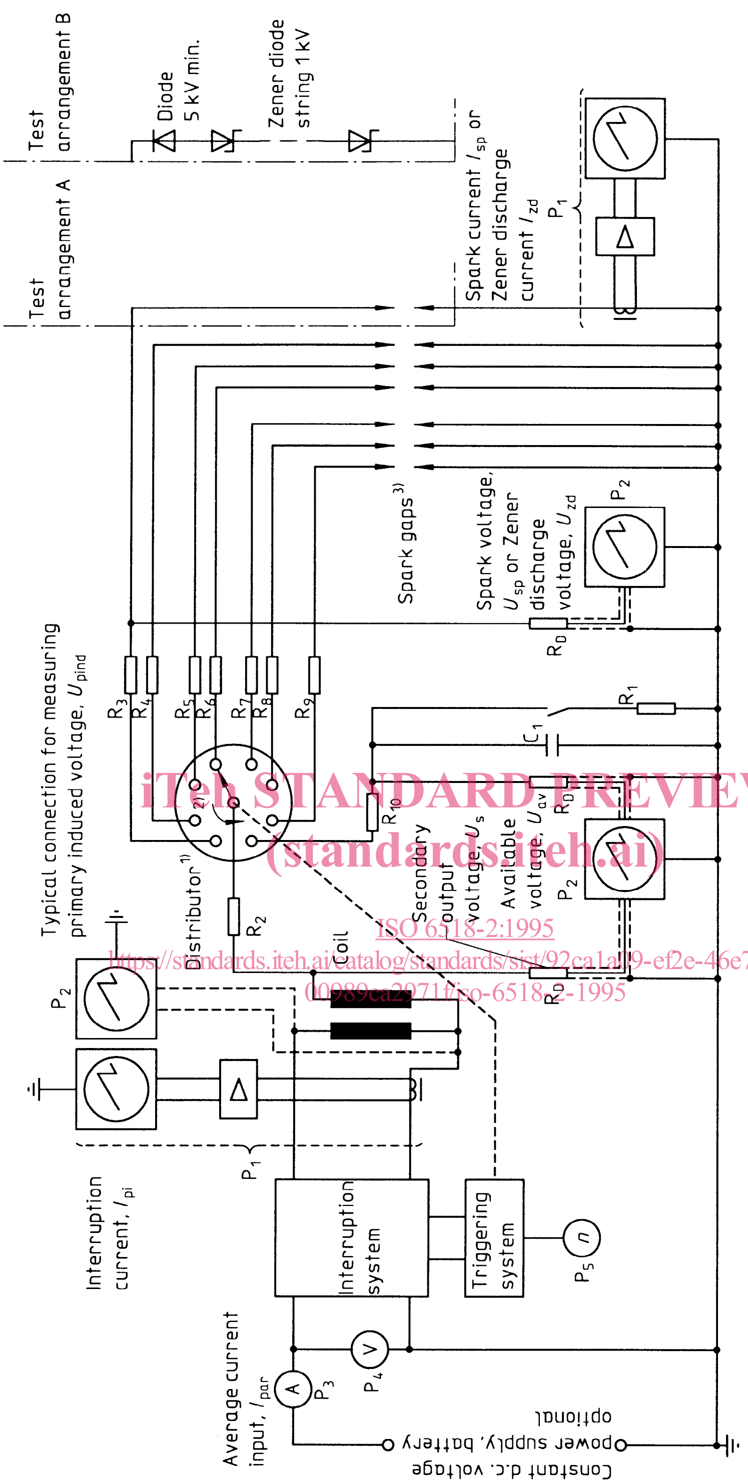
2.1.2 Coil ballast resistor or resistors, if the coil being tested requires a ballast resistor, or any fixed or variable means to make the voltage and/or the current in the ignition circuit vary.

2.1.3 Distributor 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 to the engine.

2.1.4 Auxiliary switching device implicit with the system being tested such as a transistorized control unit.

2.2 Static (distributorless) ignition system with single-ended coils

The following components shall be interconnected as shown in figure 2 or in any other circuit which has been proved to be equivalent.



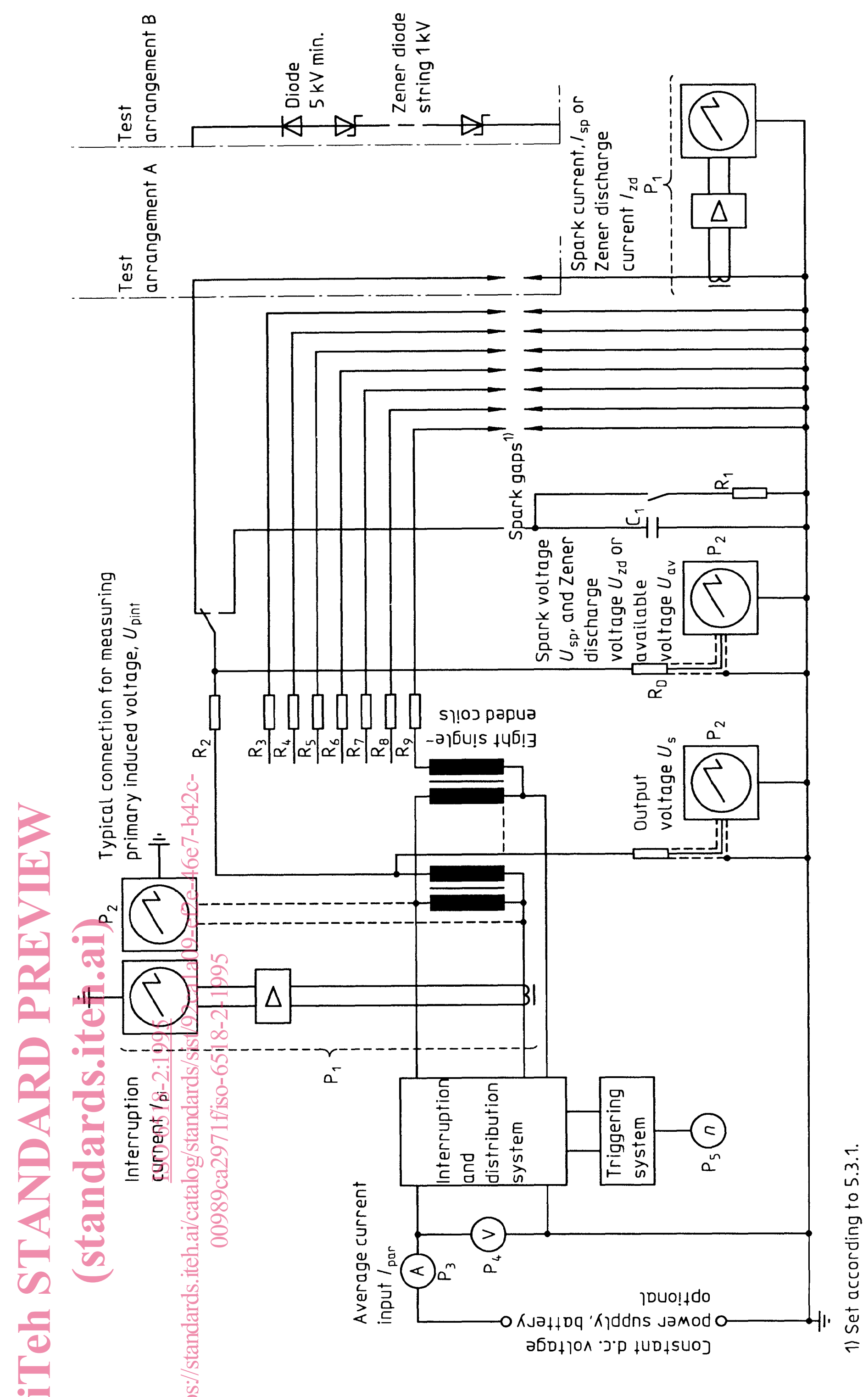
1) The distance between rotor electrode and cap electrode shall be maintained constant during spark duration or as agreed between user and supplier.
2) The arrow shows the sequence of the sparks.
3) Set according to 5.3.1.

Key

P_1 = current probe, amplifier and oscilloscope	C_1 = load capacity
P_2 = voltage-measuring oscilloscope	R_1 = load resistor
P_3 = d.c. ammeter	R_2 to R_{10} = suppression impedances (the current and resistance of which are fixed by agreement between the manufacturer and the user)
P_4 = d.c. voltmeter	
P_5 = tachometer	R_D = voltage probe

NOTE — An example of an eight-cylinder system is shown

Figure 1 — Test circuit for ignition systems with mechanical distributor



Key

P1 = current probe, amplifier and oscilloscope
P2 = voltage-measuring oscilloscope
P3 = d.c. ammeter
P4 = d.c. voltmeter
P5 = tachometer (crankshaft rotational frequency signal)
NOTE — An example of an eight-cylinder system is shown

C1 = load capacity
R1 = load resistor
R2 to R9 = suppression impedances (the current and resistance of which are fixed by agreement between the manufacturer and the user)
RD = voltage probe

Figure 2 — Test circuit for static ignition systems with single-ended coils

2.2.1 Coils which, depending on the system tested, may be

— single-ended coils as described in 2.1.1, or

— a multiple high-tension terminal assembly formed by single-ended coils, or

— plug-top coils.

2.2.2 Auxiliary switching device implicit with the system being tested such as a transistorized control unit.

2.3 Static (distributorless) ignition system with double-ended coil(s)

The following components shall be interconnected as shown in figure 3 or in any other circuit which has been proved to be equivalent.

2.3.1 Coils which, depending on the system tested, may be

— double-ended coils, or

— a multiple high-tension terminal assembly formed by double-ended coils.

2.3.2 Auxiliary switching device implicit with the system being tested such as a transistorized control unit.

3 Test equipment

3.1 Variable d.c. 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 with or without a charging system. The power supply shall be positioned immediately adjacent to the system being tested.

3.2 Oscilloscope with a maximum rise time of 35 ns, with a minimum band pass of 10 MHz, shall be used (P_1 and P_2). The overall uncertainty of measurement including voltage and current probes (see 3.3 and 3.4) shall be less than 3 %.

3.3 Voltage probe (R_D) with an input capacitance smaller than or equal to 5 pF and an input resistance of 100 MΩ or greater.

3.4 Current probe (P_1) suitable for d.c. to 10 MHz.

3.5 d.c. ammeter (P_3) with a maximum voltage drop of 100 mV under test conditions.

3.6 Voltmeter (P_4) with an input resistance of at least 10 kΩ/V and with sufficient resolution to indicate differences of 10 mV easily.

3.7 Distributor or **trigger wheel drive stand** and attached **tachometer** (P_5) conforming to the following:

a) a continuously variable rotational frequency adjustment, capable of being varied between 10 min^{-1} and 4 000 min^{-1} for a distributor drive stand and between 20 min^{-1} and at least 6 000 min^{-1} for a trigger wheel drive stand;

b) the rotational frequency shall be within ± 5 % below 400 min^{-1} and ± 20 min^{-1} above 400 min^{-1};

c) a tachometer accurate to within ± 0,2 % of indicated rotational frequency.

3.8 Loads shall be connected to the ignition system by high-voltage, non-resistive metal conductor ignition cables. The length depends on the capacitive load (see 3.8.2).

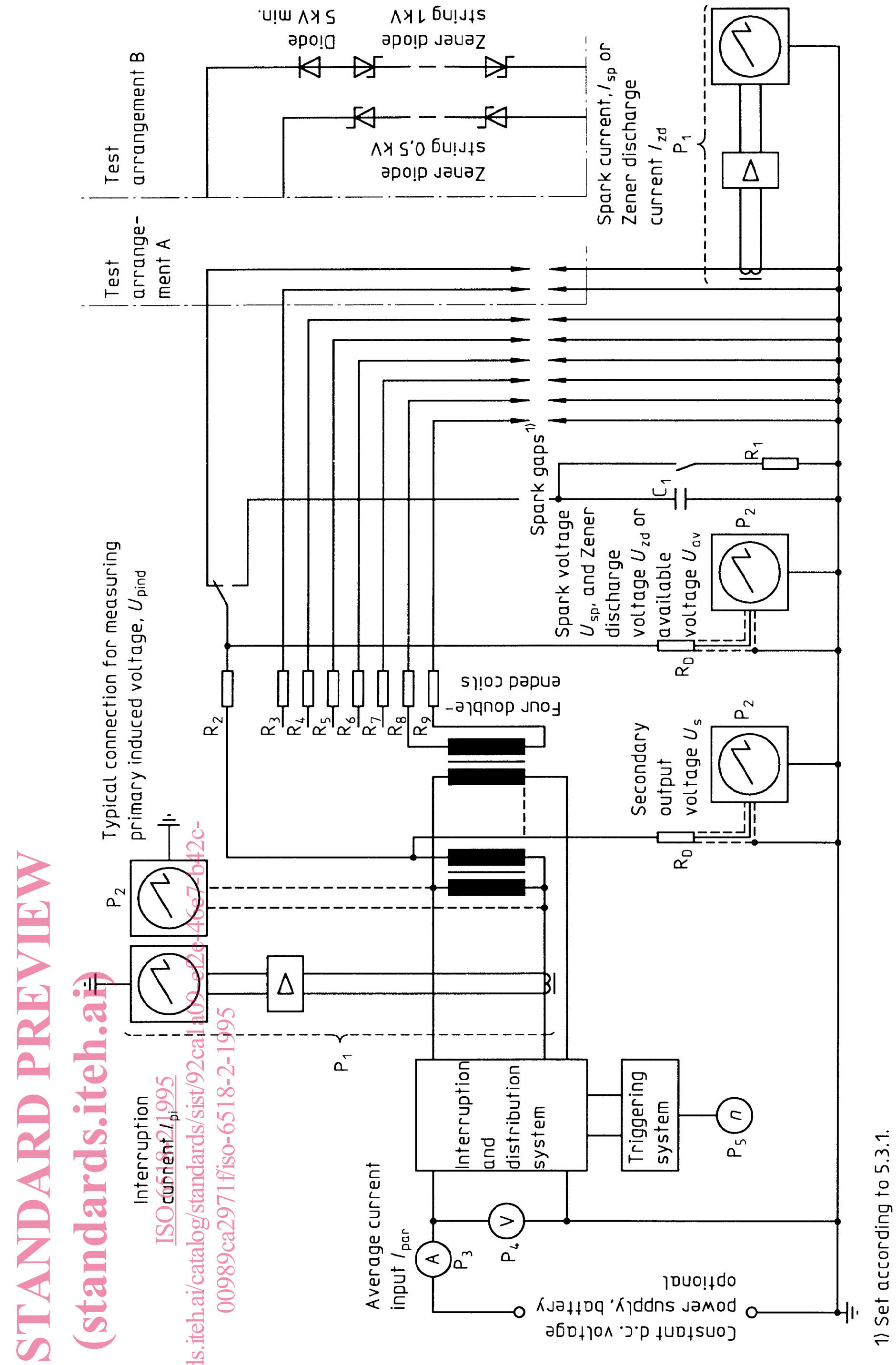
3.8.1 Multi-point spark gap stand, each gap being individually variable (see figure 5).

3.8.2 The **capacitance** C_1 simulates the capacitance of the cables and spark-plugs as normally encountered on the engine. This capacitance shall be a low dissipation factor (not greater than 3 % at 1 kHz) secondary ignition cable of a length such that, in conjunction with the capacitor and high-tension probe, the total capacitance is

50 pF to 55 pF for ignition systems with distributor;

25 pF to 30 pF for static ignition system with single-ended coils;

50 pF to 55 pF for static ignition systems with double-ended coils.



Key

P_1 = current probe, amplifier and oscilloscope
P_2 = voltage-measuring oscilloscope
P_3 = d.c. ammeter
P_4 = d.c. voltmeter
P_5 = tachometer (crankshaft rotational frequency signal)
C_1 = load capacity
R_1 = load resistor
R_2 to R_9 = suppression impedances (the current and resistance of which are fixed by agreement between the manufacturer and the user)
R_D = voltage probe

NOTES

1 For double-ended coils, secondary outlets shall be tested at high voltage.

2 An example of an eight-cylinder system is shown.

Figure 3 — Test circuit for static ignition systems with double-ended coils

To measure the total capacitance, the distributor spark gaps, and the impedances R_2 to R_{10} if lumped resistors, shall be shunted and the ignition cable shall be removed from the ignition coil.

NOTES

1 It may be necessary to consider the effect of parasitic capacitances.

2 Other values of capacitance may be agreed upon depending on the application.

3.8.3 The **resistor** R_1 simulates lead or carbon fouled spark-plugs. This resistor shall have a low voltage coefficient (maximum 0,000 5 %/V), non-inductive, approximately 10 W and 1 MΩ ± 5 %. It shall be connected in parallel to the capacitance for some measurements.

3.8.4 A **Zener diode string** of 1 kV for single-ended coils and **two Zener diode strings** of 1 kV and 0,5 kV for double-ended coils (see figure 3), each with a Zener voltage tolerance of ± 5 % under test conditions.

4 Parameters to be measured or determined

4.1 Available voltage, U_{av}

Comparing the available voltage, U_{av}, to the voltage required, U_{spc}, to fire spark-plugs in a given engine determine the adequacy of the ignition system [see figure 4 a)]. It shall be measured when the system is loaded with the capacitance C_1 described in 3.8.2.

4.2 Minimum available voltage, U_{avm}

The minimum available voltage[1)], U_{avm}, shall be measured when the system is loaded with the capacitance C_1 and the resistor R_1 connected in parallel. The minimum amplitude shall be recorded. This represents the level which can be guaranteed from the system being tested at an ambient temperature of 23 °C ± 5 °C, a trigger wheel rotational frequency of 2 000 min^{-1} and a supply voltage of 13,5 V.

4.3 Secondary output voltage, U_s

The secondary output voltage, U_s, may also be measured for comparison with values obtained for available voltage, U_{av}.

4.4 Interruption current, I_{pi}

The interruption current[1)], I_{pi}, determines the energy into the system [see figure 4 c)].

4.5 Average current input, I_{par}

The average current input, I_{par}, determines the average current draw of the system with respect to the d.c. source (alternator, generator, battery, etc.).

4.6 Energy

4.6.1 Inductive spark energy, E_{spi}

The inductive spark energy[2)], E_{spi}, is determined by test method A (see 5.3.1). It is calculated from the integration of the product of the measured values of spark voltage, U_{sp} [adjusted to U_e: see figure 4 f)] and spark current I_{sp} over the spark duration t_{fsp} [see figure 4 f)].

$$E_{spi} = \int_{t_e}^{t_f} U_{sp} \times I_{sp} \, dt_{fsp}$$

4.6.2 Zener discharge energy, E_{zd}

The Zener discharge energy, E_{zd}, is determined by test method B. It is calculated from the integration of the measured values of the product of Zener discharge voltage U_{zd} and Zener discharge current I_{zd} over the Zener discharge duration t_{fzd} [see figure 4 g)].

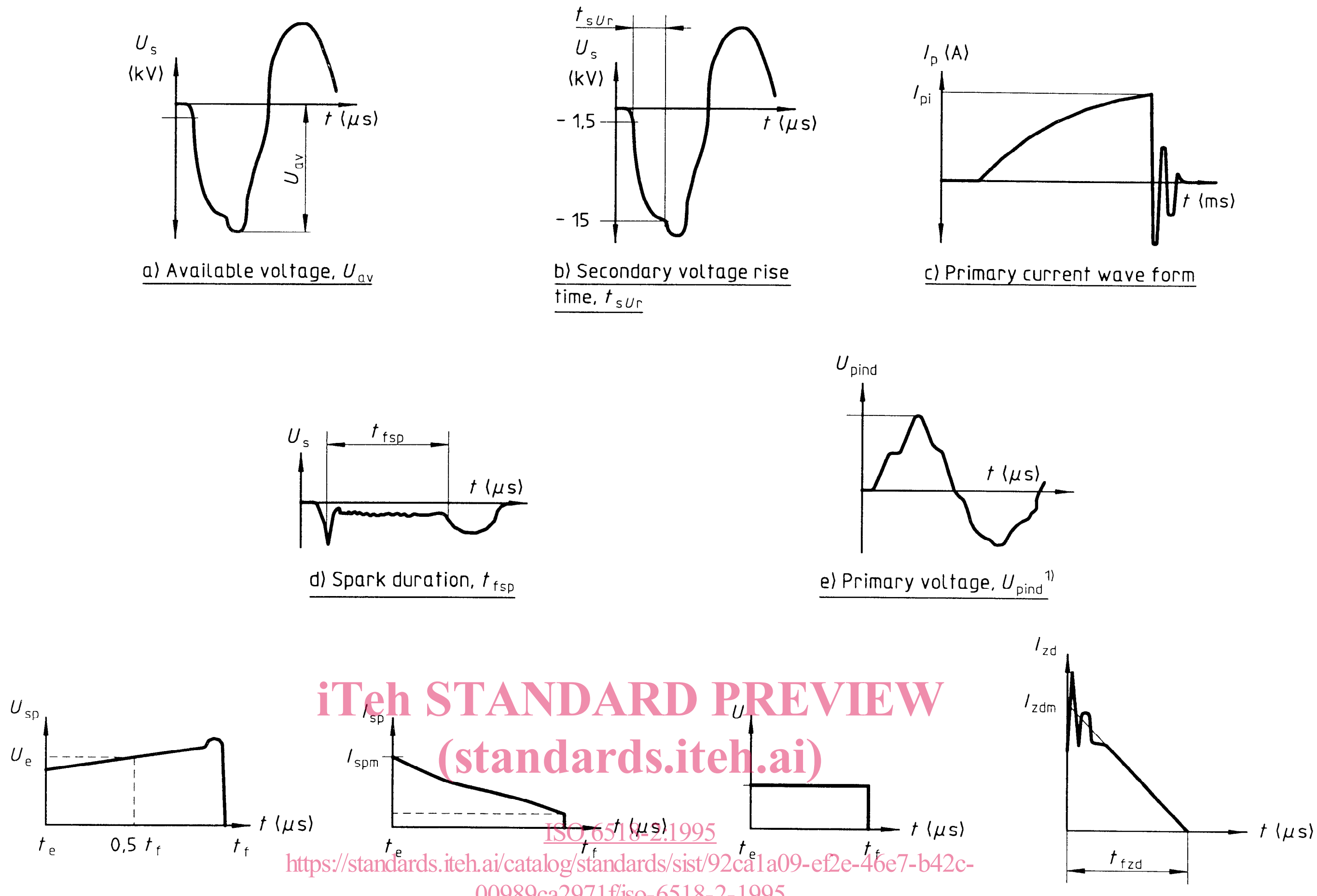
$$E_{zd} = \int_{t_e}^{t_f} U_{zd} \times I_{zd} \, dt_{fzd}$$

4.6.3 Spark duration or Zener discharge duration

This duration within limits is indicative of the igniting capability of the ignition coil output under marginal fuel conditions[2)] [see figures 4 d), f) and g)].

1) This measurement does not apply to capacitor discharge ignition systems.

2) This is an indication of the amount of electrically caused erosion which will occur on spark-plug electrodes. Experience is required to use this information effectively.



a) Available voltage, U_{av}

b) Secondary voltage rise time, t_{sUr}

c) Primary current wave form

d) Spark duration, t_{fsp}

e) Primary voltage, U_{pind}[1)]

f) Spark voltage U_{sp}, spark current I_{sp}, and spark duration t_{fsp}

g) Zener discharge voltage U_{zd}, Zener discharge current I_{zd} and Zener discharge duration t_{fzd}

1) The wave form shown occurs in ingnition systems with contact breaker.

Figure 4 — Examples of measurements performed on ignition systems

4.6.4 Maximum spark current, I_{spm}, or maximum Zener discharge current, I_{zdm}

The maximum spark current[1)], I_{spm}, or maximum Zener discharge current is the instantaneous current from the secondary winding of the ignition coil flowing through the spark gap after breakdown[2)] [see figure 4 f)] or through the Zener diodes [see figure 4 g)].

It shall be measured when the system is loaded with the capacitance C_1 described in 3.8.2 and the resistor R_1 described in 3.8.3.

To facilitate comparison between systems, the secondary voltage rise time shall be determined between − 1,5 kV and − 15 kV, to be repeated between + 1,5 kV and + 15 kV for double-ended coils or as agreed between user and manufacturer.

4.7 Secondary voltage rise time, t_{sUr}

The secondary voltage rise time, t_{sUr}, is an indication of the ability of an ignition system to fire shunted (fouled) spark-plugs. The shorter the secondary voltage rise time, the less system energy is lost across the fouled shunt and more voltage is available to fire the spark-plug [see figure 4 b)].

4.8 Coil primary induced voltage, U_{pind}

The coil primary induced voltage[1)], U_{pind}, is useful with respect to contact breaker life in classic ignition systems and is an indication of the stress on a semiconductor power switch (unless voltage clamping is used) in inductive energy storage ignition systems [see figure 4 e)]. If it shall be measured, it may be necessary