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Ignition System Nomenclature and Terminology

1. ***Scope—***To provide standard terminology and definitions with regard to ignition systems for spark-ignited internal combustion engines.

2. ***References***

2.1 **Applicable Publication—**The following publication forms a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J973—Ignition System Measurement Procedure

3. ***Types of Ignition Systems***

3.1 **Electronic—**A system in which the coil current is controlled by semiconductors. The semiconductors can be controlled by mechanical breaker points or other means.

3.2 **Breakerless—**A system like 3.1 except the semiconductors are controlled by means other than mechanical breaker points.

3.3 **Distributorless (Static Distribution System)—**A system that omits the rotating mechanical spark voltage distributor.

3.3.1 COIL-ON-PLUG—A distributorless system that omits ignition cables and utilizes one single-ended coil for each spark plug.

3.4 **Magneto—**A system that utilizes a permanent magnet on a rotating part of the engine to generate energy. It may be conventional (3.5.1), electronic (3.1), breakerless (3.2), or distributorless (3.3).

3.5 **Inductive—**A system that stores primary energy in a coil (inductor). (The energy can be discharged into a coil by mechanical breaker points, semiconductors, or other means.)

3.5.1 CONVENTIONAL (KETTERING)—A system that consists of a coil, rotating mechanical spark voltage distributor, battery, and mechanical breaker points to control coil current.

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3.6 Capacitor Discharge (C.D.)—A system that stores primary energy in a capacitor.

NOTE—As an example, an ignition system could be an electronic, breakerless, distributorless system; and such a system is generally either inductive or capacitor discharge although hybrid systems are known to exist. (The energy can be discharged into a coil by mechanical breaker points, semiconductors, or other means.)

4. Parameters

4.1 Available Secondary (Spark) Voltage—The minimum voltage at the spark plug terminal with the terminal open-circuited and insulated from ground. Voltage to be measured under specified conditions.

4.2 Required Secondary (Spark) Voltage—The maximum voltage required at the spark plug terminal to break down the spark plug gap. Voltage to be measured under specified conditions.

Voltage should be measured under full load (wide-open throttle) and a variety of part-load conditions, transients and cold.

4.3 Ignition Voltage Reserve—The difference between the available and required secondary (spark) voltages.

An adequate reserve is necessary for the ignition system to tolerate moisture, corona of the ignition cable, partially fouled spark plugs, etc.

4.4 Open-Circuit Coil Secondary Voltage—The voltage measured at the coil output terminal with secondary cable disconnected.

4.5 Loaded Secondary Voltage—The voltage measured at the spark plug terminal with the secondary cable disconnected from the spark plug and a noninductive (1 M Ω ± 1%, 10 W 0.0005%/V maximum voltage coefficient, dielectric strength that exceeds the system voltage) load resistor connected to the cable spark plug terminal.

4.5.1 SECONDARY VOLTAGE AT PRIMARY CURRENT SWITCH ON—Voltage which is induced in secondary winding due to rate of change of primary current at switch on.

4.6 Supply Voltage—The direct current (DC) voltage at the input terminals of the ignition system, under specified conditions.

4.7 Peak Coil Primary Voltage—The peak of the first half-cycle of the voltage at the coil primary terminals after discharge of the ignition.

4.8 Arc Voltage—The instantaneous voltage observed across the spark-gap during arcing.

4.9 Spark Current—The instantaneous current observed passing through the spark-gap electrodes during arcing.

4.10 Spark Energy—The energy dissipated between the spark-gap electrodes as determined by the integral of the product of spark voltage and spark current during current flow.

4.10.1 SPARK ENERGY—Optional method (see SAE J973).

4.11 Spark Duration—The length of time a spark is established across a spark-gap (in the spark-gap) as established by the time of current flow in the spark-gap under specified conditions.

4.12 Rise-Time—The time required (microseconds) for the secondary available voltage to rise from 10 to 90% of the peak voltage under specified conditions.

4.12.1 RISE-TIME GRADIENT—10 to 90% kV divided by the rise-time in microseconds (volts-per-microsecond).

4.13 Minimum Operating Specified Speed (Cut-in)—The minimum engine speed at which the ignition system distributes a specified spark voltage, conditions of test to be specified.

4.14 Average Supply Current—The DC input current to an ignition system, under specified conditions.

4.15 Peak Coil Current—The peak current flowing through the coil primary winding under specified conditions.

4.16 Coil Interruption Current—The peak current flowing through the coil primary winding at the time of interruption.

4.17 Timing Lag—The interval between the timing event and occurrence of a 12 kV spark under specified conditions. (Usually expressed in engine degrees per 1000 engine RPM.)

4.18 Energizing Interval (Dwell Time or Dwell Angle)—The interval during which the capacitor (CD ignition) is being charged or the coil current (inductive ignition) is flowing.

4.19 Ignition Coil—A transformer with an air or magnetic core used to step-up a low primary voltage to a high secondary voltage.

4.19.1 SINGLE-ENDED IGNITION COIL—An ignition coil with a single output secondary winding.

4.19.2 DOUBLE-ENDED IGNITION COIL—An ignition coil with one secondary winding that has a high-tension terminal at each end of the winding.

4.19.3 GROUND SPARK (OR WASTE SPARK)—A spark that takes place simultaneously at the exhaust stroke of another cylinder when a spark occurs at the compression stroke of a cylinder.

4.20 Distributor—A device that distributes the spark voltage to the various spark plugs.

4.21 External Primary (Ballast) Resistor—A resistor, if used, that is connected in series with the coil primary circuit.

4.22 Ignition Cables—Metallic—A high-voltage cable with metallic conductors. This cable routes the high voltage from the coil to distributor and distributor to spark plugs.

4.23 Ignition Cables—Nonmetallic—A high-voltage cable similar to ignition cables—metallic (4.22) except with nonmetallic conductors such as carbon fibres.

4.24 Ignition Trigger Device—The device used to initiate the discharge of the energy stored in the ignition system.

4.25 Stored Energy—Theoretically, the amount of energy stored in the storage element (capacitor or coil) of the ignition system. This value does not take into consideration inefficiencies or losses in the system.

4.25.1 INDUCTIVE SYSTEM—(See Equation 1.)

$$W = 1/2Li^2 \qquad \text{(Eq. 1)}$$

where:

W = Energy (joules) stored in coil inductive field
L = Coil primary inductive (henries)
i = Coil primary interruption current (amperes)

4.25.2 CAPACITOR DISCHARGE SYSTEM—(See Equation 2.)

$$W = 1/2\ CV^2 \qquad \text{(Eq. 2)}$$

where:

W = Energy (joules) stored in the storage capacitor
C = Storage capacitance (farads)
V = Voltage (volts) across the storage capacitor at the moment discharge begins

5. Notes

5.1 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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