



SURFACE VEHICLE RECOMMENDED PRACTICE	J139	JUL2014
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Superseding J139 NOV1999		
Ignition System Nomenclature and Terminology		

RATIONALE

This Document should be reviewed, updated and revised to include standard Nomenclature and Terminology used to describe changes to ignition system for spark ignited internal combustion engines not addressed in current revision J139 Nov 1999.

This document was reviewed, updated and revised to include standard Nomenclature and Terminology used to describe features and components of ignition systems for spark ignited internal combustion engines. The rationale to revise document existed because of system modifications and advancements not addressed in SAE J139 rev Nov 1999.

1. SCOPE

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

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publication

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J973 Ignition System Measurements Procedure

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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 Breaker-less

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

3.3 Distributor-less (Static Distribution System)

A system that omits the rotating mechanical spark voltage distributor.

3.3.1 Coil-On-Plug (single-ended coil)

A distributor-less system that omits ignition cables and utilizes a single-ended coil for each spark plug along with connecting devices. These device types can include: spring, short wire or cable, terminal, or combinations of these items, totally contained inside insulator boot.

3.3.2 Coil-On-Plug (double-ended coil)

A distributor-less system that omits ignition cables and utilizes a double-ended coil for a pair of spark plugs (firing in unison in a single cylinder) along with connecting devices. These device types can include: spring, short wire or cable, terminal, or combinations of these items, totally contained inside insulator boot.

3.3.3 Coil-near-Plug (single-ended coil)

A distributor-less system utilizing one single-ended coil and a short ignition cable for each spark plug.

3.3.4 Coil-near-Plug (double-ended coil)

A distributor-less system that utilizes one double-ended coil for a spark plug pair in opposing cylinders firing 360 crank degrees apart. This type of ignition system is called a waste spark system. (see 3.8 Multi-Pulse / Multi-spark Ignition System)

3.3.5 Magneto

A system that utilizes a permanent magnet on a rotating part of the engine to generate energy. It may be conventional (3.3.7), electronic (3.1), breaker-less (3.2), or distributor-less (3.3).

3.3.6 Inductive

A system that stores energy in the primary winding (inductor) of the ignition coil. (The primary current flow can be controlled by mechanical breaker points, semiconductors or other means.) The high voltage for the spark discharge is generated by the ignition coil (step-up transformer) when the primary current is terminated and the magnetic field collapses.

3.3.7 Conventional (Kettering)

A system that consists of a coil, rotating mechanical spark voltage distributor, battery, and mechanical breaker points to control coil current.

3.4 Capacitor Discharge (C.D.)

A system that stores primary energy in a capacitor. The high voltage for the spark discharge is generated by the ignition coil (step-up transformer) when the energy stored on the capacitor is discharged through the primary winding of the ignition coil

3.5 Angle-Based Ignition Timing System / ABITS

Angle-Based Ignition Timing System uses a high resolution engine position sensing scheme (e.g. 360 pulses per revolution) for the ECU to use for spark delivery.

NOTE: As an example, an ignition system could be an electronic, breaker-less, distributor-less 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.)

3.6 Multi-Pulse / Multi-spark Ignition Systems

An ignition system mechanization that discharges coil energy through a spark plug multiple times during one cylinder event.

3.6.1 Open Loop Multi-Pulse Control

A multi-pulse system that controls the charging and discharging of the coil following calibration values without measuring coil operating parameters. Typical calibrations include:

- Initial coil charge time (dwell)
- Initial coil discharge time (burn time)
- Subsequent coil charge time
- Subsequent coil discharge time
- Number of pulses

3.6.2 Closed Loop Multi-Pulse Control

A multi-pulse system that controls the charging and discharging of the coil using feedback from the coil primary current and the coil secondary current.

3.7 Continuous Discharge Ignition System

Continuous Discharge is a characteristic of a dual coil per cylinder ignition system that operates in an alternating charge/discharge mode with the two coil outputs summed together to fire a single spark plug. The first coil fires the spark plug initially and then the coils alternate between charging and discharging (out of phase with one another) to support a continuous discharge for as long as the ECU continues to cycle the coils.

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. Testing should include both new spark plugs and worn (end of life) spark plugs with maximum gaps.

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 non-inductive ($1\text{ M}\Omega \pm 1\%$, 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 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 Dwell Time or Dwell Angle (Energizing Interval)

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-voltage connection at each end of the winding.

4.19.2.1 Coil Polarity

Most ignition coils are wound to generate a negative polarity high voltage output on the coil tower. This puts a negative voltage on the center electrode of the spark plug. Double-ended coils have two high voltage towers connected to a common secondary winding, one with a negative output voltage and the other with a positive output voltage.

4.19.3 Waste Spark

A spark that takes place nearly simultaneously at the exhaust stroke of another cylinder when a spark occurs at the compression stroke of a cylinder.