SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Misfire Generator Functional Requirements

RATIONALE

This SAE Recommended Practice provides performance requirements and guidelines for misfire generators for spark and compression ignition misfire generators.

FOREWORD

Historically, SAE has provided recommended practices where necessary to provide guidance to the automotive industry. Currently, misfire generators are required for misfire demonstration purposes to regulatory groups, and often used for development and calibration. Given the increase of world-wide marketing of motor vehicles and harmonization efforts, it is of interest to all vehicle manufacturers and control system suppliers to have an up-to-date recommended practice for a misfire generator that is applicable to most types of combustion control systems.

INTRODUCTION

This set of requirements identifies the means in which certain misfire functions shall operate. It is intended to provide the operating guidelines for certain required and developmental functions, standardize a minimum user interface, and establish the minimum hardware performance criteria. An ideal misfire generator for demonstration purposes is an external device capable of inhibiting combustion by only being connected to the vehicle through the vehicles electrical harness. If a user of this set of requirements were to intend to create a software based misfire generator, all aspects of misfire patterns, synchronization, and control signal timing shall be adhered to in order to ensure a compliant misfire pattern. Additional clarification as to how any software based misfire generator interacts with a vehicles control system may need to be provided to any regulatory executive officer for approval. It will not set nor force constraints upon the misfire generator's internal configuration or components other than the minimum hardware performance criteria. This will allow potential manufacturers to design a misfire generator without hardware technology constraints.

Unless otherwise identified within a given individual requirement within this SAE J2901 document, all references to misfire and engine operation shall pertain to all spark ignition or fuel injector control signals for a targeted combustion event in engines which support either single or multi-strike mode. Unless a requirement is stated to be an optional content or feature, the requirement shall be considered to describe required content or feature to be included in the misfire generator design.

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1. SCOPE

The intent of the specification is to present a functional set of requirements which define the user and hardware interfaces while providing sufficient capability to meet the misfire patterns for compliance demonstration and engineering development. Throughout this requirement, any reference to “ignition or injector control signal” is used interchangeably to infer that the effected spark ignition engine’s ignition control signal or the compression ignition engine’s injector control signal is interrupted, timing phased, or directly passed by the misfire generator.

For spark ignition engines, the misfire generator behaves as a spark-defeat device which induces misfires by inhibiting normal ignition coil discharge. It does so by monitoring the vehicle’s ignition timing signals and suspends ignition coil saturation for selected cylinder firing events. The misfire generator will thereby induce engine misfire in spark ignited gasoline internal combustion engines; including rotary engines.

For compression ignition engines, the misfire generator behaves as a fuel injection-defeat device which induces misfire by inhibiting the normal fuel injection pulses. It does so by monitoring the injection pulses signal and suspending the injection pulses for selected cylinder firing events. The misfire generator will thereby induce engine misfire in compression ignition engines.

This requirement assumes that the user has a fundamental understanding of misfire diagnostics as well as ignition controls. This requirement is not intended to be an introductory misfire guideline or interpretation of regulatory requirements.

1.1 Purpose

This document is intended to define the standards for misfire generators which will be used in vehicles that are required to detect and report misfire to regulatory groups.

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 Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1930 Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms

3. TERMS AND DEFINITIONS

For the purposes of this document, the terms and definitions given in SAE J1930 and the following apply:

- ACCELERATOR PEDAL - A foot operated device which, directly or indirectly, controls the flow of fuel and/or air to the engine, controlling engine speed.
- BANK - Specific group of cylinders sharing a common control sensor, bank 1 always containing cylinder number 1, bank 2 the opposite bank.
- BATTERY - An electrical storage device designed to produce a DC voltage by means of an electrochemical reaction.
- CAMSHAFT - A shaft on which phased cams are mounted. The camshaft is used to regulate the opening and closing of the intake and exhaust valves.
- CATALYST - A substance that can increase or decrease the rate of a chemical reaction between substances without being consumed in the process. In automotive usage, the term catalyst is used to designate a device containing such substances for the purpose of lowering levels of harmful emissions in the exhaust gas that passes through it.

- COIL (IGNITION) - An electrical transformer device consisting of windings of conductors around an iron core, designed to increase the voltage, and for use in a spark ignition system.

- CONTROL - (1) A means or a device to direct and regulate a process or guide the operation of a machine, apparatus, or system. (2) An architectural system element which contains the algorithm for translating input mechanism abstractions into output mechanism abstractions and implements the desired customer and system behaviors for a given function or feature (SAE J1213-1).

- CYLINDER DEACTIVATION - An engine control strategy whereby some of the cylinders will be unfired, hence deactivated, under certain operating conditions in order to increase fuel economy. Although methodology may be different between manufactures, deactivated cylinders have some combination of being unfueled, unsparked, and valve actuation disabled.

- DEVICE - A piece of equipment or a mechanism designed for a specific purpose or function.

- ELECTRICAL - A type of device or system using actuators, motors, generators, solenoids, switches, relays, etc. and generally involving higher current flow than electronic systems or devices.

- ELECTRONIC - (1) A type of device or system using diodes, transistors, integrated circuits, microprocessors, etc. and generally involving lower current flow than electrical systems or devices. (2) The storage, retrieval, and display of information through media such as magnetic tape, laser disc, electronic read only memory (ROM), and random-access memory (RAM).

- ENGINE - A machine designed to convert thermal energy into mechanical energy to produce force or motion.

- ENGINE CYCLE - The duration in which it takes for an engine to complete the sequence of steps associated with its particular design. A four-stroke engine’s engine cycle will be completed once all four phases have completed; intake, compression, power, and exhaust.

- ENGINE CYCLE MODE - Describes a mode of operation in which the misfire generator will use engine cycles as the means to determine the interval between independent control signal interrupts; ignition coil for spark ignition engines, or fuel injector for compression ignition engines.

- GROUND - An electrical conductor used as a common return for an electric circuit(s) and with a relative zero potential.

- IGNITION - System used to provide a high voltage spark for internal combustion engines.

- IGNITION CONTROL MODULE - A component in which the Ignition Driver and Coil are combined.

- IGNITION DRIVER - An electronic switch that controls the coil’s primary winding current.

- INJECTOR DRIVER – An electronic switch that controls the injector current or voltage.

- INTEGRATED DRIVER - A common name for an Ignition Control Module.

- MISFIRE - A lack of combustion in the cylinder due to absence of spark, poor fuel metering, poor compression, or any other cause. This does not include lack of combustion events in non-active cylinders due to default fuel shut-off or cylinder deactivation strategies. This definition correlates to the CARB definition for “Engine Misfire”. The misfire described in this document is the result of defeating all ignition or injector control signals intended for a combustion event.

- MISFIRE GENERATOR - CONTROL UNIT - A component of the misfire generator assembly designed to interrupt ignition or injector control signals. This unit may also contain user inputs and outputs and displays.

- MISFIRE GENERATOR - The misfire generator assembly, whose purpose is to artificially induce a lack of combustion in one or more cylinders of an internal combustion engine. The misfire generator can consist of, but is not limited to the misfire control unit, remote unit, and remote unit interface harness.