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INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1549

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DIESEL FUEL INJECTION PUMP—VALIDATION OF CALIBRATING NOZZLE HOLDER ASSEMBLIES

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope—The fuel injection pump is intended to validate the accuracy of calibrating nozzle and holder assemblies for applications using 0.4 - 0.8 mm diameter orifice plates and to assist in identifying problems in fuel injection pump test stands.

This SAE Recommended Practice is divided into two parts:

Part I—Design, Description and Specifications of the Fuel Injection Pump; and
Part II—Test Procedures for Using the Fuel Injection Pump.

2. References

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

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

SAE J968 MAR85—Calibrating Nozzle and Holder Assembly for Diesel Fuel Injection Systems
SAE J1418 DEC87—Fuel Injection Pumps — High Pressure Pipes (Tubing) for Testing

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO4008/1—Fuel injection pump testing—Dynamic conditions (1980-11-15)
ISO7440—Calibrating nozzle and holder assemblies

3. Part 1—Design, Description and Specifications—Part I of this SAE Recommended Practice describes and establishes specifications and features of a fuel injection pump and its auxiliary equipment required to perform the above purpose.

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3.1 Design and Description—This fuel injection pump shall be a single-cylinder, self-contained and cam-operated. Details as to the manufacturer's source are available from SAE. This pump shall provide fuel deliveries and injection pressures capable to test calibrating nozzle and holding assemblies as listed in Part II.

It shall incorporate positive control rack positioning and may have preset stops corresponding to a specified delivery for each orifice size of calibrating nozzle holders.

3.2 Pump Specifications—The fuel injection pump described here shall incorporate the following features:

3.2.1 DELIVERY VALVE

9 mm dia
75 mm^3 retraction volume
Lower seated

3.2.2 DELIVERY VALVE SPRING

0.9 mm wire dia
4.8 mm spring O.D.
Total number of coils—18
Number of effective coils—16
Free length—26.2 mm
Ends square and ground

3.2.3 DELIVERY VALVE HOLDER

14 x 1.5 mm thread, 60 deg cone seat for injection tubing

3.2.4 SUPPLY PUMP

Plunger dia 22 mm
Stroke 10 mm
Displacement 3800 mm^3/stroke
Regulating pressure 2.4 bar
(35 lbf/in^2) at 60 rpm (full bypass)

3.2.5 PLUNGER AND BARREL ASSEMBLY

11 mm diameter, left-hand lower helix, 24 mm lead
Lift to Port Closure: 3 mm
Number of Ports: 2
Size of Ports: 3 mm

3.2.6 CAM TYPE, PROFILE

Tangential type
Maximum velocity 1.94 m/s @ 1000 rpm, 10 mm lift

3.2.7 TAPPET ASSEMBLY

Roller dia 25 mm

3.2.8 OVERFLOW VALVE

For system operating pressures 1.2 to 1.3 bar (17 to 19 lbf/in^2) @ 1000rpm

3.2.9 DRIVE COUPLING

Backlash free, to mate with test stand coupling and approved by the test stand manufacturer.

3.2.10 AUXILIARY EQUIPMENT

3.2.11 FUEL FILTER

Final stage to be plumbed between supply pump and pump gallery. Filter efficiency details can be obtained from SAE.

3.2.12 PRESSURE MEASUREMENTS

0 to 2 bar (0 to 30 lbf/in^2), ANSI B 40.1-1985 Grade A, measurement downstream of pump mounted final stage filter, adequately snubbed to prevent damage from severe pulsations.

3.2.13 CALIBRATION FLUID TEMPERATURE MEASUREMENTS—Must be capable of measuring calibration fluid temperature prior to entry into the gallery at 40 °C with an accuracy of ±0.5 °C.

4. Part II—Test Conditions and Procedure—Part II of this SAE Recommended Practice is intended to establish conditions and procedures for flow testing calibrating nozzle and holder assemblies in order to verify their flow accuracy.

For the purposes of these tests, two types of calibrating nozzle and holder assemblies are defined as follows:

a. "Working" type are those in continuous use for calibrating and testing pumps.
b. "Reference" type are those with deliveries within the mean flow band of the manufacturer's limits, with higher than average repeatability and used only for reference.

The objective of these tests is to compare deliveries of "working" types to "reference" calibrating nozzle and holder assemblies at pump preset deliveries under identical test conditions. Working and reference calibrating nozzle and holder assemblies must be of the same design and specifications.

NOTE—Before flow tests are initiated, make certain that "working" type calibrating nozzle and holder assembly leak tests and valve opening pressures meet SAE J968.

4.1 General—Checking and testing calibrating nozzle and holder assemblies is accomplished most effectively by dynamically flow testing them. The tests described below shall be accomplished on a test stand with the following features:

Power—3.7 kW (5 HP) minimum
Tachometer—Digital, accuracy ±1 digit, update 1 s maximum
Moment of Inertia—0.127 kgm^2 minimum[1]
Speed Stability—±1 rpm at 1000 rpm for 1 min duration, minimum.

1. Per ISO 4008/I assuming: Max delivery: 260 mm^3/str.
Peak Injection Pressure: 641 bar (9300 lbf/in^2)
Pump Speed: 1000 rpm

In addition, the measuring system must be repeatable and checked prior to the start of these tests.

The calibrating nozzle and holder assemblies that are intended to be tested using this fuel injection pump are described in SAE J968.

4.2 Test Conditions—The following general guidelines and conditions shall be adhered to during the tests:

Calibration Fluid—SAE J967
Calibration Fluid Temperature—40 °C ± 0.5 °C (104 °F ± 1 °F) measured at fuel gallery inlet
Calibration Fluid Pressure—1.2 to 1.3 bar (17 to 19 lbf/in^2) at fuel gallery inlet
Drive Coupling—Backlash free
High Pressure Tubing—6.35 mm (1/4 in) O.D. x 1.6 mm (0.062 in) I.D. x 600 mm (23.6 in) long (SAE J1418)
Settling Time[2]—30 s and consistent for each draw
Drain Time[2]— 20 to 30 s and consistent for each draw

4.3 Test Procedure—To test a set of "working" calibrating nozzle and holder assemblies (or a single assembly), proceed as follows:

4.3.1 Connect a "reference" calibrating nozzle and holder assembly to the injection pump described in Part I using high pressure tubing size as per this recommended practice.

4.3.2 Run pump at 1000 rpm for a minimum of 20 min to stabilize the system and achieve specified calibration fluid temperature.

4.3.3 Select control rack stop to achieve the approximate delivery per the table.

4.3.4 Take two draws, but do not record.

4.3.5 Take three consecutive draws with equal drain time. After settling time, record each reading. If readings are within 1 cc of each other, calculate the average and record.

NOTE—If readings are not repeatable, check test stand systems, pump and nozzle holder and correct problem before proceeding.

4.3.6 Remove "reference" calibrating nozzle and holder assembly and install a "working" unit of the same orifice size. DO NOT MOVE CONTROL RACK.

4.3.7 Repeat Step 2 (paragraph 4.3.2) for a minimum of 5 min to stabilize the temperature of the "working" calibrating nozzle and holder assembly.

4.3.8 Repeat Steps 4 and 5 (paragraphs 4.3.4 and 4.3.5).

4.3.9 Readings obtained with a "working" nozzle holder must be within ±3% of the reading of the "reference" calibrating nozzle and holder assembly and within a 2% band in a set.

4.3.10 If a calibrating nozzle and holder assembly is found to be defective, replace with new or repair according to manufacturer's instructions.

For each calibrating nozzle and holder assembly, set control rack to achieve approximate delivery per Table 1. The recommended number of strokes should be according to the test stand manufacturer's instructions. In the absence of specific instructions, fill graduates to a minimum of 50% of their capacity[2].

2. If graduates are used.