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SAE J1312 MAY87

**Procedure for
Mapping Engine
Performance Diesel
and Spark Ignition
Engines**

SAE Recommended Practice
Revised May 1987

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Submitted for Recognition as
an American National Standard

Ø PROCEDURE FOR MAPPING ENGINE PERFORMANCE
DIESEL AND SPARK IGNITION ENGINES

1. **SCOPE:** The purpose of this SAE code is to provide a standardized test procedure for generating engine performance maps. An engine performance map is a listing of engine fuel flow rates versus torque or power obtained at specific engine speeds and loads. Engine performance maps as specified by this code can be used in fuel economy simulation programs.

This standard is applicable to both two- and four-stroke spark ignition (SI) engines, with or without pressure charging or charge air cooling.

2. **REFERENCE:** SAE J1349 JUN85, Engine Power Test Code - Spark Ignition and Diesel, is the sole source reference document for this standard. All engine test procedures, including engine and test equipment, correction procedures, instrumentation, reference conditions, terminology, etc., shall be in accordance with SAE J1349 except where otherwise specified by this document.

3. **ENGINE EQUIPMENT:** A fully equipped engine is used for this test, per SAE J1349, Paragraphs 4.4.2 and 11.1. A fully equipped engine is an engine equipped with accessories necessary to perform its intended service. These include:

- a) The basic engine with only those built-in accessories required to operate (fuel, oil, water pumps, built-in emissions equipment, etc.)
- b) A representative inlet air system, including air cleaner and preheat (if applicable) or laboratory system providing equivalent restriction.
- c) A representative exhaust system or laboratory system providing equivalent restriction.

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- d) Emissions, noise and RFI control equipment, and any applicable fuel metering, boost pressure control and timing/spark advance systems shall be adjusted to meet the manufacturer's specification.
- e) Generator (alternator) - not used, unless required to operate the "fully equipped" engine, in which case it should operate only at a load sufficient to power the engine.
- f) Fan - not used, but losses accounted for in accordance with SAE J1349, Section 11, footnote 2.

A fully equipped engine does not include accessories that power auxiliary systems that are unessential to operation of the engine itself. Examples include the power steering pump, freon and air compressors. If the test engine is equipped with any of these accessories, the power absorbed may be determined and added to the net brake power.

- 4. POWER CORRECTIONS: Measured engine torque or power levels must be corrected to standard reference test conditions. The corrections are made in accordance with SAE J1349, Sections 6, 7 and Paragraph 8.2 except:
 - 4.1 For CI engines, the correction procedure shall be used for both full and part load operation.
 - 4.2 Since no adequate part load correction procedure is documented for SI engines, no corrections shall be made to the measured data. Therefore, inlet air must be controlled to standard conditions.

Standard Inlet Air Conditions:

Inlet Air Temperature: 25°C

Dry Inlet Air Pressure: 99 kPa

Water Vapor Pressure: 1 kPa

- 5. TEST PROCEDURES: The engine test data for performance maps must be generated at specific engine speed and loads. All other test procedures are conducted in accordance with SAE J1349, Sections 9 - 15.
 - 5.1 Test data must be obtained at each of the following speeds:
 - a) Rated or maximum speed
 - b) Peak torque speed
 - c) Idle speed
 - d) Intermediate speeds
 - e) Optional speeds
 - 5.1.1 Rated (or maximum), peak torque and idle speeds are defined by the manufacturer.

- 5.1.2 Intermediate speeds should be obtained at equal 10% increments of rated (or maximum) speed, from rated speed to idle speed (for example, 90% of rated, 80% of rated, etc.). Intermediate speeds may be rounded to the nearest 100 rpm. Intermediate speeds falling within 100 rpm of any other required test speeds may be omitted.
- 5.1.3 Optional speeds are any additional speeds deemed by the manufacturer as necessary to adequately define the shape of the power curve or to simulate vehicle operational requirements.
- 5.2 At each test speed, the engine shall be run at no less than five (5) loads. Specific test load levels shall be determined by the engine manufacturer, based on engine/vehicle operational characteristics. This may include motoring (negative) load levels.
- 5.2.1 Data acquisition at certain speeds and loads may be subject to the capabilities of the test dynamometer. In such cases, these test points may be omitted from the map, at the manufacturer's discretion, if it can be shown that vehicle operational requirements do not utilize these data.
- 5.3 If engine performance is affected by vehicle related hardware, it may be necessary to generate additional maps to simulate specific operating conditions. Examples include individual vehicle restriction effects, or engine control devices based on torque converter position, gear ratio, vehicle speed, etc. When additional maps are run, each shall be clearly labeled with applicable test conditions or hardware.
6. PRESENTATION OF RESULTS:
- 6.1 Data shall be recorded for test documentation in accordance with SAE J1349, paragraph 9.2. Additional data may be recorded at the manufacturer's discretion.

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6.2 Engine data obtained and required specifically for the performance map shall be tabulated in a format acceptable for use by the vehicle simulation program. The following sample format may be used:

<u>Engine Speed</u>	<u>% Load</u>	<u>Reference Condition Torque or Power</u>	<u>Fuel Flow Rate</u>
Rated: X	Highest ↓ Lowest	X ↓ X	X ↓ X
1st Intermediate:	Highest ↓ Lowest	X ↓ X	X ↓ X
2nd Intermediate:	etc.	etc.	etc.
etc.			

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RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J1349 JUN85, Engine Power Test Code - Spark Ignition and Diesel

APPLICATION:

This standard is applicable to both two and four stroke spark ignition (SI) and compression ignition (CI) engines, with or without pressure charging or charge air cooling.

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