SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2458 JUL2012

Issued 1998-07
Stabilized 2012-07

Superseding J2458 JUL1998

Exhaust Brake Dynamometer Test and Capability Rating Procedure

RATIONALE

This procedure has been used consistently for a number of years. No need for changes is anticipated.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Truck and Bus Advanced and Hybrid Powertrain Steering Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. ***Scope***—This SAE Recommended Practice has been adopted by SAE to specify:

a. A basis for net engine retarder power rating
b. Reference inlet air test conditions
c. A method for correcting observed engine retarder power to reference conditions
d. A method for determining net engine retarder power with a dynamometer

1.1 **Field of Application—**This test code document is applicable to engine exhaust retarders on four-stroke compression ignition (CI), with and without charge air cooling. This document does not apply to aircraft, marine, spark ignition (SI), two-stroke compression ignition (CI) or mechanical super-charged ignition engines, compression release retarders, or combination exhaust and compression release retarders.

2. ***References***—This test code was modeled after SAE J1621 AUG94.

2.1 **Applicable Publications—**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, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1621—Engine Retarder Dynamometer Test and Capability Rating Procedure
SAE J1349—Engine Power Test Code—Spark Ignition and Compression Ignition—Net Power Rating

3. ***Definitions***—This section contains the definitions of key terms used to describe the engine exhaust retarder dynamometer test and capability rating procedure.

3.1 **Net Engine Exhaust Retarder Power—**The net power of an engine exhaust retarder when configured as a "fully equipped" engine as defined in 3.4, 3.5, 5.2, and 5.3 and tested and corrected in accordance with this document.

3.2 **Rated Net Engine Exhaust Retarder Power—**Engine exhaust retarder net power as published by the exhaust retarder manufacturer at "rated speed".

3.3 Exhaust Retarder Rated Speed—The speed determined by the exhaust retarder and engine manufacturer at which the engine exhaust retarder net power is rated.

3.4 Fully Equipped Engine with Exhaust Retarder—A "fully equipped" engine with an exhaust retarder is an engine equipped with an exhaust retarder and only those accessories necessary to perform its intended service. A fully equipped engine with an exhaust retarder does not include components that are used to power auxiliary systems. If these components are integral with the engine or for any reason are included on the test engine with an exhaust retarder, the power absorbed shall be determined and subtracted from the net exhaust retarder power. Common "fully equipped" engine accessory examples are listed in SAE J1349.

3.5 Fully Equipped Exhaust Retarder—A "fully equipped" exhaust retarder is an exhaust retarder equipped with only those accessories necessary to perform its intended service. A fully equipped exhaust retarder does not include components that are used to power auxiliary systems. If these components are integral with the exhaust retarder or for any reason are included on the test exhaust retarder, the power absorbed shall be determined and subtracted from the net exhaust retarder power. Exhaust retarder equipment is listed in Table 1.

TABLE 1—EXHAUST RETARDER EQUIPMENT

System	Required	Comments
1. Exhaust Retarder	Yes	This document is limited to exhaust retarders only. It does not include compression release retarders or combination exhaust and compression release retarders
2. Retarder Mounting Hardware	Yes	Shall be installed per exhaust retarder manufacturer guidelines.
3. Electrical System Power Supply	Yes	The power supply must be capable of providing enough voltage and current to activate all exhaust retarder switches if applicable.
Wiring Harness	Yes	Wiring harness's should be configured in such a way as to allow activation of the exhaust retarder if applicable.
Switches and Sensors	Yes	Switches and/or sensors required to insure the drive line and engine are in the proper mode so the exhaust retarder can be energized.

3.6 Reference Test Conditions—The standard or reference engine inlet air conditions to which all exhaust retarder power observed is corrected.

3.7 Engine Friction Power—The power required to drive the engine alone as equipped for the exhaust retarder power test. Friction power may be established by recording the friction torque while the engine is motored at each test speed run on the exhaust retarder power test. All readings are to be taken at the same coolant and oil temperatures as observed on the exhaust retarder power test points ±3 °C.

3.8 Indicated Engine Exhaust Retarder Power—The power developed by the engine exhaust retarder. It is defined as the net engine (with exhaust retarder) power minus friction power for the purpose of this document.

3.9 Air Supply Conditions—Refers to the conditions where the air originates into the air inlet system.

3.10 Inlet Air Conditions—Refers to the conditions of the air that is entering the engine.

3.11 Exhaust Pressure Threshold—The maximum exhaust back pressure that can be developed by the engine exhaust retarder system.

4. ***Reference Test Conditions and Corrections***—This section contains reference inlet air test conditions and specifications, recommended test ranges, and applicability of the correction procedures.

4.1 **Reference Inlet Air Conditions**—Table 2 is reference inlet air conditions and test ranges for which the correction procedures are valid.

TABLE 2—REFERENCE INLET AIR CONDITIONS

	Standard Condition	Recommended Test Range Limits
Inlet Air Supply Pressure (absolute)	100 kPa	—
Dry Air Pressure (absolute)	99 kPa	85.0–104.8 kPa
Inlet Air Supply Temperature	25 °C	18.3–32.3 °C

4.2 **Power Corrections**—The performance of CI engines with an exhaust retarder is affected by the density of the inlet air. Therefore, in order to provide a common basis of comparison, it may be necessary to apply correction factors to the observed net power to account for differences between reference air conditions and those at which the test data were acquired.

4.2.1 All power correction procedures for atmospheric air are based on the dry air conditions of the engine inlet air immediately prior to the entrance into the engine. This may be dry ambient (atmospheric) air or a laboratory air plenum (provided that it maintains air supply conditions within the range limits defined per 4.1) minus the dry portion of the pressure drop across the inlet air system.

4.2.2 On any engine where the power output is automatically controlled to compensate for changes inlet air supply test conditions, no correction for that test parameter shall be made.

4.2.3 The magnitude of the power correction should not exceed 10% for inlet air corrections. If the correction factor exceeds these values, it shall be noted in accordance with 7.1.

4.3 **Correction Formulas**—The applicable correction formulas for compression ignition engines with an exhaust retarder are listed in Section 8. These correction formulas are designed for correction of net engine exhaust retarder power.

5. ***Laboratory, Engine, and Exhaust Retarder Equipment***—This section contains a list of laboratory, engine, and exhaust retarder equipment used in the net exhaust retarder power test.

5.1 **Laboratory Equipment**—The following standard laboratory test equipment is required for the net exhaust retarder power test.

5.1.1 INLET SYSTEM—The intended service inlet system or any laboratory system that provides equivalent restriction at all speeds and loads. The inlet system begins at the point where air enters from the supply source (atmosphere or lab plenum) and ends at the entrance to the turbocharger inlet or at the entrance to the inlet manifold on naturally aspirated engines, on an engine with an exhaust retarder as appropriate.

5.1.2 EXHAUST SYSTEM—A complete intended service exhaust system (including mufflers, catalytic converters, resonators, etc.) or any laboratory system that provides equivalent restriction at all speeds and loads. The exhaust system begins at the exhaust retarder outlet.

5.1.3 FUEL SUPPLY SYSTEM—Any laboratory system that provides fuel to the fuel inlet of the fully equipped engine with an exhaust retarder. The fuel supply system shall not exceed the engine manufacturer's permissible restriction requirements.

5.1.4 CHARGE AIR COOLER—For charge-cooled engines with an exhaust retarder, a laboratory auxiliary cooler may be employed for test purposes. If used, one of the following test methods is required.

a. Standard Method—The laboratory unit is set to simulate intended in-service charge air cooler restriction and inlet manifold temperatures as if the ambient and inlet supply air temperatures were 25 °C.
b. Optional Method—The laboratory unit is set to duplicate the charge air cooler restriction and inlet manifold temperatures that would be obtained during intended service operation at the observed inlet air test conditions.

5.2 Engine Equipment—A fully equipped engine with an exhaust retarder, as defined in 3.4, is used for the net engine exhaust retarder power test. Fully equipped engine accessories and control settings required for the net exhaust retarder power test are listed in SAE J1349.

5.3 Exhaust Retarder Equipment—A fully equipped exhaust retarder, as defined in 3.5 and listed in Table 1.

***6. Test Procedures*—**This section contains the required test procedures for determining net engine exhaust retarder power.

6.1 Instrumentation Accuracy—The following minimum test instrumentation accuracy is required:

a. Torque: ±0.5% of measured value
b. Speed: ±0.2% of measured value
c. Temperatures: ±2 °C
d. Air Supply, Inlet, and Exhaust Pressures: ±0.1 kPa
e. Other Gas Pressures: ±0.5 kPa

6.2 Adjustments and Run-in

6.2.1 Adjustments shall be made before the test in accordance to the engine and exhaust retarder manufacturer's instructions. No changes or adjustments shall be made during the test.

6.2.2 The engine with exhaust retarder shall be run-in according to the engine manufacturer's recommendation. If no such recommendation is available, the engine with exhaust retarder shall be run-in until corrected brake power is repeatable within 1% over an 8-h period.

6.2.3 Record full throttle data per SAE J1349 for at least five approximately evenly spaced operating points to define the engine power curve between 1000 rpm (or the lowest stable speed) and the maximum engine speed recommended by the engine manufacturer. One of the operating speeds shall be the rated speed of the engine and another one shall be the peak torque speed. This power curve shall be compared to the engine manufacturer's published power curve. The two curves should not differ by more than 3%.

6.3 Pressure and Temperature Measurement

6.3.1 Pressure of the inlet air supply, used for the purpose of exhaust retarder power corrections, shall be measured in a manner to obtain the total or static pressure at the entrance to the engine (with exhaust retarder) inlet system. On those tests where the engine air supply is ambient air, these pressures are the barometric and vapor pressure; on those tests where the air supply is test cell ambient air, these pressures are the cell barometric and vapor pressure.

6.3.2 Inlet air pressure and temperature, used for the purpose of determining inlet system restriction, shall be measured in a manner to obtain the total or static condition immediately prior to the end of the inlet system as defined in 5.1.1.

6.3.3 Coolant temperatures in a liquid-cooled engine with exhaust retarder shall be measured at the inlet and outlet coolant connection of the engine with exhaust retarder, in air-cooled engines at points specified by the manufacturer.

6.3.4 Oil pressure and temperature shall be measured at the main oil gallery.

6.3.5 Exhaust (stack) pressure shall be measured in a manner to obtain the total (stagnation) pressure in a straight section of piping not less than three nor more than six diameters downstream of the entrance to the exhaust system as defined in 5.1.2.

6.3.6 Exhaust back pressure shall be measured upstream of the exhaust retarder.

6.4 Exhaust Retarder Operating Conditions

6.4.1 The engine with exhaust retarder installed must be started in the positive power mode and warmed up in accordance with the manufacturer's specifications.

6.4.2 Engine coolant outlet temperature for a liquid-cooled engine with exhaust retarder shall be controlled to within ±3 °C of the nominal thermostat value specified by the engine manufacturer. Engine coolant inlet air temperature for an air-cooled engine with an exhaust retarder is regulated to 35 °C ± 5 °C.

6.4.3 The exhaust gas must be vented to a reservoir having a total pressure within 0.75 kPa of the inlet air supply pressure.

6.4.4 Exhaust retarder performance data shall be taken when the total torque variation has been maintained within 1% and the engine speed has been maintained within ±10 rpm for at least 1 min.

6.5 Test Points—Record exhaust retarder data for at least five evenly spaced operating points to define the exhaust retarder power curve between the greater of 1000 rpm or the lowest stable speed and the retarder rated speed.

6.5.1 Determine exhaust pressure threshold from the data measured in 6.5. Measure and record exhaust back pressure at each engine speed. Calculate rate of rise of back pressure per 100 rpm between data points. The threshold is the first point at which the rate of rise of exhaust back pressure is equal to or less than 7 kPa per 100 rpm.

*7. Presentation of Results—*This section contains a listing of test data to be recorded and procedures for presenting results.

7.1 Reporting Requirements—All reported engine exhaust retarder test data shall carry the notation: "Performance obtained and corrected in accordance with SAE J2458". Any deviation from this document, its procedures, or limits shall be noted. All reported or advertised test data bearing the SAE J2458 notation shall include a minimum of the following information at each test point:

a. Engine exhaust retarder speed
b. Corrected net engine exhaust retarder power (or torque)