SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1621

REAF. DEC2005

Issued 1994-08
Reaffirmed 2005-12

Superseding J1621 AUG1994

Engine Retarder Dynamometer Test and Capability Rating Procedure

TABLE OF CONTENTS

TO PLACE A DOCUMENT ORDER:

Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
http://www.sae.org

SAE WEB ADDRESS:

SAE 100 Leading Our World In Motion

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 brake retarders of the compression release type on four-stroke compression ignition (CI) fix venturi turbocharged engines, with and without charge air cooling. This document does not apply to aircraft, marine, spark ignition (SI), two-stroke compression ignition (CI), mechanical supercharged or naturally aspirated compression ignition engines, exhaust brakes or combination exhaust and compression release brakes.

1.2 **Rationale**—This document has been reaffirmed to comply with the SAE 5-Year Review policy.

2. ***References***

2.1 **Applicable Publication**—This test code was modeled after SAE J1349 JUN90.

The following publication forms a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 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 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 retarder dynamometer test and capability rating procedure.

3.1 **Net Engine Retarder Power**—The net power of an engine retarder when configured as a "fully equipped" engine with retarder 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 Retarder Power**—Engine retarder net power as declared by the brake manufacturer at "rated speed."

3.3 **Braking Rated Speed**—The speed determined by the brake and engine manufacturer at which the engine retarder net power is rated.

3.4 Fully Equipped Engine With Retarder—A "fully equipped" engine with retarder is an engine equipped with a retarder and only those accessories necessary to perform its intended service. A fully equipped engine with 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 retarder, the power absorbed shall be determined and subtracted from the net retarder power. Common "fully equipped" engine accessory examples are listed in SAE J1349.

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

TABLE 1—ENGINE RETARDER EQUIPMENT

System	Required	Comments
1. Compression Release Style Brakes	Yes	This standard is limited to compression release style brakes only. It does not include exhaust brakes or combination exhaust and compression release brakes.
2. Brake Mounting Hardware	Yes	Shall be installed per brake manufacturer guidelines.
3. Electrical System		
Power Supply	Yes	The power supply must be capable of providing enough voltage and current to activate all retarder solenoids at the same time.
Wiring Harness	Yes	Wiring harnesses should be configured in such a way as to allow activation of individual brakes if applicable.
Switches and Sensors	Yes	Switches and/or sensors are required to insure the drive line and engine are in the proper mode so the brakes can be energized.
4. Engine Brake Lash Setting	Yes	Shall be set to the nominal specified lash provided by the brake manufacturer.

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

3.7 Engine Friction Power—The power required to drive the engine alone as equipped for the 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 retarder power test. All readings are to be taken at the same coolant and oil temperatures as observed on the retarder power test points ±3 °C.

3.8 Indicated Engine Retarder Power—The power developed by the engine retarder. It is defined as the net engine 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.

***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	93.7–104.8 kPa
Inlet Air Supply Temperature	25 °C	18.3–32.3 °C

4.2 Power Corrections—The performance of CI engines with retarders is affected by the density of the inlet air. Therefore, in order to provide a common basis for comparison, it may be necessary to apply correction factors to the observed net retarder 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 with retarder where the power output is automatically controlled to compensate for changes in 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 retarders are listed in Section 7. These correction formulas are designed for correction of net engine retarder power.

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

5.1 Laboratory Equipment—The following standard laboratory test equipment is required for the net 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, on engine with retarders 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 beings at the turbine outlet on engines with retarders so equipped.

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

5.1.4 CHARGE AIR COOLER—For charge cooled engines with retarders, 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 retarder, as defined in 3.4, is used for the net engine retarder power test. Fully equipped engine accessories and control settings required for the net retarder power test are listed in SAE J1349.

5.3 Engine Retarder Equipment—A fully equipped engine retarder, as defined in 3.5, reference Table 1.

6. Test Procedures—This section contains the required test procedures for determining net engine 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 retarder manufacturer's instructions. No changes or adjustments shall be made during the test.

6.2.2 The engine with retarder shall be run-in according to the engine manufacturer's recommendation. If no such recommendation is available, the engine with 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 retarder power corrections, shall be measured in a manner to obtain the total (stagnation) pressure at the entrance to the engine (with 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 (stagnation) condition immediately prior to the end of the inlet system as defined in 5.1.1.

6.3.3 Inlet manifold pressure and temperature shall be measured as static values with probes located in a section common to several cylinders. In such installations, dynamic pressure is assumed zero.

6.3.4 On charge air-cooled engines with retarders in which a laboratory cooler is employed for testing, precooler charge air pressure must also be measured for the purpose of setting in-service restrictions per 5.1.4. Precooler pressure must be measured upstream of the auxiliary unit in a manner to obtain the total (stagnation) value. Auxiliary cooler restriction is the difference between the precooler and inlet manifold pressures.

6.3.5 Coolant temperatures in liquid-cooled engines with retarders shall be measured at the inlet and outlet of the engine with retarder, in air-cooled at points specified by the manufacturer.

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

6.3.7 Exhaust 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.

6.4 Braking Operating Conditions

6.4.1 The engine with 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 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 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 Brake 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 retarder data for at least five evenly spaced operating points to define the retarder power curve between 1000 rpm (or the lowest stable speed) and the braking rated speed.

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 retarder test data shall carry the notation: "Performance obtained and corrected in accordance with SAE J1621." Any deviation from this document, its procedures, or limits shall be noted. All reported or advertised test data bearing the SAE J1621 notation shall include a minimum of the following information at each test point.

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

7.2 Recorded Test Conditions—Record the following ambient air test conditions.

7.2.1 INLET AIR SUPPLY CONDITIONS

a. Air supply pressure
b. Air supply vapor pressure