



SURFACE VEHICLE STANDARD	J1349®	NOV2025
	Issued	1980-12
	Revised	2025-11
Superseding J1349 SEP2011		
Engine Power Test Code - Spark Ignition and Compression Ignition - As Installed Net Power and Torque Rating		

RATIONALE

This standard is intended to provide the industry with a repeatable means of determining the as installed net power and torque of an engine. The current revision has been made to allow for improved flexibility for testing complex air induction systems, clarification on rating with selectable drive modes, clarification of cooling setup for small engines, and the addition of dual ratings for over 8500-pound applications with variable load cooling fans.

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1. SCOPE

This SAE Standard is intended to provide a method to obtain repeatable measurements that accurately reflect true engine performance in customer service. Whenever there is an opportunity for interpretation of the standard, a good faith effort shall be made to obtain the engine's typical in-service performance and avoid finding the best possible performance under the best possible conditions. Intentional biasing of engine component or assembly tolerances to optimize performance for this test is prohibited.

1.1 Purpose of Standard

This SAE Standard has been adopted by SAE to specify:

A basis for net engine power and torque rating reflecting the as-installed performance in the final application.

Reference inlet air and fuel supply test conditions.

A method for correcting observed power and torque to reference conditions.

A method for determining net full load engine power and torque with a dynamometer.

A procedure to ensure that engine controls are operating in a manner consistent with customer operation.

1.2 Field of Application

This test code document is applicable to both spark ignition (SI) and compression ignition (CI) engines, naturally aspirated and pressure-charged, with and without charge air cooling. This document does not apply to aircraft or marine engines. The standard is applicable to the internal combustion engine used in a hybrid powertrain, but it does not comprehend the combined output of the hybrid powertrain.

1.2.1 Standard CI diesel fuel specifications are range mean values for Type 2-D EPA test fuel per 40 CFR § 1065.703 or most recent.

1.2.2 The corresponding test code for gross power and torque rating is SAE J1995.

1.2.3 The document for mapping engine performance is SAE J1312.

1.3 Relationship to ISO 1585

ISO 1585:2020 differs from SAE J1349 in several areas, among which the most important are:

This document is not limited to road vehicles.

This document requires inlet fuel temperature be controlled to 40 °C on CI engines.

This document includes a reference fuel specification and requires that engine power be corrected to that specification on all CI engines.

This document includes a different procedure for testing engines with a laboratory charge air cooler.

This document stipulates that with a variable load cooling fan the engine shall be tested with both minimum and maximum fan duty cycle when running a steady-state test. ISO states: where a separate disconnectable or progressive fan or blower is incorporated, the test shall be made with the disconnectable fan or blower disconnected or with the progressive fan running at the maximum slip.

This document provides procedures for transient testing of light-duty vehicles with the associated changes in control parameters and exhaust back pressure.

This document includes accessory losses if the accessories are standard on the vehicle application.

ISO 1585:2020 allows $\pm 7\%$ correction on SI and $\pm 10\%$ correction on CI engines.

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: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

SAE J1312 Procedure for Mapping Performance—Spark Ignition and Compression Ignition Engines

SAE J1995 Engine Power Test Code - Spark Ignition and Compression Ignition - Gross Power and Torque Rating

2.1.2 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at www.ecfr.gov.

40 CFR § 1065.703 Distillate diesel fuel

2.1.3 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org>.

ISO 1585 Road vehicles - Engine test code - Net power

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

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

SAE J1940 Small Engine Power and Torque Rating Procedure

SAE J2723 Engine Power Test Code - Engine Power and Torque Certification

2.2.2 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at www.ecfr.gov.

40 CFR § 1065.701-1065.725

2.2.3 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 2288	Agricultural tractors and machines - Engine test code (bench test) - Net power
ISO 2534	Road vehicles - Engine test code - Gross power
ISO 3046	Reciprocating internal combustion engines - Performance
ISO 4106	Motorcycles - Engine test code - Net power
ISO 9249	Earth-moving machinery - Engine test code - Net power
ISO 15550	Internal combustion engines - Determination and method for the measurement of engine power - General requirements

3. DEFINITIONS

This section contains the definitions of key terms used to describe the net power and torque test.

3.1 NET BRAKE POWER AND TORQUE

The power and torque produced by an engine at any speed when configured as a “fully equipped” engine (per 3.5), corrected to the reference atmospheric conditions and/or reference diesel fuel specifications per Section 5, and tested in accordance with the applicable procedures contained in this standard.

3.2 RATED NET BRAKE POWER AND TORQUE

The net brake power and torque produced by the engine at the rated power speed and rated torque speed, respectively.

3.3 RATED POWER SPEED

The engine speed at which the rated brake power is achieved. The rated power speed must be achievable in the application for which the engine is rated.

3.4 RATED TORQUE SPEED

The engine speed at which the rated brake torque is achieved. The rated torque speed must be achievable in the application for which the engine is rated.

3.5 FULLY EQUIPPED ENGINE

A “fully equipped” engine is an engine equipped with only those accessories necessary to perform its intended service. Accessory components that are installed on all engines in the application, e.g., power steering pump, are also included on the engine for test. Table 6 in Section 6 lists the engine equipment and accessories required for the net power test.

3.6 REFERENCE TEST CONDITIONS

The standard or reference engine inlet air supply (atmospheric) and inlet fuel conditions to which all torque and power corrections are made.

3.7 FRICTION TORQUE AND POWER

The torque and power required to drive the engine as equipped for the net power test. Friction torque and power may be established by one of the following methods.

Preferred method: Hot motoring friction—Record friction torque at wide-open throttle at each test speed run on the power test. All readings are to be taken at the same coolant and oil temperature as observed on the power test points $\pm 3^\circ\text{C}$, and variable engine devices should be at the as calibrated settings. If the oil temperature is not within $\pm 3^\circ\text{C}$, the manufacturer must document the oil temperature at the time the friction was reported.

Alternative method: If measured friction data are not available, it is permissible to assume 85% mechanical efficiency. When measured friction data are available, they must be used in computing mechanical efficiency. When this alternative method is used, it should be noted in the reported data that the results were corrected using an assumed mechanical efficiency of 85%.

3.8 INDICATED TORQUE AND POWER

Indicated power is defined as the sum of the brake power and friction power for the purpose of this document. Indicated torque is defined as the sum of brake torque and friction torque for the purpose of this document.

4. SYMBOLS, UNITS, AND SUBSCRIPTS

4.1 Symbols and Units

SI units shall be used for all measurements unless otherwise specified.

Table 1 - Symbols and units

Symbol	Term	Unit(s)
CA	Air correction factor	
CF	Fuel correction factor	
Fa	Atmospheric factor	
Fm	Engine factor	
Fd	Fuel density factor	
Fv	Fuel viscosity factor	
α	Pressure sensitivity exponent	
β	Temperature sensitivity exponent	
S	Viscosity sensitivity coefficient	
D	Engine displacement	L
Pa	Inlet air supply total pressure	kPa
t	Inlet air supply temperature	$^\circ\text{C}$
Pm	Inlet manifold total pressure	kPa
R	Pressure ratio	
Q	Fuel delivery	mg/L cycle
BP	Brake power*	kW, hp
FP	Friction power*	kW, hp
IP	Indicated power*	kW, hp
ME	Mechanical Efficiency	%
BT	Brake torque	N-m, lb-ft
FT	Friction torque	N-m, lb-ft
IT	Indicated torque	N-m, lb-ft
N	Engine speed	min^{-1}
F	Fuel flow	g/s
SG	Fuel specific gravity at 15°C	(unitless)
ν	Fuel viscosity at 40°C	mm^2/s

* Power and torque may be expressed as HP (0.746 kW) and lb-ft (1.356 N-m). This departure from metric standards is allowed due to the common use of English units in the advertising of power and torque to consumers.



4.2 Subscripts

c = Refers to data corrected to reference inlet air and fuel supply conditions

o = Refers to data observed at the actual test conditions

d = Refers to the dry air portion of the total inlet air supply pressure

r = Refers to the reference test conditions per Section 5

5. REFERENCE TEST CONDITIONS AND CORRECTIONS

This section contains reference air and fuel supply test conditions and specifications, recommended test ranges, and applicability of the correction procedures.

5.1 Reference Atmospheric Conditions

Table 2 defines reference atmospheric conditions and test ranges for which correction factors are valid.

Table 2 - Reference atmospheric conditions

	Standard Condition	Test Range Limits
Inlet Air Supply Pressure (absolute)	100 kPa	--
Dry Air Pressure (absolute)	99 kPa	90 to 105 kPa
Inlet Air Supply Temperature	25 °C	15 to 35 °C

With the exception of humidity, no modification to the composition of intake air is permitted. Available laboratory equipment shall be set to minimize correction factors by controlling inlet air as close as possible to "reference atmospheric conditions."

5.2 SI Gasoline Specifications

The ratings of SI engines tested under this standard must reflect the performance that a customer can obtain operating the engine on the manufacturer's recommended fuel. To achieve that, fuels used in testing must have energy content (defined as lower heating value) typical of that found in commercially available gasoline. The engine rating shall be for fuel octane values typical of commercially available fuels of the grade recommended by the manufacturer. No correction for power output is made due to fuel energy content.

Maximum allowable gasoline octane numbers for engine power rating have been determined corresponding to "regular," "mid-grade," and "premium" fuels from surveys of pump gasoline available throughout the United States in 2009. These values are listed in Table 3. Nominal ethanol content of up to 15% is allowed in the test fuel to match the United States (Environmental Protection Agency, EPA) limit on ethanol content of pump gasoline. If the EPA limit for ethanol content in conventional gasoline (except E85) is increased, the nominal ethanol content allowed under this standard shall be increased to match that limit provided that the ethanol content is within the manufacturer's recommended limit for the engine.

Many SI engines have electronic knock control systems that retard spark when knock is detected. If such a system is active when the engine is rated on the dynamometer, then the fuel used must be within the specified octane limits for the recommended fuel grade. An engine with a knock control system may be tested with higher octane fuel if the knock control system is disabled and the control settings are those that would be achieved when operating on customer-recommended fuel with active knock control. Vehicle test procedures for determining those control settings are specified in Section 9. Engines without knock control settings may be rated on any octane level fuel provided that the control settings are those used with customer-recommended fuel.

Table 3 - SI gasoline specifications

Fuel Grade	Regular	Mid-Grade	Premium
Max Research Octane No.	94	96	99
Max Motor Octane No.	85	88	89
Max Lower Heating Value (LHV)	43.5 MJ/kg	43.5 MJ/kg	43.5 MJ/kg

Table 4 shall be used in determining the fuel to be used in testing SI engines:

Table 4 - Fuel type selection for SI engine rating

Manufacturer's Specification	Fuel to Use (per Table 3)	Comments
Absence of Declaration	Regular fuel	
Minimum of 87 Octane	Regular fuel	Assumed to be (R+M)/2 method.
Regular Fuel	Regular fuel	
Premium Fuel Recommended	Premium fuel	
Premium Fuel Required	Premium fuel	
91+ Octane	Premium fuel	Assumed to be (R+M)/2 method.
Premium Recommended When Towing	Regular fuel	Towing is a small subset of customer usage. It is acceptable to have dual ratings.
Flex Fuel with Gasoline or E85	Recommended gasoline E85 (conditional)	Always report the gasoline rating. If the E85 rating is more than 2% higher than the rating on gasoline, then a dual rating is permitted.
Mid-Grade Fuel Recommended	Mid-grade fuel	Premium not allowed.

5.3 Reference CI Fuel Specifications

Reference fuel specifications are defined by 40 CFR § 1065.703 or most recent and represent range mean values for Type 2-D diesel fuel. The reference fuel characteristics in Table 5 have been determined to affect engine test power and are listed with the applicable test ranges for which correction factors are valid. Note that as indicated in 5.6.2, correction factors are not applied for engines where electronic controls adjust power and torque to compensate for fuel properties. Correction factors for engines using positive displacement injection systems are given in Appendix A.

Table 5 - Reference diesel fuel specifications

	Standard Condition	Test Range Limits
Fuel Density at 15 °C	0.835 kg/L	0.820 to 0.870 kg/L
Fuel Kinematic Viscosity at 40 °C	2.6 mm ² /s	2.0 to 3.2 mm ² /s
Fuel Inlet Temperature	40 °C	39 to 41 °C (pump/line/nozzles/common rail) or 37 to 43 °C (unit injectors)
Max Lower Heating Value	44.1 MJ/kg	
Aromatics, Min Volatility	100 g/kg	Per Table 1 of 40 CFR § 1065.703

5.4 Alternative Fuels

Reference values for alternative SI and CI fuels, both liquid and gaseous, are not presented in this document. Therefore, when alternative fuels are used for the net power engine test, no corrections to reference fuel conditions shall be made. Any reference to the rated power and torque for an engine rated on alternative fuel shall specify the fuel(s) used in rating the engine along with density and LHV.