



SURFACE VEHICLE STANDARD

J1995®

SEP2025

Issued 1990-01
Reaffirmed 1995-06
Revised 2025-09

Superseding J1995 JAN2014

(R) Engine Power Test Code - Spark Ignition and Compression Ignition -
Gross Power and Torque Rating

RATIONALE

This standard is intended to provide the industry with a repeatable means of determining the gross power and torque of an engine. Fuels have changed recently, which led to updates to Tables 5 and 6. Further, the Engine Power Test Code Committee ensures consistent formatting with SAE J1349 (net power).

TABLE OF CONTENTS

1.	SCOPE.....	4
1.1	Purpose of Standard	4
1.2	Field of Application	4
1.3	Relationship to ISO 2534	4
2.	REFERENCES.....	5
2.1	Applicable Documents	5
2.1.1	SAE Publications.....	5
2.1.2	ISO Publications.....	5
2.1.3	Code of Federal Regulations (CFR) Publications	5
2.2	Related Publications	5
2.2.1	SAE Publications.....	5
2.3	ISO Publications.....	5
3.	DEFINITIONS	6
4.	SYMBOLS, UNITS, AND SUBSCRIPTS	7
4.1	Symbols and Units	7
4.2	Subscripts	7
5.	REFERENCE TEST CONDITIONS AND CORRECTIONS.....	7
5.1	Reference Atmospheric Conditions	8
5.2	SI Gasoline Specifications	8
5.3	Reference CI Fuel Specifications.....	9
5.4	Alternative Fuels	9
5.5	Correction Factor	9
5.6	Correction Formulas.....	10
5.6.1	Spark-Ignition Engine Correction Formulas	10
5.6.2	Compression Ignition Engine Correction Formulas	11

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2025 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE J1995_202509

For more information on this standard, visit https://www.sae.org/standards/content/J1995_202509/

Documents

Standard, visit Sharing Hub

6.	LABORATORY AND ENGINE EQUIPMENT.....	11
6.1	Engine Equipment.....	11
6.2	Laboratory Equipment.....	13
6.2.1	Inlet System	13
6.2.2	Exhaust System	13
6.2.3	Fuel Supply System	13
6.2.4	Charge Air Cooler	14
6.2.5	Auxiliary Power Supply	14
7.	LABORATORY TEST PROCEDURES.....	14
7.1	Measurement System Accuracy	14
7.2	Measurement Requirements.....	14
7.2.1	Inlet Air Supply Pressure and Temperature.....	14
7.2.2	Intake Manifold Pressure and Temperature.....	14
7.2.3	Charge Air Cooler Pressure and Temperature	15
7.2.4	Coolant Temperature	15
7.2.5	Oil Pressure and Temperature (if Applicable).....	15
7.2.6	Fuel Temperature and Pressure	15
7.2.7	Air/Fuel Ratio	15
7.2.8	Ignition or Injection Timing	15
7.3	Adjustments and Run-In.....	15
7.3.1	Adjustments	15
7.3.2	Run-In.....	15
7.4	Test Operating Conditions	16
7.4.1	Steady-State	16
7.4.2	Transient	16
7.5	Power and Torque Determination	16
7.5.1	Test Procedure.....	16
7.5.2	Test Points	16
7.5.3	Logging of Measurements	16
7.5.4	Engine Calibration Controls	17
7.5.5	Charge Air Cooler Settings	17
7.5.6	Boosted Engine Manifold Absolute Pressure Settings	17
7.5.7	Ambient Temperature	17
7.5.8	Inlet Air Conditions	17
7.5.9	Coolant Temperature	17
7.5.10	Coolant Type.....	17
7.5.11	Oil Temperature	17
7.5.12	Oil Type.....	18
7.5.13	Fuel Temperature.....	18
7.5.14	Fuel Pressure.....	18
8.	PRESENTATION OF TEST RESULTS	18
8.1	Reporting Requirements	18
8.1.1	General Test Information	18
8.1.2	Engine Description	19
8.2	Recorded Test Conditions	19
8.2.1	Inlet Air Supply Conditions.....	19
8.2.2	Liquid Fuel - Spark Ignition Engine.....	20
8.2.3	Gaseous Fuel - Spark Ignition Engine	20
8.2.4	Diesel Fuels	20
8.2.5	Lubricating Oil	20
8.2.6	Engine Coolant (if Applicable).....	20
8.2.7	Test Cell Measurements and Calibrations	21
8.3	Test Data Requirements	21
9.	NOTES.....	23
9.1	Revision Indicator.....	23

APPENDIX A		24
Table 1	Symbols and units.....	7
Table 2	Reference atmospheric conditions.....	8
Table 3	SI gasoline specifications.....	8
Table 4	Fuel type selection for SI engine rating.....	9
Table 5	Reference diesel fuel specifications.....	9
Table 6	Engine equipment	12
Table 7	Engine setup	16
Table 8	Test data parameters	22

1. SCOPE

This SAE Standard has been adopted to provide a basis for dynamometer determination of gross engine power and torque under reference conditions. It is intended for use primarily by engine manufacturers that supply engines for installation by others in applications where the engine manufacturer may not control the induction and exhaust system design or the speed at which the engine is run. 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 gross engine power and torque ratings
- Reference inlet air and fuel supply test conditions
- A method for correcting observed power and torque to reference conditions
- A method for determining gross full load engine power and torque with a dynamometer

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 Part 1065.703 or most recent.

1.2.2 The corresponding test code for net as installed power and torque rating is SAE J1349.

1.2.3 The document for mapping engine performance is SAE J1312.

1.3 Relationship to ISO 2534

ISO 2534 differs from SAE J1995® in several areas, among which the most important are:

- a. This document is not limited to road vehicles.
- b. This document requires inlet fuel temperature be controlled to 40 °C on CI engines.
- c. This document includes a reference fuel specification and requires that engine power be corrected to that specification on all CI engines.
- d. This document includes a different procedure for testing engines with a laboratory charge air cooler.
- e. ISO 2534 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: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1312 Procedure for Mapping Engine Performance - Spark Ignition and Compression Ignition Engines

SAE J1349 Engine Power Test Code - Spark Ignition and Compression Ignition - As Installed Net Power Rating

2.1.2 ISO Publications

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

ISO 1585 Road Vehicles - Engine Test Code - Net Power

ISO 2534 Road Vehicles - Engine Test Code - Gross Power

2.1.3 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at <https://www.ecfr.gov/>.

40 CFR Part 1065 Engine Testing Procedures

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: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1940 Small Engine Power and Torque Rating Procedure

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

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 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 gross power and torque test.

3.1 GROSS BRAKE POWER AND TORQUE

The brake power and torque of an engine at any speed when configured as a basic engine as defined in 3.5, corrected to the reference atmospheric conditions and/or reference diesel fuel specifications per Section 5, and tested and corrected in accordance to the applicable procedures contained in this standard.

3.2 RATED GROSS BRAKE POWER AND TORQUE

The gross 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.

3.4 RATED TORQUE SPEED

The engine speed at which the rated brake torque is achieved.

3.5 BASIC ENGINE

A basic engine is an engine configured with only the built-in equipment required for self-sustained operation. A basic engine does not include accessories. Accessories that are integral with the engine or for any reason are included on the test engine, the torque and power absorbed may be determined and added to the gross brake torque and power. Common basic engine accessory examples are listed in Table 6.

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 alone as equipped for the power test. Friction torque and power may be established by one of the following methods (the value is needed for correction of spark ignition engines):

- a. 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 ± 3 °C, and variable engine devices should be at the as-calibrated settings. If the oil temperature is not within ± 3 °C, the manufacturer must document the oil temperature at the time the friction was reported.
- b. Alternative method: If measured friction data is not available, it is permissible to assume 85% mechanical efficiency. When measured friction data is available, it 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	°C
Pm	Inlet manifold total pressure	kPa
R	Pressure ratio	
Q	Fuel delivery	mg/L cycle
BP	Brake power ⁽¹⁾	kW, hp
FP	Friction power ⁽¹⁾	kW, hp
IP	Indicated power ⁽¹⁾	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
v	Fuel viscosity at 40 °C	mm ² /s

⁽¹⁾ 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 the limit provided so 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. 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