



### 2.1.1 SAE Publications

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SAE J1349 Engine Power Test Code—Spark Ignition and Compression Ignition—Net Power Rating

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

## 3. TERMS AND DEFINITIONS

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

### 3.1 Certified Brake Power and Torque

The power and torque which a manufacturer certifies an engine will develop when tested under the conditions as specified in SAE J1349 or SAE J1995.

## 4. SELECTION, DOCUMENTATION AND VERIFICATION OF TEST ARTICLE

The engine to be tested shall be selected by the manufacturer as representative of the engine in the application being certified. It is preferable to test engines from regular series production. Engines built from production-intent parts with production-intent processes and tooling may be used in the testing provided that all components conform to production intent design and comply with the requirements of the applicable standard (SAE J1349 or SAE J1995). It is the intent of this process that the level of hardware and calibration compliance to production specifications will be that which is required for US EPA Emissions Certification.

## 5. WITNESS TESTING

### 5.1 Definition

Witness testing is defined to mean testing in an appropriate facility that is witnessed by a qualified witness, independent of the engine manufacturer, who is able to verify equipment function and calibrations, computations, and engine test settings as specified in the applicable standard. Testing for conformance to this standard may be done in the manufacturer's facility or in any qualified independent facility conforming to ISO 9000/9002. Qualification is established by the ability to meet the requirements for testing according to SAE J1349 or SAE J1995.

### 5.2 Qualifications of Witness

Witnesses for engine power and torque certification testing shall be registered with SAE. Witnesses shall be competent engineers who are experienced in engine testing and familiar with the requirements of the SAE J1349 and SAE J1995 standards.

Witnesses registered by SAE shall meet one of the following criteria:

- 5.2.1 Prior registration as a witness for European homologation testing and a signed statement acknowledging that the individual has studied and understands the SAE procedures.
- 5.2.2 Documented and verified experience in engine testing with three recommendations from individuals who are registered witnesses themselves or whose technical training and experience establish them as competent to evaluate the individual's skills as a witness. In addition, a signed statement is required acknowledging that the individual to be registered has studied and understands the SAE J1349 and SAE J1995 testing procedures.

5.2.3 A Bachelors Degree in Engineering or equivalent plus 5 years of related engine testing experience and completion of an SAE-approved training course. Documented participation as an "apprentice witness" in at least three (3) SAE J1349 or SAE J1995 test procedures conducted by an SAE-certified witness who attests to the competency of that individual to conduct witness tests may be substituted for completion of an SAE-approved training course.

5.2.4 Other qualified individuals who are identified and appointed by the SAE Engine Power Test Code Committee. The witness will provide a signed statement acknowledging that the individual has studied and understands the relevant SAE test procedures.

### 5.3 Responsibility of Witness

5.3.1 Confirm that the laboratory doing the testing is capable of meeting the requirements for SAE J1349 or SAE J1995 and that the calibration of measurement devices is in accordance with ISO 9000/9002. If the facility is ISO certified to ISO 9000/9002, the witness shall attach a valid certificate of compliance to the test results. If testing is done in a facility which is not ISO certified, the witness shall provide documentation to establish the capability of the laboratory to conduct testing as specified in the appropriate standard.

5.3.2 Verify that the engine tested is consistent with that described in the manufacturer's submission.

5.3.3 Verify that the engine induction and exhaust system are those for the application being evaluated or, if applicable, verify that the exhaust backpressure is set appropriately.

5.3.4 If applicable, review data on vehicle transient testing to ensure that engine settings for dynamometer testing are correct. The data required for this shall include identification of the vehicle from which test data were obtained and the transient test data determined using the procedure in SAE J1349. These data shall include: engine control settings, temperatures, intake manifold pressure and exhaust back pressure as functions of time and vehicle speed.

5.3.5 Verify that fuel, coolant and lubricants used in testing are consistent with the manufacturer's specification for the application being rated.

5.3.6 The witness shall verify by appropriate means that critical measurements required for engine power and torque measurement are accurate. This may include testing of instrumentation.

5.3.7 Verify calculations by checking the output of the calculations with a test data set and by processing raw data from a test condition independently.

5.3.8 Verify that all control settings and test cell conditions are within the tolerance specified by the applicable standard.

5.3.9 Verify that the instrumentation is appropriately installed and that the signals from the instrumentation are accurately recorded and entered into the calculations.

5.3.10 Witness completion of the SAE J1349 or SAE J1995 Engine Power and Torque test procedure.

## 6. MANUFACTURER'S RESPONSIBILITIES FOR CERTIFICATION

A manufacturer wishing to certify an engine shall provide the following:

### 6.1 Test Article

The manufacturer shall provide an engine that is representative of the production engines being certified.

### 6.2 Manufacturer's Statement

The manufacturer shall supply documentation to SAE that includes the information listed in the following sections.

### 6.2.1 Engine Description

- All measurements and descriptions as listed in the appropriate standard
- Induction and exhaust system part name and part number list.
- Listing of oil, fuel and coolant used with appropriate specifications.
- Completed Form J2723 A. Engine Content Description
- ECU part number with software and calibration identifier/version.
- Engine build phase

### 6.2.2 Declaration of Power and Torque

The manufacturer shall report the declared power, declared torque and the respective speeds at which those values are achieved. The power and torque shall be designated as net (SAE J1349) or gross (SAE J1995). The declared values are those values that the manufacturer can use as "SAE Certified" in their product advertising and sales literature. The measured values of torque and power must be at least 99% of the declared values to be certified.

### 6.2.3 Test results as documented in SAE J1349 or SAE J1995.

### 6.2.4 Certification Statement

The manufacturer shall complete and submit form SAE J2723B as the actual certification document.

### 6.2.5 Production Variation

Engines certified under this standard are subject to normal production variation. It is expected that most engines, when fully friction stabilized and tested in accordance with SAE J1349 or SAE J1995 will produce power and torque values that are at least 98% of their certified values.

## 7. SAE RESPONSIBILITY

### 7.1 Review of Certification Data

SAE shall do the following prior to adding an engine to its listing of Certified Power and Torque:

- a. Review all documentation to establish:
  1. The engine description documentation is complete.
  2. The witness for engine testing was an SAE-qualified witness.
  3. The test data submitted are complete as required by J1349 or SAE J1995.
  4. The manufacturer has completed and an authorized representative has signed the certification statement.

### 7.2 Maintaining of Data Repository

SAE shall maintain a database of the certification data submitted by the manufacturers.

## 8. OPTIONAL METHOD FOR MANUFACTURERS TO CERTIFY ENGINES FOR APPLICATIONS WITH VARYING BACKPRESSURE AND INDUCTION RESTRICTION

A manufacturer may elect to test only one engine in order to certify multiple power ratings of a base engine configuration where the only differences among the ratings result from changes in restriction of the induction system ahead of the throttle and/or exhaust restriction after the exhaust manifold. The architecture of the induction and exhaust systems and manifolds of the different applications must be sufficiently similar that there are not any tuning differences among them. Use of this procedure requires that the engine calibration provide equivalent combustion timing and fueling for applications rated. Equivalence for combustion timing and fueling is to be interpreted as allowing slight alterations due to the intake and exhaust restrictions but not allowing changes in air-fuel ratio or combustion timing which would degrade power beyond the effects of the intake and exhaust restrictions.

When it is desired to certify an engine with multiple ratings, the manufacturer shall provide a chart similar to Figure 1 showing the power of the engine as a function of intake restriction and exhaust back pressure. The "base value" for this chart shall be defined by the intake and exhaust restriction values determined using procedure SAE J1349. The witness shall verify the power determined for the "base value" and may require additional test points to verify the accuracy of the chart.

Charts such as Figure 1 may also be used for engine torque ratings. In this case, it is understood that some minor variation in the speed at which peak torque is achieved may occur. When a single engine is rated at multiple torque levels through this method, the torque ratings shall be those corresponding to the torque at the rated speed of the base application. Alternatively, a manufacturer may elect to provide tabular data for multiple power and torque ratings of the same engine. The witness may elect to validate any of those data.

The rationale for allowing the certification of multiple applications through a limited number of tests lies in the concept that the manufacturer is certifying the product, and the role of SAE is to serve as the registrar and to confirm that testing of a representative engine was conducted according to SAE procedures.

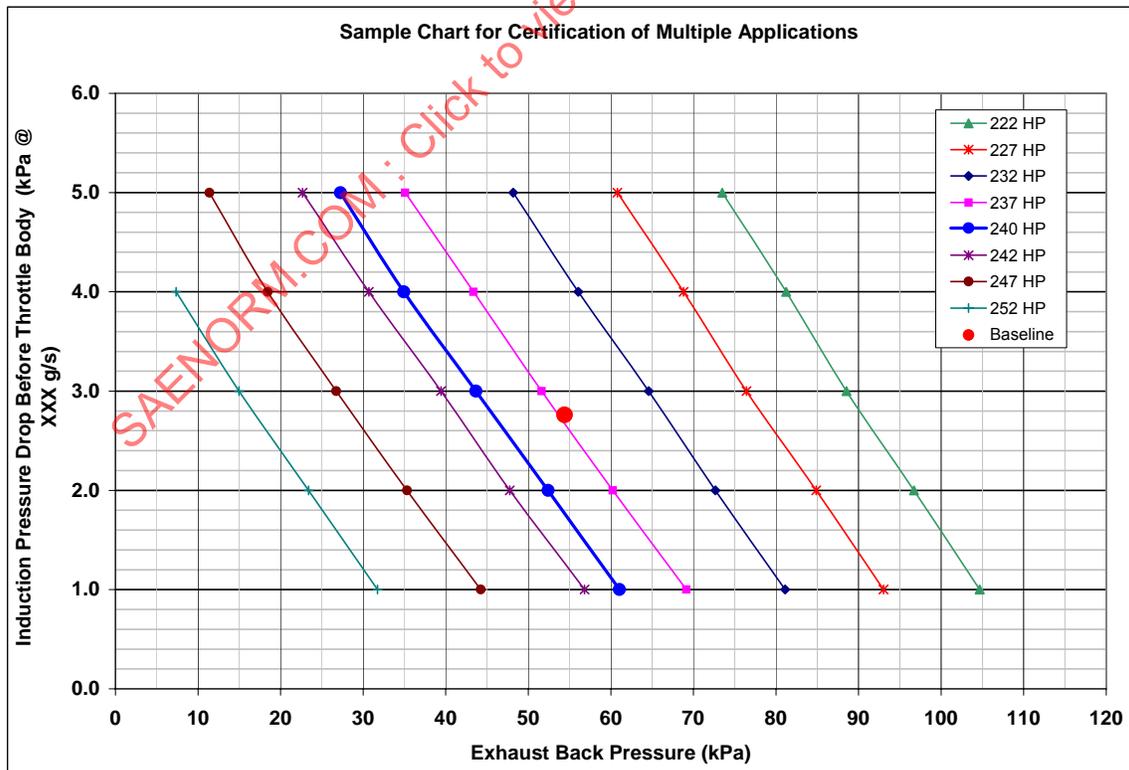


FIGURE 1 - SAMPLE ISOPOWER PLOT

## 9. AMENDMENTS TO CERTIFICATION

It is inevitable that engines in production will see slight changes from year to year or within a year. An example of such a change might be the resourcing of a component from a different supplier, or the revision of a calibration to correct a problem or improve fuel consumption or emissions. When these changes result in a change in the power and torque values of an engine that are less than or equal to 2% of the previously certified values, a manufacturer may file an amendment to the certification and advertise those values as certified without performing additional witness tests. In no case shall the amended values deviate from the original witnessed values by more than 2%. Specifically, amended values can be amended a second time only if the values remain within 2% of the original values certified through witness testing.

Any amendment to an existing certification must be filed with SAE to be valid and must include a description of the changes in hardware or calibration that occurred as well as the new power and torque values resulting from the changes. The vehicles for which the amended values apply must also be indicated.

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**SAE Power Certification  
Form J2723 A****ENGINE DESCRIPTION  
SAMPLE (As Tested):**

<b>Displacement:</b>	3700 cc
<b>Configuration/Number of Cylinders:</b>	60° V-6
<b>Valve Train:</b>	SOHC
<b>Type:</b>	Gasoline
<b>Combustion Cycle:</b>	Four Stroke
<b>Pressure Charging:</b>	Naturally Aspirated
<b>Charge Air Cooling:</b>	None
<b>Bore:</b>	93 mm
<b>Stroke:</b>	90.8 mm
<b>Cylinder Numbering Convention</b>	From front of crank nose rearward
<b>Firing Order:</b>	1-6-5-4-3-2 (120° Even Fire)
<b>Compression Ratio:</b>	9.7:1
<b>Fuel System:</b>	Port Fuel Injection
<b>Fuel System Pressure</b>	400 kPa (Nominal)
<b>Ignition System:</b>	Electronic Spark Ignited Coil on Plug
<b>Knock Control:</b>	Dual Wide-Band Knock Sensors
<b>Intake Manifold:</b>	Passive plastic shell molding
<b>Exhaust Manifolds:</b>	Cast Iron - Log Style
<b>Cooling System:</b>	Forced flow liquid cooling
<b>Coolant Liquid:</b>	50% water and 50% HOAT ethylene glycol (by volume)
<b>Thermostat:</b>	Inlet side – blocked open
<b>Cooling Fan</b>	Electric Motor Driven
<b>Lubricating Oil:</b>	SAE 5w30
<b>Fuel:</b>	Regular (87 PON)
<b>Fuel Shut Off Speed:</b>	6000 RPM

## SAE Power Certification



## Form J2723 B

MANUFACTURER: \_\_\_\_\_

ENGINE: \_\_\_\_\_

MODEL YEAR &amp; VEHICLE APPLICATION: \_\_\_\_\_

TEST STANDARD: \_\_\_\_\_

TEST LOCATION: \_\_\_\_\_

ENGINE SERIAL NUMBER: \_\_\_\_\_

TEST/RUN NUMBER: \_\_\_\_\_

## RESULTS:

The engine described herein was tested on Month, day, year, according to the requirements prescribed in SAE J1349, Engine Power Test Code in the presence of a qualified SAE witness, and was determined to produce the following results:

Parameter	Rated Speed	Rated Output	Measured Speed	Measured Output	% Difference
Power (hp/kW)					
Torque (lb-ft/Nm)					

## APPROVALS:

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 SAE Certified Witness, Date

The manufacturer declares that the engine tested for this report is representative of engines in series production. The manufacturer further declares that the performance of engines in series production will characteristically be at least 98% of the rated torque and power values indicated on this report.

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 Name                      Title                      Date



**WOT ENGINE TEST DATA SAMPLE**

Parameter	Units	1	2	3	...	...	...	...	...	...	n-1	n
Test Point		1	2	3	...	...	...	...	...	...	n-1	n
Engine Speed	rpm											
Observed Torque	lb-ft											
Observed Torque SI	N-m											
Corrected Torque	lb-ft											
Corrected Torque SI	N-m											
SAE Corrected Brake Power	hp											
Corrected Brake Power SI	kW											
Motoring Friction Torque	N-m											
Motoring Friction Power	kW											
Cooling Fan Loss (if applicable)	kW											
PS Pump Loss (if applicable)	kW											
SAE J1349 Correction Factor												
BMEP	kPa											
Air/Fuel Ratio (Left)	:1											
Air/Fuel Ratio (Right)	:1											
Mass Airflow	g/sec											
Mass Fuel Flow	g/sec											
Fuel Meter Temperature	°C											
Fuel Rail Temperature	°C											
Coolant Outlet Temperature	°C											
Coolant Inlet Temperature	°C											
Oil Sump Temperature	°C											
Exhaust Gas Temperature (Left)	°C											
Exhaust Gas Temperature (Right)	°C											
Ambient Temperature	°C											
Inlet Air Temperature	°C											
Ambient Pressure	kPa											
Inlet Air Vapor Pressure	kPa											
Inlet Air Pressure	kPa											
Intake Manifold Pressure	kPa											
Fuel Rail Pressure	kPa											
Oil Pressure	kPa											
Exhaust Manifold Pressure (Left)	kPa											
Exhaust Manifold Pressure (Right)	kPa											
ecu Engine Speed	rpm											
ecu Mass Airflow	g/sec											
ecu MAP	kPa											
ecu Spark Advance	BTDC											
ecu Intake Cam Phase Position	deg											
ecu Exhaust Cam Phase Position	deg											
ecu Commanded AFR (Left)	:1											
ecu Commanded AFR (Right)	:1											
ecu Throttle Position	volts											
ecu Battery Voltage	volts											
ecu Coolant Temperature	°C											
ecu Charge Air Temperature	°C											
ecu Barometric Pressure	kPa											
<b>Boosted Engines Only</b>												
Compressor Outlet Temperature	°C											
Manifold Inlet Temperature	°C											

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