



SURFACE VEHICLE RECOMMENDED PRACTICE

J1491™

MAY2025

Issued 1985-06
Reaffirmed 1995-03
Cancelled 2002-10
Revised 2025-05

Superseding J1491 JUL2006

(R) Vehicle Acceleration Measurement

RATIONALE

SAE J1491 has been updated to:

- Provide updated guidance on new propulsion systems, specifically hybrid and battery electric vehicles
- Clarify two time-zero definitions for launch testing representing customer-style and driver's best effort maneuvers
- Adapt to modern data acquisition systems

1. SCOPE

To define a test procedure that will provide repeatable measurements of a vehicle's maximum acceleration performance for launch and passing maneuvers and standardize time zero used in reported results.

1.1 Purpose

Launch testing is used to characterize the vehicle's acceleration and performance starting from a stop under standard test conditions. Launches are sometimes called standing start, drive-away, and take-off maneuvers. Launches are broken into two test types:

- Customer-style, which replicates the typical customer experience and calculates performance metrics in a way that correlates with customer perception
- Driver's best effort, which yields best performance when driving aggressively and calculates performance similar to a dragstrip measurement where the driver can choose how to control the vehicle to obtain the best possible performance

The passing test characterizes the vehicle's performance when fully pressing the accelerator pedal starting from a stabilized vehicle speed under standard test conditions.

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 J1491_202505

For more information on this standard, visit
https://www.sae.org/standards/content/J1491_202505/

Documents

Standard, visit Sharing Hub

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 J2807 Performance Requirements for Determining Tow-Vehicle Gross Combination Weight Rating and Trailer Weight Rating

3. DEFINITIONS

3.1 TIME ZERO

Time zero is used to define the start time for some performance metrics such as 1/4 mile time and 0 to 60 MPH time as is specified in Section 9. Note that the time zero definition is different based on whether the test is a customer-style launch, driver's best effort launch, or passing maneuver.

3.2 UNLOADED VEHICLE WEIGHT

The weight of the vehicle as built with production parts with maximum capacity of all fluids necessary for operation of the vehicle.

3.3 MILES PER HOUR and KILOMETERS PER HOUR

Miles per hour is a unit of speed, expressing the number of international miles covered per hour used in countries using the English system. The common abbreviation in everyday use is MPH, although mi/h, using the SI method of expressing derived units, is sometimes used, especially in the United States. While the preferred SI unit for velocity is meters per second, KPH or kilometers per hour is often used to express vehicle speed in countries using the metric system.

4. INSTRUMENTATION

All instrumentation must be calibrated.

4.1 Speed

Instrumentation to measure vehicle speed as a function of elapsed time meeting the following specifications:

a. Time

1. Accuracy of ± 0.01 second
2. Resolution of 0.01 second

b. Vehicle Speed

1. Accuracy of ± 0.4 KPH (± 0.25 MPH), care should be taken with global positioning systems (GPS) to place the antenna(s) to avoid multipath signal noise
2. Resolution of 0.2 KPH (0.1 MPH)

c. Engine Speed (tachometer) – Optional for internal combustion engine equipped vehicles

1. Accuracy of ± 50 RPM
2. Resolution of 25 RPM

4.2 Distance (Recommended)

Equipment to measure distance traveled which defines time zero for driver's best effort launches and 1/4 mile and 400 m distance traveled for all launch tests.

- a. Accuracy of ± 20 mm (0.787 inch)
- b. Resolution of 1 mm (0.04 inch)

NOTE: It is strongly recommended to use distance measurement equipment; however, integrating speed-time data can be used if distance measurement equipment is not available.

4.3 Temperature

Equipment to measure ambient temperature during the test; note that sensing elements must be shielded from radiant heat sources.

- a. Accuracy of ± 1 °C (± 2 °F)
- b. Resolution of 1 °C (2 °F)

4.4 Atmospheric Pressure

Atmospheric pressure should be measured with a barometer with an accuracy of ± 0.7 kPa (± 0.2 in Hg).

4.5 Wind

Wind, speed, and direction during the test should be continuously monitored. Wind measurements should permit the determination of average longitudinal and crosswind components to within ± 2 KPH (± 1 MPH).

4.6 Vehicle Weight

Vehicle weight should be measured to an accuracy of ± 5 kg (± 10 pounds) per axle.

4.7 Tire Pressure

Tire pressure should be measured to an accuracy of ± 7 kPa (± 1 psi).

4.8 Accelerator Pedal Position

Data acquisition of accelerator pedal position used to calculate time zero for customer-style launch and passing maneuver tests.

Accelerator pedal position can be measured using controller area network (CAN) data acquisition equipment if the CAN data rate is 25 ms or faster. Otherwise, direct pedal sensor voltage measurements and/or an external displacement transducer such as a string pot or linear displacement variable transducer are the preferred data acquisition methods.

Accelerator pedal position is linearly interpolated between minimum (0%) and maximum (100%) pedal travel when using an external sensor.

4.9 Accelerometer (Optional)

An accelerometer may be used to help in the analysis of data. An accelerometer with ± 2.0 g capability, 1% accuracy, and 0.005 g resolution is suggested.

5. TEST MATERIAL

5.1 Test Vehicle

The test vehicle will normally be representative of a standard production-built vehicle; any nonstandard equipment must be noted (i.e., roof racks, optional mirrors, fog lamps, spoilers, optional axle ratio, etc.). Record any equipment that is removed for test. The vehicle mass shall be set for the intended test purpose and recorded.

5.2 Test Fuel (for Internal Combustion Engine or Fuel Cell Equipped Vehicles)

Commercially available fuel as recommended by the manufacturer will normally be used for test purposes. If the information is available or if a special test fuel is used, the fuel specifications should be recorded, such as: fuel generic type, gasoline octane rating or diesel cetane rating, brand name, specific gravity, Reid vapor pressure.

5.3 Lubricants

Lubricants used shall conform to the manufacturer's recommendation for the predominant weather condition in which the vehicle is being tested.

6. TEST CONDITIONS

6.1 Test Location

Any proving ground can be used if the track surface is dry, clean, flat, smooth, and length is sufficient to safely perform the test and ambient conditions are within specifications. The road surface should be high quality concrete or rolled asphalt (or equivalent) in good condition.

6.2 Ambient Conditions

Tests should be run as close as possible to the standard conditions to assure results are as repeatable as possible. (See Table 1.)

Table 1 - Standard ambient conditions

	Standard Condition	Correction Not Required If within This Range
Ambient Temperature	20 °C (68 °F)	15-25 °C (59-77 °F)
Barometric Pressure (absolute)	99 kPa (29.2 in Hg)	98-100 kPa (28.9-29.5 in Hg)
Relative Humidity	50%	30-95%

6.3 Adverse Weather Conditions

The tests may not be run during foggy, rainy, or snowy conditions.

6.4 Wind Velocity

The tests may not be conducted when wind speeds average more than 15 KPH (9.3 MPH) or when peak wind speeds are more than 25 KPH (15.5 MPH).

6.5 Road Conditions

The test surface must be dry, clean, smooth, and must not exceed 0.5% grade. In addition, the grade should be constant, and the road should be straight. The road surface should be concrete, rolled asphalt, or equivalent and in good condition. Testing should not be conducted on slippery roads. Recommended track length is 1200 m or greater to enable safe testing.

6.6 Speed Limitation

These tests should be run on a controlled track or proving grounds. If these tests are run on public roads or highways, speed should not exceed the posted speed limit, and the vehicle should not interfere with traffic flow or otherwise operate in a manner that would be hazardous.

7. VEHICLE PREPARATION, SETUP, AND CONFIGURATION

7.1 Break-In

The vehicle should have at least 1609 km (1000 miles) of operation or mileage to ensure vehicle performance is stabilized as determined by manufacturer. Tires must have at least 75% of the tread remaining, and tread must be in good condition. All tires must have at least 161 km (100 miles) of run in before test. For high performance vehicles, it is recommended to have at least 98% tread remaining to enable the best possible performance.

7.2 Vehicle Checklist

- The vehicle must be inspected and adjusted where necessary to meet manufacturer's specifications. Verify that no diagnostic codes are active or pending, fluids are full, and maintenance is performed. Make sure all other adjustments, such as front-end alignment and functional checks, are performed in accordance with manufacturer's published procedures.
- Ensure that there are no obstructions like floor mats blocking the accelerator pedal from reaching its full travel.
- If the vehicle is equipped with an automatic transmission, ensure that the automatic transmission shift points are within manufacturer's published specifications. If shift points fall outside specifications, repeat the maneuvers to see if adaptive learning occurs. If shift points still do not achieve expectations after multiple runs, consult the manufacturer to receive instructions on any required transmission adaptive learning.
- Ensure that brake drag is not excessive.
- Check to ensure the vehicle is not in a special warm-up or thermal derate mode during the test.

7.3 Instrumentation

The speed-time measurement device and other necessary test equipment must be installed so that they do not hinder vehicle operation or alter the operating characteristics of the vehicle.

Table 2 provides guidance on required signals to record during the performance tests.

Table 2 - Required signals to record during performance tests

Required Parameter	BEV	HEV	ICE/Fuel Cell	Transmission	Measurement Notes	How Parameter Is Used
Accelerator Pedal Position	X	X	X	X	Can measure with LVDT, string pot or similar, or CAN DBC	Time-based triggers
Ambient Temperature	X	X	X	X	Can use a clip-on external thermocouple, CAN DBC, or track weather station	Performance correction, etc.
Ambient/Barometric Pressure		X	X	X	Can use the track weather station, external pressure transducer, or CAN DBC	Performance correction, etc.
High Voltage Battery Displayed State of Charge - Start & End of Each Run	X	X			Driver can record state of charge from IP/cluster before and after each test run and note, CAN DBC can be used if output matches the cluster display	Battery/performance characterization
Test Vehicle Mass	X	X	X	X	Recommend to run each day performance testing is run	Correlate performance to simulation
Time	X	X	X	X		Performance metrics
Tire Pressure	X	X	X	X	Can measure and record before and after test or use CAN DBC during test	Performance debug
Vehicle Distance Traveled	X	X	X	X	Can integrate vehicle speed if necessary or use GPS; CAN DBC is permitted if it meets specifications in Section 4	Performance metrics
Vehicle Speed	X	X	X	X	Typically measured with GPS or wheel encoders; CAN DBC is permitted if it meets specifications in Section 4	Performance metrics

Table 3 provides guidance on optional signals to record during the performance tests. Optional signals can help debug test results or correlate simulation models after testing.

Table 3 - Optional signals to record during performance tests

Optional Parameter	BEV	HEV	ICE/Fuel Cell	Transmission	Measurement Notes	How Parameter Is Used
Accessory Loads	X	X	X	X	Typically requires external instrumentation (current clamps and voltage probes)	Detailed energy management analysis
Actual Engine Torque	X	X	X	X	Requires a CAN DBC or external instrumentation	Detailed performance debug
High Voltage Battery Current	X	X			Typically measured with a current clamp or CAN DBC	Battery/performance characterization
High Voltage Battery Power	X	X			Can be calculated with current and voltage measurements	Battery/performance characterization
High Voltage Battery State of Charge - Realtime Measurement	X	X			Typically measured with a CAN DBC	Battery/performance characterization
High Voltage Battery Temperature	X	X			Typically measured with a thermocouple or CAN DBC	Battery/performance characterization
Low Voltage Battery Voltage	X*	X	X	X	Typically measured with a voltage probe or CAN DBC *For BEV vehicles so equipped	Determine alternator accessory load
High Voltage Battery Voltage	X	X			Typically measured with a voltage probe or CAN DBC	Battery/performance characterization
Brake Pedal Position	X	X	X	X	Can measure with LVDT, string pot or similar, or CAN DBC	Time-based triggers
Manual Transmission Clutch Pedal Position				X	Can be measured with a LVDT or string pot or CAN DBC	Time-based triggers (MTX Only)
Commanded Gear				X	Typically measured with a CAN DBC	Gear shift characterization
Current Gear				X	Typically measured with a CAN DBC or calculated from Turbine/Vehicle Speed	Gear shift characterization