SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

J1491	REV. JUL2006
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(R) Vehicle Acceleration Measurement

RATIONALE

SAE J1491 Acceleration and Launch Performance is being updated to:

- reflect current practice,
- add standard test conditions, and
- clarify measurement parameters.

1. SCOPE

To define a test procedure that will provide a repeatable measure of a vehicle's launch response and maximum accelleration performance.

1.1 Purpose

This SAE Recommended Practice provides a standardized means of measuring launch response and acceleration performance of passenger cars and light-duty trucks.

2. REFERENCES

There are no referenced publications specified herein.

3. DEFINITIONS

3.1 Time Zero

The time used in the calculation for Launch Response Time and Acceleration Response Time. It is derived as specified in Section 9.

3.2 Launch Response Time

Vehicle response in seconds from driver control input measured by a) initial throttle pedal movement (automatic transmission) or b) clutch movement (manual transmission) to Initial Vehicle Movement. See 3.3.

3.3 Initial Vehicle Movement (IVM)

Movement of vehicle a distance of 0.3048 m (one foot) from rest position.

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3.4 Acceleration Response Time

Vehicle response in seconds from IVM to test end speed or distance. The Acceleration Response Time for distance is usually calculated at one quarter mile (0.402km).

3.5 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.

3.6 Miles per Hour

Miles per hour is a unit of speed, expressing the number of international miles covered per hour. 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. The preferred SI unit for velocity is m/s, although km/h is often used as a replacement for mph.

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 ±0.1 s

    2. Resolution 0.1 s

b. Vehicle Speed

    1. Accuracy ±0.8 km/h (±0.50 mph)

    2. Resolution 0.4 km/h (0.25 mph)

c. Engine Speed (tachometer)

    1. Accuracy ±50 rpm

    2. Resolution 25 rpm

4.2 Distance (One Foot) Optional

Equipment to measure Initial Vehicle Movement.

1. Accuracy ±5 mm

2. Resolution 12.5 mm

NOTE: This equipment is optional since the one foot distance used in calculations may be made by integration of speed.

4.3 Temperature

The ambient temperature measurement devices must have a resolution of 1 °C (2 °F) and an accuracy of ±1 °C (±2 °F). The sensing elements must be shielded from radiant heat sources.

4.4 Atmospheric Pressure

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 km/h (±1 mph).

4.6 Vehicle Weight

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

4.7 Tire Pressure

Should be measured to an accuracy of ±7 kPa (±1 psi).

4.8 Distance (optional)

A distance indicating device is required for the 402 m (1/4 mile) test so that driver knows when to end test. This device must be capable of indicating distance to within 1 ft and must be capable of accuracy within 1 m in 1 km (5 ft in 1 mile). Fixed markers at the side of the test road can also be used.

NOTE: The 0.3048 m (one foot) test point will be measured using the speed and time during the data calculations.

4.9 Throttle Position Monitor (optional)

A readout to monitor/regulate throttle position. This can be used to monitor/regulate wheel spin on some vehicles.

4.10 Accelerometer (optional)

An accelerometer may be used to help in the analysis of data by providing information on shift points. An accelerometer with 2.0 g capability, 1% accuracy and .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.

Consideration should be made to test automatic transmission shift modes like “sport” or “power.”

5.2 Test Fuel

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 Ambient Conditions

Tests should be run as close as possible to the standard conditions:

TABLE 1 – STANDARD AMBIENT CONDITIONS

	Standard Condition	Correction preferred but not required if within this range	Test Range
Ambient temperature	20 °C (68 °F)[1]	15 – 25 °C (59 – 77 °F)	–1.0 and 32 °C (30 and 90 °F)
Barometric Pressure (absolute)	98.21 kPa (29.0 in Hg)[1]	98-100 kPa	90-102 kPa
Relative Humidity	50%	40 – 60%	<95%

1. Standard condition temperature and pressure are based on SAE J2263, "Roadload Measurement Using Onboard Anemometry and Coastdown Techniques."

6.2 Adverse Weather Conditions

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

6.3 Wind Velocity

The tests may not be conducted when wind speeds average more than 24 km/h (15 mph) (or when peak wind speeds are more than 32 km/h (20 mph)).

6.4 Road Conditions

The roads 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 or rolled asphalt (or equivalent) and in good condition; testing should not be conducted on slippery roads.

6.5 Speed Limitation

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

7. VEHICLE PREPARATION

7.1 Break-In

The vehicle should have at least 1609 km (1000 miles) of operation or mileage to assure 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.

7.2 Vehicle Check List

- The vehicle must be inspected and adjusted where necessary to meet manufacturer's specifications, particularly if vehicle is exhibiting abnormal performance characteristics during acceleration. Tune and time engine, and make all other adjustments, such as front end alignment, and functional checks in accordance with manufacturer's published procedures.
- Operate, observe, and reset, if necessary, the throttle system linkage to ensure that wide open throttle occurs.
- If the vehicle is equipped with automatic transmission, ensure that automatic transmission shift points are within manufacturer's published specifications.
- Ensure that brake drag is not excessive.

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.

7.4 Test Weight

The vehicle weight shall be set for the intended test purpose and recorded.

7.5 Tire Pressure

The cold tire pressure should be the standard recommended by the manufacturer for the vehicle test weight and installed tires.

7.6 Vehicle Warm-up

The vehicle must be driven a minimum of 32 km (20 miles) at an average speed of 88 km/h (55 mph ± 5 mph) immediately prior to the test. Alternative schedules that provide equivalent vehicle warm-up can be substituted. There should not be more than a 5 min time lapse between the warm-up and the start of test.

8. TEST PROCEDURE

8.1 Test Schedules Summary

Perform wide open throttle (WOT) accelerations from a standing start and record the following:

- Launch Response Time (Control Input to IVM)
- Acceleration Response Time (IVM to test end speed)

Also perform the following test at wide-open-throttle:

- 64 to 97 km/h (40 to 60 mph) – Elapsed Time

8.2 Automatic Transmission Operating Procedure

From a standing start with engine at idle (braked, if necessary), with the shift selector in the “drive” position for normal operation, accelerate with wide-open-throttle. The vehicle should be operated to achieve maximum performance with minimum wheel spin. Begin recording data the instant the driver’s foot moves the accelerator pedal.

8.3 Manual Transmission Operating Procedure

From a standing start, the vehicle should be operated to achieve maximum performance with minimum wheel spin. Clutch operation, as well as shift point selection, should be optimized for performance without exceeding the maximum specified engine rpm. Begin recording data at the instant of clutch pedal movement.

8.4 Test Procedure 40 to 60

Starting from a stabilized 64 km/h (40 mph), accelerate with wide-open throttle to 97 km/h (60 mph). Manual transmissions should be run both in top gear and top gear less one, with 4- or 5-speed transmissions. Test in 4th and 5th gear with a 6-speed manual transmission. Three-speed manual transmission should be run in top gear only. Manual transmissions should not be downshifted during this test. Begin recording data on throttle or clutch pedal movement per the manual or automatic procedure in 8.3 or 8.4 as applicable.

Automatic transmissions will be allowed to downshift as determined by the vehicle transmission controls.

8.5 Number of Tests and Delay

8.5.1 Run a minimum of three pairs of tests, with each pair conducted in opposing directions. When difficulty is experienced in one run, the pair is excluded.

8.5.2 A delay period of 30 seconds (default) or as requested by engineer is required between runs to maintain “closed-loop” mode. The delay avoids built-in engine control calibration overrides or changes which may occur under repeated back-to-back runs. The delay interval must be done with the vehicle moving to allow powertrain cool down.

8.6 Operation of Accessories

The headlamps are to be off. If the vehicle is equipped with pop-up lamps, the lamp pods should be in the down position. The lights should be on if required for safe vehicle operation, and so noted in test results.

- The heater blower motor shall be used in the "low" position only.
- Vehicles equipped with air conditioning should have the compressor clutch wire disconnected before the start of test.
- Radio operation is optional.
- All other electrical accessories must be in the off position.
- Windows should remain closed during test runs.
- Traction control system shall be in the “state providing maximum acceleration” determined by the requesting engineer.

9. DATA REDUCTION

9.1 Data Calculation

9.1.1 Time Zero. Launch and Acceleration Response Only

Time Zero is the time at which the pedal has gone through 10% of its travel. See Figure 1.

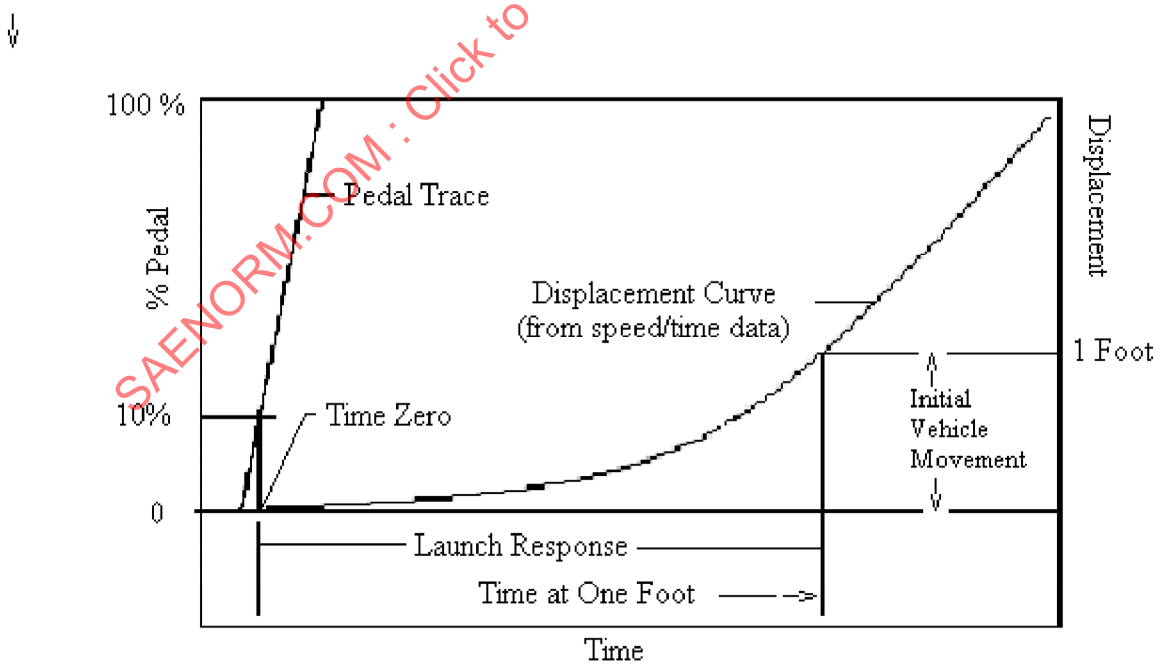

FIGURE 1 – GRAPHICAL DEFINITIONS

9.1.2 One Foot

Calculate the one foot distance by integrating the speed/time data to obtain a distance plot. See Figure 1. It may also be measured directly using optional instrumentation.