The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1491

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Submitted for recognition as an American National Standard

VEHICLE ACCELERATION MEASUREMENT

***Foreword*—**This Reaffirmed Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. ***Scope*—**To define a test procedure that when conducted will provide a repeatable measure of a vehicle's maximum acceleration performance.

1.1 **Purpose—**This SAE Recommended Practice provides a standardized means of measuring acceleration performance of passenger cars and light-duty trucks.

2. ***References*—**There are no referenced publications specified herein.

3. ***Definition***

3.1 **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.

4. ***Instrumentation*—**(All instrumentation must be calibrated.)

4.1 **Speed-Time—**An instrument to measure vehicle speed as a function of elapsed time is used in this procedure. The device must meet 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 **Temperature—**The ambient temperature indicating 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.

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4.3 **Atmospheric Pressure—**A barometer with an accuracy of ±0.7 kPa (±0.2 in Hg).

4.4 **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).

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

4.6 **Tire Pressure—**Should be measured to an accuracy of ±7 kPa (±1 psi).

4.7 **Distance—**A distance indicating device is required. 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).

5. ***Test Material—***(See Figure 1.)

5.1 **Test Vehicle—**The test vehicle shall be completely defined on the Vehicle Specification Sheet. 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.

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 Temperature—**The test should be conducted at ambient temperatures between –1 and 32 °C (30 and 90 °F).

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 3218 km (2000 miles) of operation before test. 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.

LEVEL ROAD W.O.T. ACCELERATION PERFORMANCE
VEHICLE SPECIFICATION SHEET

Report No. _____
Date _____

Vehicle: Make _____ Model _____ Year _____ Car No. _____
Odometer _____ Km/mi VIN _____
Test Weight _____ kg (lb) RF _____ kg (lb) LF _____ kg (lb) RR _____ kg (lb) LR _____ kg (lb)

EQUIPPED WITH

Engine: Type _____ Displacement, L (in^3) _____ Compression Ratio _____
No. of Cylinders _____ Rated SAE Power, kW (hp) _____
Fuel System _____
Engine Fan Type _____
Knock Sensor Yes _____ No _____
Idle Speed _____ rpm (Drive) _____ rpm (Neutral)
Redline _____ rpm Initial Timing _____
Boost, kPa (psi) _____ Valves per Cylinder _____

Transmission: Type _____
Forward Ratios _____

Axle Ratio: Front Wheel Drive[1] _____
Rear Wheel Drive[2] _____
[1] Overall Top Gear Ratio = Transfer Drive Ratio X Final Reduction Gear Ratio
[2] Rear Wheel Drive = Rear Axle Ratio

Tires: Manufacturer _____ Model _____
Type _____ Size _____
Pressure (Cold) Front _____ kPa (psi) Rear _____ kPa (psi)

Brake Type: Front _____ Rear _____

Exhaust System
Type: _____

Operational Checklist:
Throttle Operation _____
Transmission Operation _____
Brake Drag _____
Parking Brake _____
Wheel Alignment (include rear for IRS) _____

Fluid Level Checklist:
Engine Oil _____
Transmission _____
Coolant _____
Brake _____
Differential _____
Power Steering _____

Test Fuel Specifications:
Test Fuel Type and Grade _____
Gravity (API or Specific) _____ @ 60 °F (15.6 °C)
Reid Vapor Pressure _____ psi (kPa)
Distillation 10% _____ °F (°C)
50% _____ °F (°C)
90% _____ °F (°C)
Test Fuel Octane No. _____
$\frac{R+M}{2}$ _____
Diesel Test Fuel Cetane No. _____
Diesel Test Fuel Viscosity _____

Optional Equipment: _____

Equipment Removed
for Test: _____

Notes: _____

FIGURE 1—VEHICLE SPECIFICATION SHEET

7.2 Vehicle Check List

7.2.1 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.

7.2.2 Operate, observe, and reset, if necessary, the throttle linkage to ensure that wide open throttle occurs.

7.2.3 If the vehicle is equipped with automatic transmission, ensure that automatic transmission shift points are within manufacturer's published specifications.

7.2.4 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 unloaded vehicle weight plus 136 kg (300 lb) (includes driver and all instrumentation) and the fifth wheel in the raised position.

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.

7.7 Vehicle Data—Record all information as specified on the attached Vehicle Specification Sheet Figure 1.

8. Test Procedure

8.1 Test Schedules

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

a. 0 to 48 km/h (0 to 30 mph)—Record Elapsed Time
b. 0 to 80 km/h (0 to 50 mph)—Record Elapsed Time
c. 0 to 97 km/h (0 to 60 mph)—Record Elapsed Time
d. 402 m (1/4 mile)—Record Elapsed Time and Terminal Speed
e. 0 to 5 s—Record Distance Covered and Terminal Speed

8.1.2 Also perform the following test at wide open throttle:

a. 64 to 97 km/h (40 to 60 mph)—Record 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, accelerate with wide open throttle. The vehicle should be operated to achieve maximum performance with minimum wheel spin. Time zero starts at 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. Time zero starts at the instant of clutch pedal movement.

8.4 40 to 60 Test Procedure—Starting from a stabilized[1] 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.

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

8.5 Test Data

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 Record all data specified on the Vehicle Data Sheet (see Figure 2.)

8.6 Operation of Accessories

8.6.1 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 under remarks on the Vehicle Data Sheet (see Figure 2).

8.6.2 The heater blower motor shall be used in the "low" position only.

8.6.3 Vehicles equipped with air conditioning should have the compressor clutch wire disconnected before the start of test.

8.6.4 Radio operation is optional.

8.6.5 All other electrical accessories must be in the off position.

8.6.6 Windows should remain closed during test runs.

9. Data Reduction

9.1 Data Calculation—Simple averages will be calculated for all valid multiple test observations (pairs of data).

9.2 Data Presentation—Data should be presented in accordance with the Vehicle Data Sheet (see Figure 2). Alternatively, continuous plots may be charted as follows: speed versus time, time versus distance, or other data considered appropriate.

1. Vehicle speed shall be within ±0.8 km/h (±0.5 mph) of start speed for at least 2 s before proceeding with acceleration.

FIGURE 2—VEHICLE DATA SHEET

LEVEL ROAD W.O.T. ACCELERATION PERFORMANCE
VEHICLE DATA SHEET

Report No. _____
Date _____

Vehicle: Make _____ Model _____ Year _____ Car No. _____
Odometer _____ km (mile)

Test Location _____ Track Orientation _____
Start of Test: Date _____ Time _____
Completion of Test: Date _____ Time _____
Driver _____
Transmission: Automatic Shift Mode _____ Manual Launch rpm _____
Shift rpm (1-2) _____ (2-3) _____ (3-4) _____
Remarks:

Ambient Conditions for Test:
Temp. _____ °F _____ °C Barometric Pressure _____ kPa (in Hg) Relative Humidity _____ %[1]
Wind Velocity _____ km/h (mph) Direction _____ Peak Wind Velocity _____ km/h (mph)

0-48 km/h (0-30 mph) (Elapsed Time)[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ s Variability[3] _____ %

0-80 km/h (0-50 mph) (Elapsed Time)[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ s Variability[3] _____ %

0-97 km/h (0-60 mph) (Elapsed Time)[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ s Variability[3] _____ %

64-97 km/h (40-60 mph) (Elapsed Time) Top Gear[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ s Variability[3] _____ %

64-97 km/h (40-60 mph) (Elapsed Time) Top Gear—Less One[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ s Variability[3] _____ %

0-5 s (Distance Covered)[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ m (ft) Variability[3] _____ %

0-5 s (Terminal Speed)[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ km/h (mph) Variability[3] _____ %

402 m (1/4 mile) (Elapsed Time)[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ s Variability[3] _____ %

402 m (1/4 mile) (Terminal Speed)[2]
1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ Avg. _____ km/h (mph) Variability[3] _____ %

[1] Record, if available.
[2] Tests must be conducted in opposing directions then collectively averaged. Two valid paired runs are considered adequate. When difficulty is experienced in one run, the pair should be excluded.
[3] Variability equals standard deviation of tests divided by test average multiplied by 100. See 9.3.1.1 and 9.3.1.2 for equations.