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

SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J1491 | REV. JUN90

Issued 1985-06
Revised 1990-06-29

Superseding J1491 JUN85

(R) VEHICLE ACCELERATION MEASUREMENT

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:

No ISO comparable.

2.1 Definition:

2.1.1 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.

3. INSTRUMENTATION:

(All instrumentation must be calibrated.)

3.1 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 ±0.50 mph (0.8 km/h)
   (2) Resolution 0.25 mph (0.4 km/h)
c. Engine Speed (tachometer):
   (1) Accuracy ±50 rpm
   (2) Resolution 25 rpm

3.2 Temperature:

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

3.3 Atmospheric Pressure:

A barometer with an accuracy of ±0.2 in Hg or 0.7 kPa.

3.4 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 ±1 mph (±2 km/h).

3.5 Vehicle Weight:

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

3.6 Tire Pressure:

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

3.7 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 5 ft in 1 mile.

4. TEST MATERIAL: (See Figure 1)

4.1 Test Vehicle:

The test vehicle shall be completely defined on the test vehicle specifications and preparation list. The test vehicle will normally be representative of a standard production built vehicle; any optional or 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.

4.2 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.

4.3 Lubricants:

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

5. TEST CONDITIONS:

5.1 Ambient Temperature:

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

5.2 Adverse Weather Conditions:

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

5.3 Wind Velocity:

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

5.4 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.

5.5 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.

6. VEHICLE PREPARATION:

6.1 Break-In:

The vehicle should have at least 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 100 miles of run in before test.

6.2 Vehicle Check List:

6.2.1 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.

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

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

6.2.4 Ensure that brake drag is not excessive.

6.3 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.

6.4 Test Weight:

The unloaded vehicle weight +300 lb (includes driver and all instrumentation) and the fifth wheel in the raised position.

6.5 Tire Pressure:

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

6.6 Vehicle Warm-Up:

The vehicle must be driven a minimum of 20 miles at an average speed of 55 mph ± 5 (88 km/h) 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.

6.7 Vehicle Data:

Record all information as specified on the attached Vehicle Specification Sheet. (See Figure 1).

7. TEST PROCEDURE:

7.1 Test Schedules:

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

a. 0 to 30 mph: Record Elapsed Time
b. 0 to 50 mph: Record Elapsed Time
c. 0 to 60 mph: Record Elapsed Time
d. 1/4 mile: Record Elapsed Time and Terminal Speed
e. 0 to 5 s: Record Distance Covered and Terminal Speed

7.1.2 Also perform the following test at wide open throttle:

a. 40 to 60 mph: Record Elapsed Time

7.2 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.

7.3 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.

7.4 40 to 60 Test Procedure:

Starting from a stabilized 40 mph, accelerate with wide open throttle to 60 mph. Manual transmissions should be run both in top gear and top gear less one, with 4- or 5-speed transmissions. 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.

7.5 Test Data:

7.5.1 Run a minimum of six individual runs, three in each direction. When difficulty is experienced in one run, the pair is excluded.

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

7.6 Operation of Accessories:

7.6.1 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).

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

7.6.3 The vehicles equipped with air-conditioning should have the compressor clutch wire disconnected before the start of test.

7.6.4 Radio operation is optional.

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

7.6.6 Windows should remain closed during test runs.

8. DATA REDUCTION:

8.1 Data Calculation:

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

8.2 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 vs. time, time vs. distance, or other data considered appropriate.

8.3 General:

8.3.1 Data Variability: Because of unpredictable effects of wind on vehicle performance, the following guideline is suggested as a criterion for test acceptability.

The coefficient of variation (standard deviation of the paired runs)/mean of individual runs should not be greater than 3%. On the 40 to 60 mph acceleration, the coefficient of variation should not exceed 6%.

8.3.2 Weather Correction: No provision for weather correction is made in this procedure. Variables such as temperature, humidity, barometric pressure, wind speed, and direction should be considered by the tester in evaluating the test results.

The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

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

Report No._____
Date_____

Vehicle: Make_____ Model_____ Year_____ Car No._____
Odometer_____ VIN_____
Test Weight_____lb RF_____lb LF_____lb RR_____lb LR_____lb

EQUIPPED WITH

Engine: Type_____ Displacement_____ Compression Ratio _____
No. of Cylinders_____ Rated SAE Horsepower _____
Fuel System_____
Engine Fan Type _____
Electronic Engine Control Yes_____ No_____ Knock Sensor Yes_____ No_____
Idle Speed_____rpm (Drive) _____rpm (Neutral)
Redline_____rpm Initial Timing _____
Boost_____ Number of Valves_____

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_____psi Rear_____psi

Brake Type: Front_____ Rear_____
Exhaust System
Type: _____

Operational Checklist:
Choke Operation_____
Throttle Operation_____
Transmission Operation_____
Brake Drag_____
Parking Brake_____
Wheel Alignment_____

Fluid Level Checklist:
Engine Oil_____
Battery_____
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. RON_____MON_____
R + M / 2_____
Test Fuel Cetane No._____
Test Fuel Viscosity_____

Optional Equipment: _____
_____
Equipment Removed for Test: _____
_____
_____

Notes: _____
_____
_____
_____

FIGURE 1 - Vehicle Specification Sheet

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

Report No._____
Date_____

Vehicle: Make_____ Model_____ Year_____ Car No._____
Odometer_____

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_____in Hg (kPa) Relative Humidity_____%[a]
Wind Velocity_____mph Direction_____ Peak Wind Velocity_____mph

0-30 mph (Elapsed Time)[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____s	Variability[c]_____ %
0-50 mph (Elapsed Time)[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____s	Variability[c]_____ %
0-60 mph (Elapsed Time)[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____s	Variability[c]_____ %
40-60 mph (Elapsed Time) Top Gear[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____s	Variability[c]_____ %
40-60 mph (Elapsed Time) Top Gear--Less One[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____s	Variability[c]_____ %
0-5 s (Distance Covered)[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____ft	Variability[c]_____ %
0-5 s (Terminal Speed)[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____mph	Variability[c]_____ %
1/4 mile (Elapsed Time)[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____s	Variability[c]_____ %
1/4 mile (Terminal Speed)[b]	1_____	2_____	3_____	4_____	5_____	6_____	Avg._____mph	Variability[c]_____ %

[a]Record, if available.
[b]Tests must be conducted in alternate directions then collectively averaged. Two valid paired runs are considered adequate. When difficulty is experienced in one run, the pair should be excluded.
[c]Variability equals standard deviation of tests divided by test average multipled by 100.

FIGURE 2 - Vehicle Data Sheet