



Determination of the Center of Gravity of a Vehicle

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The primary purpose of this procedure is to determine the center of gravity coordinates in the X-Y-Z direction relative to the center of the front axle, the longitudinal axis of the vehicle and the road surface it is parked on.

1.2 Applicability. For all passenger cars and light trucks.

1.3 Remarks. Reference SAE J670E for vehicle dynamics terminology.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ISO 9001 SAE J670E

2.2 GM Standards/Specifications.

GMW15887

3 Resources

3.1 Facilities. Not applicable.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Scales to determine wheel loads (axle loads).

3.2.2 Equipment to determine wheel base, track, trim height, and static rolling radius.

3.2.3 Three (3) pairs of platforms with 300 mm, 400 mm and 500 mm of height. Each pair of platforms must be the same height.

3.2.4 Equipment to lift the vehicle's axle to platform height.

3.3 Test Vehicle/Test Piece. This test procedure applies to any vehicle equipped with the requested content.

3.4 Test Time.

Calendar time: 0 days

Test hours: 3 h

Coordination hours: 0 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Operator must be qualified and documented as capable to run this test as required by ISO 9001.

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4 Procedure

4.1 Preparation.

4.1.1 Fill fuel tank to maximum capacity, make sure that all other fluids are at maximum level, and that warning triangle and first aid kit are placed in the respective stowage provisions.

4.1.2 Set the front and rear tire pressures (cold) to the pressures recommended for the requested load condition.

4.1.3 Vehicle Preparation.

4.1.3.1 The test vehicle should be inspected to ensure that the proper content installed, and that all chassis components are in operational condition.

4.1.3.2 Check to be certain that all wheel lugs are present and have the specified torque. Loose or missing wheel fasteners are to be replaced, installed or tightened before the test may begin.

4.1.3.3 Ballast the vehicle to the requested weight and weight distribution (if applicable).

4.1.3.4 Check and adjust vehicle's trim height to nominal values for the load condition required.

4.1.4 (Optional) Suspension Locking. Lock both front and rear suspension travel using an appropriate device. See Appendix A for an optional locking device example.

4.1.5 Make sure the parking brake is fully released and the shift lever is in neutral position during the entire test.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

Note: Be sure that all scales are calibrated and indicating zero when no load is applied.

4.3.1 Measurement. With the vehicle parked on a level surface, measure and record the following:

- Wheel loads.
- Trim heights.
- Static tire rolling radius.
- Wheel base.
- Front and Rear Track.

4.3.2 Lift vehicle's front axle slowly and place the wheels on the 300 mm high platforms while the rear axle is placed on the scales.

4.3.3 Record the rear axle loads.

Note: If electronic scales are used, wait until the reading stabilizes.

4.3.4 Lift the vehicle and remove the platforms.

4.3.5 Repeat steps 4.3.2 through 4.3.4, first using 400 mm platform heights, and then using 500 mm platform heights.

4.3.6 Lower the vehicle.

4.3.7 Repeat steps 4.3.2 through 4.3.5 lifting the rear axle this time, while the front axle is placed on the scales.

5 Data

5.1 Calculations.

5.1.1 Data Preparation. The data stored on the data spreadsheet should be uploaded to the appropriate network data storage location for processing using documented procedures and the data filenames specified on the test request sheet.

All required information should be recorded on the Test Sheet. See Appendix B, Data Sheets B1 and B2 for a sample Test Sheet.

Inform assigned engineer when the data file is loaded. Be prepared to provide a full vehicle description at this time. This should include the following:

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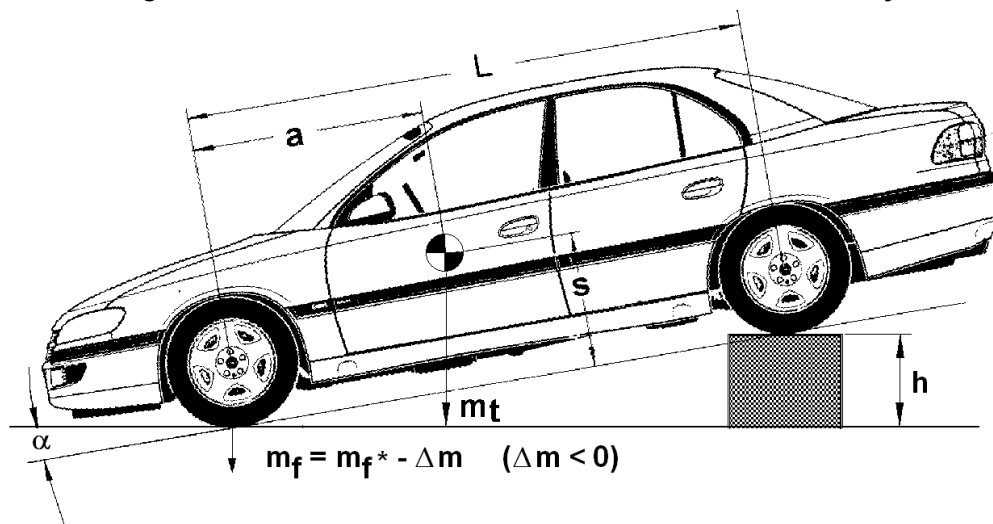
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- Vehicle description and number.
- Vehicle option content.
- Wheelbase and track.
- Tire brand, size, and pressures.
- Test loads.
- Test date, time, and operator.
- Data filename.

5.1.2 Calculations.

See Figure 1 and the definitions following for calculations.

Figure 1: Calculation of the Distances to the Center of Gravity



t_f	front track
t_r	rear track
r_f	front tire rolling radius
r_r	rear tire rolling radius
L	wheel base
H	platform height
α	tilt angle (positive when lifting front axle)
m_t	$= m_r^* + m_f^*$ total mass
m_f	mass front, vehicle lifted on rear axle
m_f^*	mass front on plane surface
m_r	mass rear, vehicle lifted on front axle
m_r^*	mass rear on plane surface
Δm	$= m_r - m_r^* = m_f^* - m_f$ mass transfer
m_{fl}	mass front LH side
m_{fr}	mass front RH side
m_{rl}	mass rear LH side
m_{rr}	mass rear RH side

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