



Brakes – Vehicle Center of Gravity Height – Twin Post Hoist Method

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 purpose of this standard is to determine the height of the Center of Gravity (CG) of a vehicle.

1.2 Applicability. This standard is applicable to trucks where the physical size of the vehicle prohibits testing to GMW15461 at the Milford Proving Ground Vehicle Inertial Measurement Facility (VIMF) or equivalent test facility. The physical restrictions for using the VIMF are in GMW15461.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15461 (ID)

2.3 Additional References.

CG Tip Workbook (ID)

(ID) = This reference is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

3 Resources

3.1 Facilities. Facility with vehicle hoist rated for weight of test vehicle at required ballast condition.

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.

Note: See Appendix A, Figures A1 thru A9 for photographs taken during this test. Some of the equipment is shown in the photographs.

3.2.1 Vehicle scales.

3.2.2 Height gauge.

3.2.3 Inclinator.

3.2.4 Ballast.

3.2.5 Optional: Fixtures to replace front and rear shock absorbers: threaded rod turnbuckles.

3.2.6 Bearing surfaces (granite blocks) for air bearings.

3.2.7 Air bearings.

3.2.8 Force transducer plates.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

September 2017

Page 1 of 13

3.2.9 All instrumentation is to be calibrated as required. Document the instrumentation details and calibration dates in the test record.

3.3 Test Vehicle/Test Piece. The specific vehicle chosen and ballasted for CG testing should be representative of the vehicle as it would be used for further testing and/or customer usage. For brake testing, extreme load conditions such as lightly Loaded Vehicle Weight (LLVW) maximum front load distribution and Gross Vehicle Weight Rating (GVWR) minimum front load distribution may be appropriate. For other testing, curb load or a customer usage load condition might be the requested test weight.

3.4 Test Time.

Calendar time: 1 day

Test time: 4 hours

Coordination time: 4 hours

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. At least one (1) brake technician trained to perform this standard.

4 Procedure

4.1 Preparation.

4.1.1 Fill all fluid tanks per requester's direction. If fluid slosh or fluid migration during testing will affect CG location, a representative solid mass should replace the fluids.

4.1.2 Inflate tires to the specified pressures.

4.1.3 Ballast the vehicle to the test weight and load distribution per requester's direction.

4.1.4 Measure and document the free trim height and Static Loaded Radius (SLR) for each corner of the vehicle. The free trim height is measured at the wheelhouse.

4.1.5 Measure and document the four (4) corner wheel masses at free trim heights.

4.1.6 If requested, replace the shocks with the turnbuckles and adjust the body to the free trim heights. This step is optional depending on the amount of suspension deflection.

4.1.7 Check the calibration of the digital inclinometer and, on level ground, measure the free frame angle on a flat area of the left hand frame rail. When the front is lower, the frame angle is positive. Record this angle in the test record. Do not move the inclinometer after this free frame angle is established.

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: All distances are to be measured in millimeters to one decimal place. All weights are to be measured in whole kilograms. All angles are to be measured in degrees to one decimal place. Ensure the doors and the hood are closed while the vehicle is being weighed.

Note: See Appendix A, Figures A1 thru A9 for photographs taken during this test.

4.3.1 Lock the steering wheel so that the wheels are straight and shift the transmission to Neutral.

4.3.2 Raise the vehicle on the hoist.

4.3.3 Set the granite blocks under the front tires. Level each block both individually and relative to each other.

4.3.4 Place the air bearings on top of the granite blocks near the front and centered side-to-side.

4.3.5 Place the transducer plates on top of the air bearings.

4.3.6 Zero and calibrate the strain gauge readouts.

4.3.7 Lower the vehicle onto the transducer plates.

4.3.8 Connect the air supply to the air bearings.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

September 2017

Page 2 of 13



Documents

Document Sharing Hub

4.3.9 Adjust the rear height of the vehicle so that the vehicle is at the free frame angle and document the corresponding total front mass.

4.3.10 Make sure the vehicle is secure and lift the rear of the vehicle as high as possible or a maximum of 20 degrees readout from the inclinometer by the rear tires or with roller bearings under the axle tubes. Watch for any unexpected interferences. This is the maximum tilt angle.

4.3.11 Document the maximum tilt angle and the corresponding total front mass.

4.3.12 Lower the vehicle to the free frame angle and document the total front mass again.

4.3.13 Disconnect the air supply from the air bearings.

4.3.14 Raise the front of the vehicle off the transducer plates.

4.3.15 Repeat 4.3.6 thru 4.3.14 for a total of three (3) runs.

4.3.16 Repeat the procedure as needed for additional load conditions.

5 Data

5.1 Calculations.

5.1.1 Input the parameters measured in section 4 into the CG Tip Workbook. The CG Tip Workbook is an interactive tool that calculates CG height based on inputs, which include the vehicle wheelbase, corner weights, SLR, and tilt angles. Contact the engineers at the General Motors North America (GMNA) Brake Development Group for access to the CG Tip Workbook.

5.1.2 From the user inputs, the CG Tip workbook calculates the CG height at each tested loading condition.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation.

5.3.1 Document test information including vehicle description (year, model, style, engine, powertrain), brake components, tire description (size, make, type, and test pressure), test weights and weight distributions per wheel.

5.3.2 Tabulate at each weight condition the following: CG height with respect to the ground (mm); fore-aft distance from the front axle to CG (mm); total weight (kg); percent front weight (%); and static loaded radius (mm).

5.3.3 Publish the requested test information, test data and calculated results in a test report.

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary.

Free Trim Height: Front and rear wheelhouse heights at test weight.

Free Frame Angle: Test vehicle frame angle measured with vehicle setting on level ground at free trim height.

Maximum Tilt Angle: The frame angle of the test vehicle with its rear axle lifted as high as possible by the hoist/lift equipment.

Positive (+) Frame Angle: The sign convention for vehicle frame angles. A down-in-front attitude is a positive angle.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

September 2017

Page 3 of 13



Documents

Document Sharing Hub

7.2 Acronyms, Abbreviations, and Symbols.

CG	Center of Gravity
GMNA	General Motors North America
GSSLT	Global Subsystem Leadership Team
GVWR	Gross Vehicle Weight Rating
LLVW	Lightly Loaded Vehicle Weight
SLR	Static Loaded Radius
VIMF	Vehicle Inertial Measurement Facility

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW16611

9 Release and Revisions

This standard was originated in May 2011. It was first approved by Brake Global Subsystem Leadership Team in March 2012. It was first published in March 2012.

Issue	Publication Date	Description (Organization)
1	MAR 2012	Initial publication.
2	SEP 2017	Revised to current template. (Chassis Brake Global Subsystem Leadership Team (GSSLT))

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

September 2017

Page 4 of 13