TP-523-00
October 29, 2024

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

49 CFR Part 523, VEHICLE CLASSIFICATION

ENFORCEMENT
Office of Vehicle Safety Compliance
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Washington, DC 20590

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PREFACE

In accordance with the Energy Policy and Conservation Act (EPCA), the National Highway Traffic Safety Administration (NHTSA) promulgates and administers Corporate Average Fuel Economy (CAFE) standards. NHTSA established requirements in 49 CFR 523 to determine whether a light-duty automobile is classified as a passenger car or a light truck (LT) for the purposes of meeting CAFE standards promulgated in accordance with Title 49 of the United States Code Chapter 329 (49 U.S.C. 329). Per 49 CFR 523.5, an automobile may be classified as a light truck if it has a gross vehicle weight (GVWR) of more than a 6,000 pounds or a 4-wheel drive mechanism, and it is capable of off-highway operation through having at least four of the following characteristics calculated when the automobile is at curb weight, on a level surface, with the front wheels parallel to the automobile's longitudinal centerline, and the tires inflated to the manufacturer's recommended pressure—

(i) Approach angle of not less than 28 degrees,
(ii) Breakover angle of not less than 14 degrees,
(iii) Departure angle of not less than 20 degrees,
(iv) Running clearance of not less than 20 centimeters,
(v) Front and rear axle clearances of not less than 18 centimeters each.

In accordance with 49 CFR 537.7(c)(5), manufacturers are required to report data on these vehicle attributes for each model type classified as a light truck capable of off-highway operation under 49 CFR 523.5. NHTSA expects manufacturers of LTs to report accurate information to ensure t vehicles are classified in the correct fuel economy standards. As part of its compliance programs, OVSC conducts validation testing on production vehicles to confirm manufacturer-reported attribute data. NHTSA issued this standardized test procedure to outline the methods that will be used to physically measure the attributes of production LTs in their as-equipped configurations. If NHTSA determines that the reported values for LTs are inaccurate, particularly those resulting in a higher attribute measurement, an investigation will be commenced which could lead to reclassifying vehicles as passenger cars.

REVISION CONTROL LOG
FOR OVSC LABORATORY
TEST PROCEDURES

TP-523
Vehicle Classification

TEST PROCEDURE		49 CFR Part 523.5		
REV. No.	DATE	AMENDMENT	EFFECTIVE DATE	DESCRIPTION
n/a	06/22/1976	41 FR 25015 06/22/1976 Final Rule	06/22/1976	Final Rule (41 FR 25015) delegates authority to NHTSA to establish vehicle classification definitions and vehicle categories.
n/a	03/20/2009	74 FR 14449 03/30/2009 Final Rule	10/01/2011	Modification to part 523.5. The final rule (74 FR 14449) established a clear contrast between a light truck and passenger car. NHTSA has tightened its application of the definition of "non-passenger automobiles."
n/a	12/15/2022	87 FR 25710 05/02/2022 Final Rule	12/15/2022	NHTSA (87 FR 25710, page 26025) proposes to issue a test procedure to validate light truck classification data provided by manufacturers in their pre-model reports.
00	10/11/2024	n/a	10/29/2024	Draft test procedure, TP-523-00, issued for public review and comments.

1. PURPOSE AND APPLICATION

This document is provided by the National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) for the purpose of presenting procedures for uniform testing and providing suggestions for the use of specific equipment for contracted testing laboratories. The test procedures are based off of the requirements specified in the 49 CFR 523. The OVSC test procedures include requirements that are general in scope to provide flexibility for contracted testing laboratories to perform compliance testing and are not intended to limit or restrain a contractor (contracted testing laboratory) from developing or utilizing any testing techniques or equipment which will assist in procuring the required compliance test data. These test procedures do not constitute an endorsement or recommendation for use of any particular product or testing method.

Prior to conducting compliance testing, contracted laboratories are required to submit a detailed test procedure to the Contracting Officer's Representative (COR) to demonstrate concurrence with the OVSC laboratory test procedure and the applicable regulation(s). If a contractor views any part of an OVSC laboratory test procedure to be in conflict with a regulation or observes deficiencies in a laboratory test procedure, the contractor is required to advise the COR and resolve the discrepancy prior to the start of compliance testing or as soon as practicable. The contractor's test procedure must include a step-by-step description of the methodology and detailed check-off sheets. Detailed check-off sheets shall also be provided for the testing instrumentation including a complete listing of the test equipment with make and model numbers. The list of test equipment shall include instrument accuracy and calibration dates. All equipment shall be calibrated in accordance with the manufacturer's instructions. There shall be no contradictions between the laboratory test procedure and the contractor's in-house test procedure. Written approval of in-house test procedures shall be obtained from the COR before initiating the compliance test program.

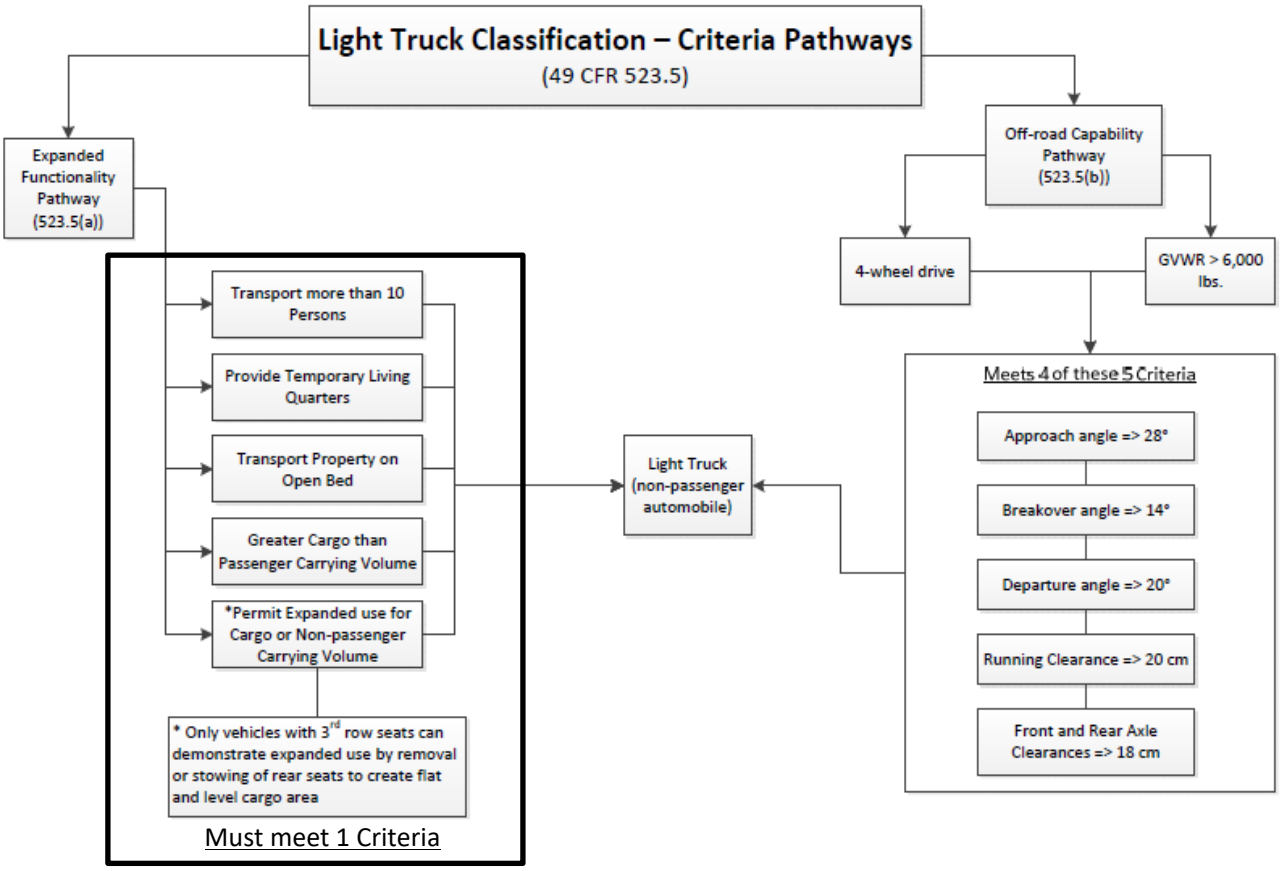
NOTE: The OVSC Laboratory Test Procedures, prepared for the limited purpose of use by independent laboratories under contract to conduct compliance tests for the OVSC, are not rules, regulations, or NHTSA interpretations regarding the meaning of a regulation(s). **The OVSC Laboratory Test Procedures do not carry the force or effect of the law nor are they intended to bind the public in any way, except that they may be binding on a government contractor consistent with the terms of their contract.** The laboratory test procedures are not intended to limit the requirements of the applicable regulation(s). In some cases, the OVSC laboratory test procedures do not include all the various minimum performance requirements. Recognizing applicable test tolerances, the laboratory test procedures may specify test conditions that are less severe than the minimum requirements of the FMVSS or regulation. In addition, the laboratory test procedures may specify test conditions that are less severe than the minimum requirements of the standard. The laboratory test procedures may be modified by the OVSC at any time without notice, and the COR may direct or authorize contractors to deviate from these procedures, as long as the tests are performed in a manner consistent with the standard itself and within the scope of the contract. Laboratory test procedures may not be relied upon to create any right or benefit in any person. Therefore, compliance of a vehicle or item of motor vehicle equipment is not necessarily guaranteed if the manufacturer limits its certification tests to those described in the OVSC laboratory test procedures.

2. GENERAL REQUIREMENTS

Per 49 CFR 523.5, in order for an automobile to be properly classifiable as a light truck, it must meet either have expanded functional characteristics or be capable of off-road operation (in addition to other requirements), which includes meeting at least four of the below mentioned ground clearance criteria. (see Figure 1)

(i) Approach angle of not less than 28 degrees
(ii) Breakover angle of not less than 14 degrees,
(iii) Departure angle of not less than 20 degrees,
(iv) Running clearance of not less than 20 centimeters,
(v) Front and rear axle clearances of not less than 18 centimeters each.

FIGURE 1: Light Truck Classification – Criteria Pathways



For vehicles utilizing the "expanded functionality" classification pathway, the 3rd row of seating must be equipped as standard equipment. Optional 3rd row seating cannot be included in 49 CFR 523.5(a) expanded functionality.

In accordance with 49 CFR 537, manufacturers are required to provide pre- and mid-model year (PMY and MMY) reports that contain early model year production information to NHTSA. Specifically, 537.7(c)(5) requires manufacturers to report the attribute data listed above for each model type classified as a light truck capable of off-highway operation under 49 CFR 523.5 based on the product configuration of each vehicle.

NHTSA drafted the classification requirements in 49 CFR 523.5 with detailed vehicle and

production testing setup factors (e.g. automobile at curb weight, on a level surface, front wheels parallel to the automobile's longitudinal centerline, etc.) as a way to instruct manufacturers to measure the angle and clearance attributes of vehicles in their as-equipped configuration. Attribute dimensions taken from engineering templates or CAD models may vary significantly from actual dimensions on the production vehicles and therefore, they should not be used to classify a vehicle as a light truck under CAFE requirements. Also, NHTSA clarifies that ground clearance, as well as all the other off-highway criteria for a light truck determination, should use the measurements from vehicles with all standard and optional equipment installed, at the time vehicles are shipped to dealerships.

METRIC SYSTEM OF MEASUREMENT

Section 5164 of the Omnibus Trade and Competitiveness Act (Pub. L. 100-418) establishes that the metric system of measurement is the preferred system of weights and measures for trade and commerce in the United States. Executive order 12770 directs Federal agencies to comply with the Act by converting regulatory standards to the metric system after September 30, 1992. In a final rule published on March 15, 1990 (60 FR 13639), NHTSA completed the first phase of metrication, converting English measurements in several regulatory standards to the metric system. Since then, metrication has been applied to other regulatory standards (63 FR 28912).

Accordingly, the OVSC laboratory test procedures include revisions to comply with governmental directives in using the metric system. Regulatory standards converted to metric units are required to use metric measurements in the test procedures, whereas standards using English units are allowed to use English measurements or to use English measurements in combination with metric equivalents in parentheses. For any testing equipment that is not available for direct measurement in metric units, the test laboratory shall calculate the exact metric equivalent by means of a conversion factor carried out to at least five significant digits before rounding consistent with the specified metric requirement.

All final compliance test reports are required to include metric measurements for standards using metrication. However, 49 CFR Part 523.5 specifies requirements in inches and square feet, so the values must be converted accordingly.

NOTE: The methodology for rounding measurement in the test reports shall be made in accordance with ASTM E29-06b, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications."

3. SECURITY

The contractor shall provide appropriate security measures to protect the OVSC test vehicles and Government Furnished Property (GFP) from unauthorized personnel during the entire compliance testing program. The contractor is financially responsible for any acts of theft and/or vandalism which occur during the storage of test vehicles and GFP. Any security problems which arise shall be reported by telephone to the Industrial Property Manager (IPM), Office of Acquisition Management, within two working days after the incident. A letter containing specific details of the security problem shall be sent to the IPM (with copy to the COR) within 48 hours.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each vehicle test. No information concerning the vehicle safety compliance testing program shall be released to anyone except the COR, unless specifically authorized by the COR

or the COR's Division Chief.

NOTE: No individuals, other than contractor personnel directly involved in the compliance testing program or OVSC personnel, shall be allowed to witness any vehicle or equipment item compliance test unless specifically authorized by the COR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the entire vehicle compliance testing area, test fixtures and instrumentation in a neat, clean and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall submit a test schedule to the COR prior to conducting the first compliance test. Tests shall be completed at intervals as required in the contract. If not specified, the first test shall be conducted within 6 weeks after receiving the first delivered unit. Subsequent tests shall be completed in no longer than 1-week intervals unless otherwise specified by the COR.

Scheduling of tests shall be adjusted to permit vehicles (or equipment, whichever applies) to be tested to other FMVSSs as may be required by the OVSC. All compliance testing shall be coordinated with the COR in order to allow monitoring by the COR and/or other OVSC personnel if desired. The contractor shall submit a monthly test status report and a vehicle status report (if applicable) to the COR. The vehicle status report shall be submitted until all vehicles are disposed of. The status report forms are provided in the forms section.

6. TEST DATA DISPOSITION

The contractor shall make all preliminary compliance test data available to the COR within 24 hours after completing all testing. Final test data, including digital printouts and computer-generated plots (if applicable), shall be available to the COR in accordance with the contract schedule or if not specified within two working days. Additionally, the contractor shall analyze the preliminary test results as directed by the COR.

All backup data sheets, strip charts, recordings, plots, technicians' notes, etc., shall be either sent to the COR or destroyed at the conclusion of each delivery order, purchase order, etc.
The contractor shall protect and segregate the data that evolves from compliance testing before and after each test.

TEST DATA LOSS

A. INVALID TEST DESCRIPTION

An invalid compliance test is one, which does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

B. INVALID TEST NOTIFICATION

The contractor shall notify NHTSA of any test not meeting all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test, by email or telephone, within 24 hours of the test and send written notice to the COR within 48 hours of the test completion.

C. RETEST NOTIFICATION

The Contracting Officer Representative of NHTSA is the only NHTSA official authorized to notify the contractor that a retest is required. The retest shall be completed within 2 weeks after receipt of notification by the COR that a retest is required.

D. WAIVER OF RETEST

NHTSA, in its sole discretion, reserves the right to waive the retest requirement. In the situation where the COR determines a retest is required, the COR will make the determination as to whether the cost of the retest will be paid by the contractor or the manufacturer. Manufacturers may request a retest at their expense. This provision shall not constitute a basis for dispute over NHTSA's waiving or not waiving any requirement.

E. TEST VEHICLE

NHTSA shall furnish and pay the cost for only one original vehicle for each test ordered. The contractor shall furnish the vehicle required for the retest, and the cost will be paid by either the contractor or the manufacturer. The retest vehicle shall be equipped as the original vehicle. The original vehicle used in the invalid test shall remain the property of NHTSA, and the retest vehicle shall remain the property of the contractor. The contractor shall retain the retest vehicle for a period not exceeding 180 days if it fails the test. If the retest vehicle passes the test, the Contractor may dispose of it upon notification from the COR that the test report has been accepted.

F. TEST REPORT

No test report is required for any test that is determined to be invalid unless NHTSA specifically decides, in writing, to require the contractor to submit such report. The test data from the invalid test must be safeguarded until the data from the retest has been accepted by the COR. The report and other required deliverables for the retest vehicle are required to be submitted to the COR within 3 weeks after completion of the retest. The electronic data and draft final test report shall be submitted within 14 days of the final test. The final test report and dummy calibration report shall be submitted within 7 days after receiving comments from the COR.

G. DEFAULT

The contractor is subject to the default and subsequent re-procurement costs for non-delivery of valid or conforming test (pursuant to the “Termination for Default” clause in the contract).

H. NHTSA'S RIGHTS

None of the requirements herein stated shall diminish or modify the rights of NHTSA to determine that any test submitted by the contractor does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

GFP consists of test vehicles and testing equipment. The GFP is authorized by contractual agreement. The contractor is responsible for the following.

A. ACCEPTANCE OF TEST VEHICLES

The contractor has the responsibility of accepting each GFP test vehicle whether delivered by a new vehicle dealership or another vehicle transporter. In both instances, the Contractor acts on behalf of the OVSC when signing an acceptance of the GFP test vehicle delivery order. When a GFP vehicle is delivered, the contractor must verify:

1) All options listed on the "window sticker" are present on the test vehicle.
2) Tires and wheel rims are new and the same as listed.
3) There are no dents or other interior or exterior flaws in the vehicle body.
4) The vehicle has been properly prepared and is in running condition.
5) The glove box contains an owner's manual, warranty document, consumer information, and extra set of keys.
6) Proper fuel filler cap is supplied on the test vehicle (if equipped).
7) Spare tire, jack, lug wrench and tool kit (if applicable) are located in the vehicle cargo area.
8) The VIN (vehicle identification number) on the vehicle condition report matches the VIN on the vehicle.
9) The vehicle is equipped as specified by the COR.
10) The Contractor must confirm any applicable recalls have been performed/remedied prior to the start of testing.

A Vehicle Condition form will be supplied to the Contractor by the COR when the test vehicle is transferred from a new vehicle dealership or between test contracts. The upper half of the form is used to describe the vehicle as initially accepted. The lower half of the Vehicle Condition form provides space for a detailed description of the post-test condition. The contractor must complete a Vehicle Condition form for each vehicle and deliver it to the COR with the Final Test Report or the report will NOT be accepted for payment.

If the test vehicle is delivered by a government contracted transporter, the contractor should check for damage which may have occurred during transit. GFP vehicle(s) shall not be driven by the contractor on public roadways unless authorized by the COR.

B. TESTING EQUIPMENT

Test equipment may be furnished to the contracted laboratory by the OVSC. Otherwise, the contracted laboratory will be responsible for obtaining the test equipment required to execute this test.

C. NOTIFICATION OF COR

The COR must be notified within 24 hours after a vehicle (and/or equipment) has been delivered. In addition, if any discrepancy or damage is found at the time of delivery, a copy of the Vehicle Condition form shall be sent to the COR immediately.

8. CALIBRATION OF TEST INSTRUMENTS

Before the Contractor initiates the vehicle safety compliance test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices. The calibration system shall include the following as a minimum:

A. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the Contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 12 months for instruments and 12 months for the calibration standards except for static types of measuring devices such as rulers, weights, etc., which shall be calibrated at periodic intervals not to exceed two years. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment.

C. All measuring and test equipment and measuring standards shall be labeled with the following information:
   1) Date of calibration
   2) Date of next scheduled calibration
   3) Name of the technician who calibrated the equipment

D. A written calibration procedure shall be provided by the Contractor, which includes as a minimum the following information for all measurement and test equipment:
   1) Type of equipment, manufacturer, model number, etc.
   2) Measurement range
   3) Accuracy
   4) Calibration interval
   5) Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident)
   6) The actual procedures and forms used to perform the calibrations.

E. Records of calibration for all test instrumentation shall be kept by the Contractor in a manner that assures the maintenance of established calibration schedules.

F. All such records shall be readily available for inspection when requested by the COR. The calibration system shall need the acceptance of the COR before vehicle safety compliance testing commences.

G. Test equipment shall receive a system functional check out using a known test input immediately before and after the test. This check shall be recorded by the test technician(s) and submitted with the final report.

H. The Contractor may be directed by NHTSA to evaluate its data acquisition system.

Further guidance is provided in the International Standard ISO 10012-1, “Quality Assurance Requirements for Measuring Equipment” and American National Standard ANSI/NCSL Z540-1, “Calibration Laboratories and Measuring and Test Equipment General Requirements.”

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COR's discretion and shall be performed without additional cost.

9. SUGGESTED TEST EQUIPMENT

A. Handheld laser distance meter with a measuring range of at least 15.24 meters (50 feet), resolution of 1 mm, and an accuracy of 1.5 mm (e.g. Fluke 411D, 416D, 417D, or 424D Laser Distance Meter, or equivalent).

B. Digital level with a measuring range of 0° to 90° and an accuracy of ±0.1° (e.g. SmartTool 48" Digital Level, or equivalent).

C. Digital angle measuring device with a measuring range of 0° to 220°, an accuracy of ±0.1°, an arm length of 60 cm (23.62"), and vertical and horizontal levels (e.g. Laserliner ArcoMaster 60 cm, or equivalent).

D. Digital inclinometer with range of 0 - 360°, a resolution of 0.1º, and an accuracy of + 0.2°, (e.g., Digital Protractor Angle Finder, Model Pro 360, or equivalent).

E. 90-degree angle brackets (for checking alignment of plates).

F. Elevation gauge or other elevation measuring device (for checking vertical vehicle movement).

G. Tape measure with a measuring length of at least 7,620 mm (300 inches), with 1 mm graduated increments (e.g., Tajima Tool Corp G-Series Shock Resistant Tape Measure, Model No. G-25BW, or equivalent); or caliper device/telescoping measuring arm, such as a tram gauge with minimum measuring length of 4,572 mm (180 inches), with 1 mm graduated increments (e.g. Dent Fix Equipment DF-3TC5A, or equivalent).

H. Portable tire pressure gauge with bleeder valve and an operating pressure of 0-700 kPa (0-100 psi), accuracy of +/- 0.5% of applied pressure, and graduated increments of 1 kPa (0.1 psi) (e.g. Intercomp Digital Air Pressure Gauge, Model 360045, or equivalent).

I. Supplemental jacks (e.g., motorcycle jacks, jack stands, scissors jacks, cylinder jacks, etc.)

J. Carbon Fiber Device (or equivalent): A fabricated device using a rigid 3/8" (9.5 mm)-thick flat carbon fiber sheet (of sufficient length to extend from tire to tire in the front or rear of the vehicle - 48" L x 84" W plate, with structural reinforcements as needed) and two supplemental jack supports (item I) to raise the plate. Equivalent devices must use a sheet constructed of a rigid material with consistent flatness over its entire surface. The sheet must be large enough to accommodate the wheelbase and front and rear vehicle overhangs of production light trucks applicable to 49 CFR Part 523. See photos in Figures 2 and 3 below:

Figure 2

Figure 3

K. Rolling Jack Device (or equivalent): A fabricated device used to measure the vehicle clearances specified in section 13.4: (1) Running Clearance; (2) Axle Clearance; and (3) Breakover Angle. The device is fabricated from a 15” x 9” flat top motorcycle jack stand and a fabricated rolling dolly and attached to a removable control handle, multi-directional wheels, a fabricated jack roof (as a mounting base), fabricated mountable lifting surfaces (angle mounts) of varying heights, fabricated mountable laser holding clamp, and standard 7/8” socket with 42”-48” lightweight socket extension (for jack height adjustment). Measurement devices for running and axle clearances must be capable of vertical measurements from any surface under the vehicle and to the ground. Equivalent devices may be used to measure each vehicle clearance separately. See photos and diagrams in Figures 4-8 below:

Figure 4

Figure 5

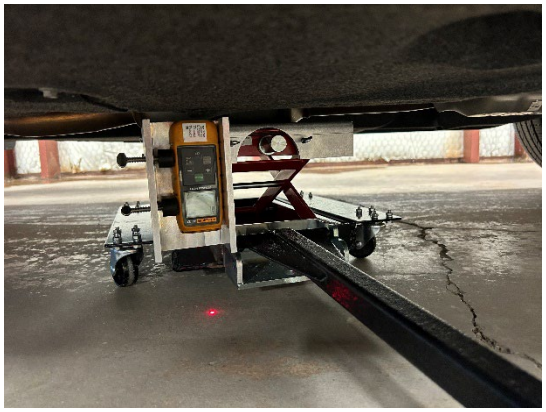


Figure 6

Figure 7

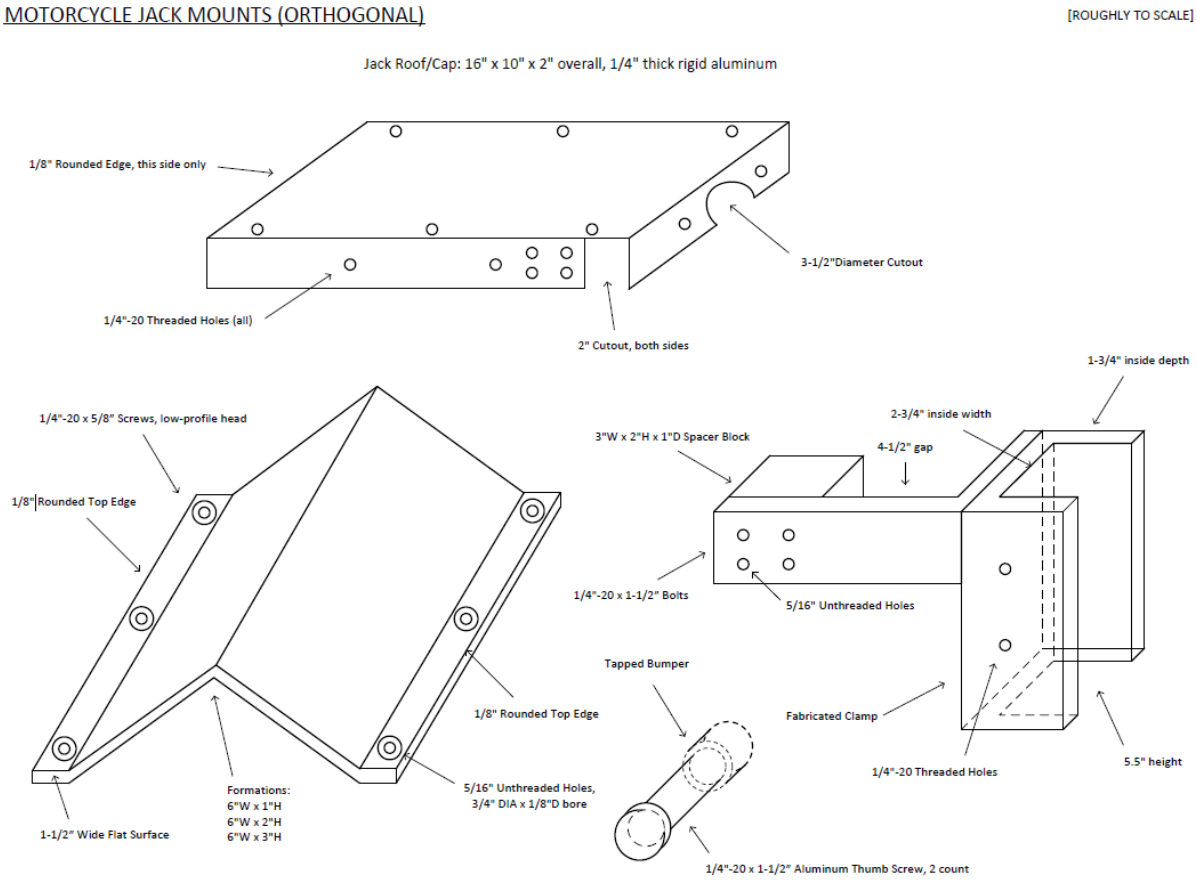


Figure 8

L. Breakover Angle Plate Assembly (or equivalent): A customizable fabricated device constructed of plates with interconnecting square poles of varying selected lengths, aligned pole positioning sleeves with locking set screws, a hinged cap plate assembly (24” L x 84” W recommended for each piece, hinged together), two base plates (20” L x 84” W recommended), and one sliding plate (8” L x 84” W recommended). Measurement devices for the breakover angle must be capable of adjusting to multiple angles and long enough to contact between each of inner sides of the front and rear wheels. Any plates used for this device must remain in the same surface plane whenever adjusted to different angles. See photos in Figures 9-12 below:

Figure 9

Figure 10

Figure 11

Figure 12

10. PHOTOGRAPHIC DOCUMENTATION

DIGITAL PHOTOGRAPHS

The contractor shall take digital photographs of the test procedure execution. Photographs shall be taken in color and contain clear images. A vehicle Model Year and Carline Name, NHTSA number, and photograph description with Test Procedure name shall appear in each photograph and must be legible. Utilizing the tent cards identify the test number and location of the tire to be tested on the vehicle. Each photograph shall be labeled as to the subject matter. The required resolution for digital photographs is a minimum of 1,600 x 1,200 pixels. Digital photographs are required to be created in color and in a JPG format. Glare from any illuminated or reflective surface should be minimized while taking photographs.

The test reports should include enough photographs to describe the testing in detail and should be organized in a logical succession of consecutive pictures. The photographs should be taken such that they serve as evidence for a description, operation, or dimensional information of the vehicle or device. The digital photographs should be included in the test report in a logical order detailing the testing. Any non-conformance must be photographed at various angles to assure complete coverage. Upon request, the photographs should be sent to the COR on a CD or DVD and saved in a "read only" format to ensure that the digital photographs are the exact pictures taken during testing and have not been altered from the original condition.

PHOTOGRAPHIC VIEWS

As a minimum, the following test photographs shall be included in each vehicle final test report, submitted by the contractor:

A. Left Side of Vehicle Three-Quarter View

B. Vehicle Certification Label

C. Vehicle (Tire) Placard

D. Vehicle Monroney Label

E. Tire Showing Manufacturer

F. Tire Showing Model

G. Tire Showing Size, Load, & Speed Index

H. Digital level verifying ground levelness and flatness (under front/rear bumper & left/right sills)

I. Rolling Jack Device with mounted laser distance meter identifying the lowest point of the front and rear axle clearances and showing the measurement complies (e.g. via the digital display of the mounted laser measuring device) (see section 13.7).

J. Rolling Jack Device with mounted laser distance meter identifying the lowest point of the running clearance and showing the measurement complies (e.g. via the digital display of the mounted laser measuring device) (see section 13.7).

K. Level showing levelness and flatness of approach and departure angle plate and support jacks

L. Digital angle measuring device and carbon fiber plate showing approach and departure angles on both driver and passenger sides of the plate

M. Tape measure or tram gauge with digital inclinometer verifying the levelness of measurements of the vehicle wheelbase

N. Temporary markings of vehicle center line for establishing the breakover angle

O. Rolling Jack Device with breakover angle plates raised to the contact point(s) under the vehicle

P. Measurement on the digital angle measuring device for breakover angle measurements from the front driver, front passenger, rear driver, and rear passenger sides

Q. Vehicle undercarriage front/rear showing underbody protection and axles

R. Obstructions to axle measurement (if applicable)

11. DEFINITIONS

Approach Angle[1]
The smallest angle, in a plane side view of an automobile, formed by the level surface on which the automobile is standing and a line tangent to the front tire static loaded radius arc and touching the underside of the automobile forward of the front tire.

Axle Clearance[2]
The vertical distance from the level surface on which an automobile is standing to the lowest point on the axle differential of the automobile.

1 49 CFR §523.2 Definitions
2 49 CFR §523.2 Definitions

Breakover Angle[3]
Breakover angle means the supplement of the largest angle, in a plan side view of an automobile that can be formed by two lines tangent to the front and rear static loaded radii arcs and intersecting at a point on the underside of the automobile.

Cargo-carrying Volume[4]
The luggage capacity or cargo volume index, as appropriate, and as those terms are defined in 40 CFR 600.315-08, in the case of automobiles to which either of these terms apply. With respect to automobiles to which neither of these terms apply, "cargo-carrying volume" means the total volume in cubic feet, rounded to the nearest 0.1 cubic feet, of either an automobile's enclosed non-seating space that is intended primarily for carrying cargo and is not accessible from the passenger compartment, or the space intended primarily for carrying cargo bounded in the front by a vertical plane that is perpendicular to the longitudinal centerline of the automobile and passes through the rearmost point on the rearmost seat and elsewhere by the automobile's interior surfaces.

Departure Angle[5]
The smallest angle, in a plan side view of a motor vehicle, formed by the level surface on which the motor vehicle is standing and a line tangent to the rear tire static loaded radius arc and touching the underside of the motor vehicle rearward of the rear tire.

Gross Vehicle Weight Rating (GVWR)[6]
The value specified by the vehicle manufacturer as the load-carrying capacity of a single axle system, as measured at the tire-ground interfaces.

Model Type[7]
Model type means a unique combination of car line, basic engine, and transmission class.

Model Year[8]
The manufacturer's annual production period (as determined by the Administrator of the Environmental Protection Agency) which includes January 1 of such calendar year. If a manufacturer has no annual production period, the term "model year" means the calendar year.

Nominal Suspension Setting
The default suspension setting that occurs during on-road operation in real-world conditions while the vehicle is moving.

Running Clearance[9]
The distance from the surface on which an automobile is standing to the lowest point on the automobile, excluding unsprung weight.

Standard Equipment[10]

3 49 CFR §523.2 Definitions
4 49 CFR §523.2 Definitions
5 49 CFR §523.2 Definitions
6 49 CFR §571.3(a) Definitions
7 40 CFR §600.002 Definitions
8 40 CFR §86.1803-01 Definitions
9 49 CFR §523.2 Definitions
10 40 CFR §86.1803-01 Definitions

Standard equipment means those features or equipment which are marketed on a vehicle over which the purchaser can exercise no choice.

Static Loaded Radius Arc[11]
A portion of a circle whose center is the center of a standard tire-rim combination of an automobile and whose radius is the distance from that center to the level surface on which the automobile is standing, measured with the automobile at curb weight, the wheel parallel to the vehicle's longitudinal centerline, and the tire inflated to the manufacturer's recommended pressure.

Transmission Class[12]
A group of transmissions having the following common features: Basic transmission type (e.g., automatic, manual, automated manual, semi-automatic, or continuously variable); number of forward gears used in fuel economy testing (e.g., manual four-speed, three-speed automatic, two-speed semi-automatic); drive system (e.g., front wheel drive, rear wheel drive; four wheel drive), type of overdrive, if applicable (e.g., final gear ratio less than 1.00, separate overdrive unit); torque converter type, if applicable (e.g., non-lockup, lockup, variable ratio); and other transmission characteristics that may be determined to be significant by the Administrator.

Unloaded Vehicle Weight (UVW)[13]
The weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use.

Vehicle Configuration[14]
A unique combination of basic engine, engine code, inertia weight class, transmission configuration, and axle ratio.

Vehicle Placard and Optional Tire Inflation Pressure Label
The sources of cold tire inflation pressure recommended by the vehicle manufacturer and provided in the location and format per Federal Motor Vehicle Safety Standard (FMVSS) No.110.

Wheelbase[15]
The longitudinal distance between front and rear wheel centerlines measured parallel to the ground

NOTE**:** Measured from the vertical centerlines of the wheels parallel to the ground.

Work Truck[16]
A vehicle that is rated at more than 8,500 pounds and less than or equal to 10,000 pounds gross vehicle weight, and is not a medium-duty passenger vehicle as defined in 49 U.S.C. 32901(a)(19).

12. TEST VEHICLE IDENTIFICATION AND INSPECTION

A. Inspect test vehicle. Document required test vehicle information.

11 49 CFR §523.2 Definitions
12 40 CFR §600.002 Definitions
13 49 CFR §571.3(c) Unloaded vehicle weight
14 40 CFR §86.1803-01 Definitions
15 40 CFR §86.1803-01 Definitions
16 49 CFR §523.2 Definitions

B. Review all test preparation, safety standard performance, and test instrumentation requirements relating to this compliance test. Personnel supervising and/or performing the compliance test shall be thoroughly familiar with all of the requirements.

C. Review all applicable contents of the vehicle Owner's Manual or equivalent documentation.

D. Verify COTR approval of contractor's detailed in-house test procedure.

E. Review all test preparation, regulation definitions and specifications, and test instrumentation requirements relating to this compliance test. Personnel supervising and/or performing the compliance test program shall be thoroughly familiar with the requirements, test conditions, and equipment for the test to be conducted.

F. Contracted laboratories must submit to the COR a list of the NHTSA procured test vehicles received. For each test vehicle note the make, model, engine, transmission, installed tire size(s), and tire model/manufacturer information.

G. Verify the calibration status of test equipment.

H. Document vehicle installed tire size, manufacturer, tire name and tire identification number (TIN). All tires must be new. The vehicle must be tested with the tires installed on the vehicle at the time of initial vehicle sale. From the Vehicle Placard or optional Tire Inflation Pressure Label, identify the vehicle's designated tire size(s). Notify COTR if any tire installed on the vehicle is different from the manufacturer's designated tire size obtained from the Vehicle Placard or optional Tire Inflation Pressure Label, and request further guidance before proceeding. Tire changes should not be required; however, if a tire change is necessary no tire mounting lubricant should be used when the tires are mounted to the rims.

I. Document vehicle default and selectable configurations affecting the vehicle clearance dimensions.

13. TEST EXECUTION

Personnel supervising and/or performing the compliance test program shall be thoroughly familiar with the requirements, test conditions, and equipment for the test to be conducted. Testing will be accomplished as indicated below. Test personnel shall make note of all discrepancies and deviations from the applicable regulation and this Laboratory Test Procedure.

13.1 TEST PREPARATION

A. Make sure that the vehicle is at UVW and check that the vehicle tire air pressure conforms with the manufacturer recommendation on the Vehicle (Tire) Placard[17], adjusting to conform if necessary.

B. Locate and inspect test location. Location shall be clean, uniform (no dips, cracks, etc.), free of equipment obstruction, large enough for testing, and having a consistent and level grade.

17 See 49 CFR § 571.110 S4.3

C. If a vehicle's owner's manual identifies certain parameters for off-road usage, the test lab will take reasonable measures to meet those conditions. This applies to both automated (e.g. an off-road mode) and manual modification (e.g. physical parts removal) features.

D. If a vehicle comes equipped with adjustable suspension packaging, measure the vehicle's 49 CFR 523.5(b)(2) characteristics with its adjustable suspension placed in the position(s) intended for off-road operation under real-world conditions. The vehicle must be placed in the off-road mode prior to positioning the vehicle. If the vehicle has an adjustable suspension without a setting for off-road, adjust the vehicle's suspension height to the manufacturer's on-road nominal suspension setting.

E. Inspect the test vehicle for installed equipment which may cause testing obstructions adversely impacting vehicle clearance measurements, such as front/rear spoilers, hubcaps, running boards, mud flaps, etc. If the equipment is not indicated on the Monroney label, consult with the COR for determining if the aftermarket equipment should be removed for testing. Remove any equipment the owner's manual recommends removing for off-road capability, if reasonably possible to do so. Follow the guidelines below regarding factory installed equipment which are not otherwise removed.

F. If the installed equipment or shielding on the vehicle underbody is an obstruction and installed by the vehicle manufacturer, treat this equipment as follows for the purposes of obtaining the 49 CFR 523.5(b)(2) measurements:

    a. If the equipment is intended to be permanently installed, such as side running boards, rigid mudflaps, non-deformable aerodynamics deflectors, non-deformable shielding, rigid bolts, etc., include these in the determination of the measurements.

    b. Any hanging object, obstruction, or shielding should only be excluded for the purposes of obtaining measurements if it is capable of bending sufficiently forwards and backwards (i.e. facilitates operating conditions) to allow the vehicle to meet a characteristic requirement (per 49 CFR 523.5(b)(2)) when loaded and positioned. Objects which must be forced to bend or that would break or be permanently deformed if bent should not be excluded when obtaining measurements.

    c. If the test laboratory is uncertain whether the equipment is non-deformable or deformable, consult with the COR.

G. If an axle or axle differential does not exist, or if the axle differential is unreasonably obstructed by structural parts or shielding, the axle clearance measurement cannot be obtained or else cannot be obtained accurately. If this measurement can only be obtained for one of the front or rear of the vehicle, then the one measurement obtained will be compared to the criterion of 49 CFR 523.5(b)(2)(v). If neither the front nor the rear axle clearance measurement can be obtained, then the criterion found in 49 CFR 523.5(b)(2)(v) will not be considered. In this case, the other (4) criteria found in 49 CFR 523.5(b)(2) must be met in order for the vehicle to be classified as a non-passenger automobile (light truck). In the case where an axle or axle differential is present but is obstructed by other vehicle components, a measurement will be taken from the lowest hanging vehicle component below the axle to indicate that the axle clearance is at least this value or greater. Such measurements will be marked with the measurable value followed by a "+" in the test data sheets.

13.2 CALCULATION and ROUNDING

A. All rounding done during the calculation of results must be done according to ASTM E29-93a as indicated in 40 CFR Part 91.509.

B. Outline of ASTM Rounding
   a. If the first discarded digit is less than 5, the last digit retained is not changed.
   b. If the first discarded digit is greater than 5 or is a 5 followed by at least one digit greater than 0, increase the last retained digit by one unit.
   c. If the first discarded digit is exactly 5, not followed by anything greater than 0, the last digit should be rounded up if it is an odd number and unchanged if it is an even number.

C. Measurements shall be rounded off based on ASTM E29 with the following accuracy:
   a. Angle measurements shall be rounded off the nearest 1/10 of a degree.
   b. Distance measurements shall be rounded off the nearest millimeter.

13.3 PROGRAM TOLERANCES

The allowable program tolerances for vehicle measurements vs the manufacturer reported information in the PMY Report are as follows:

Approach Angle	within + 0.5º of the rounded measured angle
Breakover Angle	within + 0.5º of the rounded measured angle
Departure Angle	within + 0.5º of the rounded measured angle
Running Clearance	within + 0.5 cm/+5 mm of the rounded measured distance
Front and Rear Axle Clearance	within + 0.5 cm/+5 mm of the rounded measured distance

If the OVSC measured values are above OEM supplied data, then the vehicle is compliant. If the OVSC measured values are below OEM supplied data even after considering tolerances, then the vehicle is non-compliant.

13.4 RECORDING MANUFACTURER AND VEHICLE INFORMATION

A. Record data from the PMY reports onto Data Sheet 1 - TEST VEHICLE MANUFACTURER'S REPORTED INFORMATON. If the data from the PMY reports has not been received yet by the OVSC, use the manufacturer's testing setup information for comparing to the measured vehicle clearances verified in this procedure. The information received in the manufacturer's setup information submissions will later be compared to the measurements in the PMY and MMY reports for verifying compliance with 49 CFR Part 537.

B. Verify and record the following information and that the information recorded matches test vehicle information:
   i. Verify that model year, make, model, body type, engine type/displacement, transmission type (manual/automatic, CVT, number of speeds, etc.), drive system (FWD/RWD/AWD), tire branding, and sizes on vehicle all match the information recorded from the Pre-Model Year report.
   ii. Verify that the vehicle mileage is less than 300 miles.
   iii. If the conditions in this section are not met, contact the COR.

13.5 TEST VEHICLE POSITIONING

Follow the steps below for vehicle positioning to perform the testing:

A. Position test vehicle within test area, pulling vehicle forward one car length, holding position for approximately five seconds, then reversing into the testing area ensuring that the steer wheels are pointed straight forward by adjusting the steering wheel so the vehicle's front tires are pointed in the forward direction parallel to the longitudinal centerline of the vehicle. When exiting the vehicle, ensure that steering direction is not altered by the operator contacting the wheel. If moving the vehicle for testing purposes is not viable, cycle the vehicles' suspension by "bouncing" the vehicle several times and allowing the vehicle to settle. Notate if this alternative procedure is used in the "notes" section of the data sheet.

B. Secure test vehicle (for automatic transmission place the transmission in "Park" and set the parking brake. For manual transmission, place the transmission in first gear and setting the parking brake).

C. Allow vehicle suspension to rest for five minutes to allow for it to settle.

13.6 SURFACE MEASUREMENTS

Surface measurements should be taken as follows:

A. Measure test surface attitudes, the measurements should be carried out utilizing the digital inclinometer placed on top of the 48-inch-long straight edge. The straight edge is utilized in order to ensure that the measurement is indicative of the inclination over a wider area so as to disallow localized defects from skewing the measurements.
B. Measure under the center of the front bumper, left sill, rear bumper, and right sill of the vehicle.
C. All measurements must be less than 0.4 degrees, otherwise a new test location must be found.
D. Using chalk or painters' tape, mark the vehicle testing surface to repeat vehicle position for subsequent tests.

13.7 TESTING PROCEDURE

A. Running Clearance

Use the Rolling Jack Device adjusted to a height of 20 cm to run under the entire undercarriage of the vehicle in search of any obstructions of lower hanging components. Attach flat custom jack "roof" to top of jack surface using set screws to secure position, and attach laser device clamp with laser clamped at 90 degree angle and pointed towards the ground surface. Verify a 90-degree angle of the laser device beam with the level ground surface by using an angle measuring device to confirm the laser device mounting orientation. Utilize an attached dolly steering/control handle to move the Rolling Jack Device.

1. If the Rolling Jack Device stand encounters any obstruction, visually isolate the lowest hanging point in the obstruction region, and use the laser device (ideally mounted to the Rolling Jack Device) to check for the running clearance between the lowest hanging point and ground. This must exclude the unsprung weight. (See note.)

2. If the Rolling Jack Device does not encounter any obstruction, use the laser device (ideally mounted to the Rolling Jack Device) to measure the lowest visible point of the automobile after isolating the region in which the lowest point occurs. Ensure that the reference surface of the top of the Rolling Jack Device makes contact with the lowest point in order to enable an accurate measurement of the distance between the contact point and the ground surface. This is accomplished by adjusting the height of the flat top surface of the Rolling Jack Device to match the height of the lowest ground clearance, and then taking a laser measurement associated with the jack height. This must exclude the unsprung weight. (See note.)

3. Record measurement on the appropriate Datasheet.

NOTE: Raise the Rolling Jack Device until it makes physical contact with the vehicle underbody. Do not continue to raise the apparatus such that the vehicle ride height is altered. Verify that any change in vehicle ride height does not exceed 2 millimeters (mm) using an elevation measuring device (e.g. elevation gauge). If the vehicle ride height is altered, lower the jack until the vehicle returns to its original height within 2 mm. If the vehicle will not return to the original height within 2 mm, repeat the vehicle positioning procedure found in the previous section.

B. Axle Clearance

Adjust the Rolling Jack Device adjusted to a height of 18 cm. Attach a flat custom jack "roof" to the top of the jack surface using set screws to secure position and attach laser device clamp with laser clamped at 90-degree angle and pointed towards the ground surface. Verify a 90-degree angle of the laser device beam with the level ground surface by using an angle measuring device to confirm the laser device mounting orientation. Utilize an attached dolly steering/control handle to move the Rolling Jack Device under the front axle and rear axle differential of the undercarriage of the vehicle in search of any obstructions hanging lower than the test device.

1. If the Rolling Jack Device stand encounters any obstruction, visually isolate the lowest hanging point in the obstruction region and use the laser device (ideally mounted to the Rolling Jack Device) to check for the axle clearance between the lowest hanging point and ground. This must exclude the unsprung weight. (e.g., wheels, semi-sprung control arms).

2. If the Rolling Jack Device does not encounter any obstruction, use the laser device (ideally mounted to the Rolling Jack Device) to measure the lowest visible point of the automobile after isolating the region in which the lowest point occurs on the axle. Ensure that the reference surface of the top of the Rolling Jack Device makes contact with the lowest

point in order to enable an accurate measurement of the distance between the contact point and the ground surface. This is accomplished by adjusting the height of the flat top surface of the Rolling Jack Device to match the height of the lowest ground clearance, and then taking a laser measurement associated with the jack height. This must exclude the unsprung weight. (e.g., wheels, semi-sprung control arms).

3. Record measurement on the appropriate Datasheet.

NOTE: If the vehicle has an off-road capability but has no differential present to use as a reference point in determining the lowest point on the axle differential of the automobile, any other lowest hanging component of the axle which does not have an unsprung weight can be used as a reference point in the measurement. If an axle is not present at the front or rear of the vehicle, do not attempt to take an axle clearance measurement at that location. Only take an axle clearance measurement at locations where an axle is present. If obstruction caused by the vehicle structures or components makes it impossible to take a measurement of a lowest axle component, then measure to the lowest hanging point of the vehicle structure in the region of the axle, and record this measurement followed by a "+" as the axle clearance entry in the appropriate Datasheet. (See the test preparation section above.)

C. Approach and Departure Angles

For measuring approach angle, use the 3/8"-thick Carbon Fiber Device and align with the left front and right front tire by slanting it to touch the underside of the automobile. Use supplemental supporting jacks in alignment with the tires on the driver and passenger sides of the vehicle to apply pressure to the underside of the sheet and to hold it in place. Adjust height and/or fine tune the sheet position as required in order to maintain unassisted positioning of the Carbon Fiber Device as described above. Raise until the plates make physical contact with the vehicle underbody. Do not continue to raise the apparatus such that the vehicle ride height is altered. Verify that any change in vehicle ride height does not exceed 2 mm using an elevation measuring device (e.g. elevation gauge). If the vehicle ride height is altered, lower the jack until the vehicle returns to its original height within 2 mm. If the vehicle will not return to the original height within 2 mm, repeat the vehicle positioning procedure found in the previous section.

Use a tape measure to verify ground to plate height at each jack location. Use a level to verify side-to-side plate levelness and top to bottom plate flatness. If the vehicle will not return to the original height, repeat the vehicle positioning procedure found in the previous section.

Use the digital angle measuring device and place the arm length of the device against the thin Carbon Fiber Device and take the reading on both driver and passenger sides of the vehicle for the approach angle and departure angles. Average the two values, and record one final measurement on the appropriate Datasheet.

NOTE: If required to keep the level from touching the ground, place blocks at the bottom of the plate at each rear tire in order to keep the level making contact with the plate only. If the vehicle has permanent obstructions, such as side running boards, rigid mudflaps, non-

deformable aerodynamics deflectors, etc., treat these according to the test preparation section above for the purposes of obtaining measurements.

For measuring departure angle, repeat the above step for the rear tires and underbody of the vehicle**.**

D. Breakover Angle

Measure the breakover angle of the vehicle using the Rolling Jack Device, Breakover Angle Plate Assembly, and appropriately selected angle mounts and poles.

Plate Support Poles selection guidelines:

Poles will be movable through support sleeves attached to each plate piece. Poles must be selected to allow sufficient movement for plate assembly while not exceeding space limitations. Therefore, the following rough guideline can be used in pole selection:

Pole Length ≈ ½ Wheelbase Length – 20”

Poles should be available in 30”-60” lengths in gradual increments (4 sets) in order to accommodate the range of possible wheelbase lengths. See process below for wheelbase measurement or utilize existing measurements.

Angle mount selection guidelines:

An angle mount will be installed to the top of the Rolling Jack Device roof mount in order to make contact with the hinged cap plates and allow for a workable initial angle of the plates. Obstructions on the jack roof should be removed for the lifting process. These include the laser device clamp mount and any protruding set screw ends (i.e. the screws on the long edges). The height of the angle mounts will be used to set an appropriate initial angle of the cap plates. Multiple set heights should be available for these mounts (i.e. 1”, 2”, and 3”). Use the following general consideration for angle mount selections when the approximate vehicle center running clearance is:

- <6” (~15cm): not measurable with apparatus, non-compliant
- 6”-8” (~15cm-20cm): use 1” height angle mount
- 9”-10” (~23cm-25.5cm): use 2” height angle mount
- >10” (~25.5cm): use 3” height angle mount

1. Breakover Angle Measurement:

    a) Select (4) plate support poles and an angle mount per the guidelines listed above.

b) Assemble the Rolling Jack Device with an appropriately selected angle mount mounted jack roof. Remove the potential obstructions from the jack roof, such as protruding set screws.

c) Measure vehicle wheelbase per the process below, or utilize existing measurements derived from TP-537.

d) Using chalk or other removable/washable marking substance and a measuring tool, mark the longitudinal vehicle center line on the outer portion of the vehicle underbody and on the bottom of the vehicle trim on both the right and left sides of the vehicle. Use chalk or equivalent to mark the longitudinal vehicle center line on the level ground surface below the outer of right and left sides of the vehicle. Use these markings as a reference to guide the Rolling Jack Device and the Breakover Angle Plate Assembly into a centered position in reference to the vehicle underbody.

e) Assemble the Breakover Angle Plate Assembly. Using a properly selected length of poles, run each of (4) plate support poles into the (4) sleeves of the ground plates, firmly locking these into the same position on each sleeve once the pole makes contact with the stopper device installed on the sleeve. The extension of the poles from the ground plate sleeves will allow for the sliding plate (if applicable) and the hinge plates to be added to the assembly. (These additional plates have 26” of combined sleeve length, which results in 36” of total sleeve length when combined with the ground plate.) Slide the additional plates into position by sliding the pole protrusions into the hinged cap plate sleeves, and loosely fasten all plates into assembled position using the set screws located on each sleeve of each plate. All sleeves should be located on the same side of the plate assembly.

   NOTE: For cases in which the vehicle wheelbase is relatively small (e.g. 100-inches or less), it may be desirable and/or necessary to exclude the sliding plate. This allows for a starting assembly length that will not exceed the available gap between the front and rear tires of the vehicle. However, in some cases, the sliding plate must be installed in order to address plate gaps when dealing with hanging obstructions.

f) Position the Breakover Angle Plate Assembly such that all sleeves rest on the level ground surface and lift and place the Breakover Angle Plate Assembly onto the Rolling Jack Device. Position the angle mount of the Rolling Jack Device at a laterally and longitudinally centered position, using the central gap in the hinges of the hinged cap plates for approximate positional guidance. Alternatively, the hinged cap plate can be rested on the Rolling Jack Device prior to sliding poles into sleeves and prior to adding ground plates to the assembly. In this case, firmly attach poles to the ground plates first, and then slide poles into position on the hinged cap plate. Loosely lock set screws into position on the hinged cap plate following assembly.

NOTE: The hinged center line of the hinged cap plate should rest directly on the vertex of the Breakover Angle Plate Assembly without touching the other edges of the Assembly. If the hinged cap plate makes contact with the other edges of the Breakover Angle Plate Assembly after moving the apparatus into final position under the vehicle, then ensure that the angle mount selection guidelines above were properly followed. If necessary, utilize a rubber mallet to gently tap the Breakover Angle Plate Assembly into complete alignment with the hinged center line of the hinged cap plate.

g) Roll the Breakover Angle Plate Assembly into a centered position under the vehicle using the Rolling Jack Device, and utilize the vehicle center line chalk markings as guidance. The Breakover Angle Plate Assembly should protrude from either side of the vehicle underbody by approximately the same distance on either side of the vehicle in order to ensure lateral centering. If the vehicle body width is greater than the width of the Breakover Angle Plate, position the Breakover Angle Plate Assembly in the most centered position possible; adjust as necessary and confirm assembly is centered by taking measurements from the edge of the assembly to a common point on either side of the vehicle.

   Raise the Breakover Angle Plate Assembly using the Rolling Jack Device controlled by a 7/8" with long extension handle, keeping marked vehicle center line in consideration for correct alignment. Raise until the plates make physical contact with the vehicle underbody. Do not continue to raise the apparatus such that the vehicle ride height is altered. Verify that any change in vehicle ride height does not exceed 2 mm using an elevation measuring device (e.g. elevation gauge). If the vehicle ride height is altered, lower the jack until the vehicle returns to its original height within 2 mm. If the vehicle will not return to the original height within 2 mm, repeat the vehicle positioning procedure found in the previous section.

h) Loosen (if necessary) the hinged cap plate sets screws in order to extend the plate assemblies on each side of the vehicle center line, such that the ground plates are in tangent with the static loaded radius arc of each tire while the hinged intersection of the Breakover Angle Plate Assembly remains in alignment with the marked vehicle center line. Use a tape measure to verify that all plates are the same length from the bottom edge of the ground plate to the top edge of the hinge plate. This ensures that the lateral axis of the plates is perpendicular to the longitudinal axis of the vehicle and that each plate edge is extended properly to the static loaded radius arc of each tire. The gaps between ground and hinge plates can alternatively be measured as an indicator of alignment. Using a tape measure, check the heights of the breakover angle plates on the driver and passenger sides of the vehicle, ensuring that these plates are as close to the same height from the ground on both sides as the equipment will allow. If required, utilize supplemental jacks to assist in maintaining equal height on both sides of the vehicle. Retighten the set screws of the hinged cap plate sleeves once the

positioning is correct. Be vigilant not to raise the height of the vehicle inadvertently during the process of setting the breakover equipment.

NOTE: During the final positioning of the overall Breakover Angle Plate Assembly, if any of the plates make contact with the vehicle underbody due to hanging obstructions, then the Rolling Jack Device must be lowered until the assembly barely makes contact with the vehicle underbody obstruction when properly positioned. This may require some fine tuning of jack vertical position and base plate position. Refer to the test preparation section above for guidance on the treatment of obstructions for the purposes of taking measurements.

i) Ensure that there are no obstructions within the open space between the plate support poles and each of the plates. Loosen the set screws of the sliding plate, and slide the plate up to the hinged cap plates and back down to the ground plates. If no obstruction of sliding plate movement occurs, proceed to taking breakover angle measurements.

If a sliding plate is obstructed by a vehicle underbody protrusion, then lower the Rolling Jack Device until the sliding plate is visibly lower than the lowest vehicle underbody protrusion. Position the sliding plate to be directly under the protrusion and lock the plate into position using the sleeve set screws. Raise the Rolling Jack Device until the sliding plate barely makes contact with the vehicle underbody. Proceed to taking breakover angle measurements.

j) For improved accuracy of the breakover angle measurement, use an angle measuring device to determine the breakover angle formed by the adjoined plates in (4) different locations, and average the values. The obtained (4) measurements are taken from the (2) planes formed by the hinged cap plates and the ground plates are as follows:

- Using a level capable of spanning from top of the hinged cap plate to the bottom of the ground plate, measure the angle formed between the level ground surface and the planes, and multiply by a factor of (2) in order to calculate the breakover angle.
- (4) locations: Measure the angles of the planes on the front driver, front passenger, rear driver, and rear passenger sides.

NOTE: The angle measuring device will be set upon the entire plane formed between the hinged plates and the ground plates parallel with the plate angle, since the device will be set to use gravity as a reference plane.

k) Round the result of the averaged angle values to the nearest tenth of a degree, and record the one final breakover angle measurement on the appropriate Datasheet.

E. Wheelbase Measurement

1. Vehicles with Identical Front and Rear Wheel Size

a) Remove any hubcap or wheel trim obstructing the location of the wheel rim edges that can be easily removed.

b) Using the tape measure or tram gauge on the left side of the vehicle, measure the horizontal distance, parallel to the ground, from the forward most edge of the front wheel rim to the rearward most edge of the rear wheel rim. The measurement should be made to the nearest 1 mm. Record the distance.

c) Using the tape measure or tram gauge on the left side of the vehicle, measure the horizontal distance, parallel to the ground, between the rearward most edge of the front wheel rim to the forward most edge of the rear wheel rim. The measurement should be made to the nearest 1 mm. Record the distance.

NOTE: Ensure that while measuring the tape measure is taut and parallel with the ground using the inclinometer.

d) Calculate the left side wheelbase by averaging the measured distances in steps (b) and (c). The calculated wheelbase should be rounded to two decimal places. Record the calculated value onto the data sheet in mm.

e) Repeat steps (b) through (d) for the right side of the vehicle. Record the two measured distances.

f) Calculate the vehicle wheelbase by converting the average of the left and right-side wheelbases in mm from steps (d) and (e) to centimeters rounded to the nearest tenth of a centimeter. Record the calculated value.

2. Vehicles with Different Front and Rear Wheel Sizes

a) Remove any hubcap or wheel trim obstructing the location of the wheel rim edges that can be easily removed.

b) Using the right-angle rule and the tape measure or tram gauge, measure the horizontal distance, parallel to the ground, between the vertical lines at the forward most location of the front wheel rim to the vertical line at the rearward most location of the rear wheel rim. The measurement should be made to the nearest 1 mm. Record the distance.

c) Using the right-angle rule and the tape measure or tram gauge, measure the horizontal distance, parallel to the ground, between the vertical lines at the rearward most location of the front wheel rim to the vertical line at the forward most location of the

rear wheel rim. The measurement should be made to the nearest 1 mm. Record the distance.

d) Calculate the left side wheelbase by averaging the measured distances in steps (b) and (c). The measurement should be rounded to two decimal places. Wheelbase is calculated using two vertical lines at the edges of the rims in order to account for differences in the vertical height of the wheel centers and differences in wheel diameter sizes for vehicles equipped with different tire sizes on each axle. Record the calculated value.

e) Repeat steps (a) through (d) for the right side of the vehicle.

f) Calculate the vehicle wheelbase by averaging of the left and right-side wheelbases from steps (d) and (e). Vehicle wheelbase in mm should be rounded to two decimals places and then converted to centimeters and rounded to the nearest tenth of a centimeter (one decimal place). Record the calculated value.

F. Record all values and round the values according to ASTM E29-93a as indicated in 40 CFR Part 91.509 to be consistent with PMY/MMY data from manufacturers. Record information on the appropriate Datasheet for use with marking the vehicle centerline.

G. Record the dealership name, contact information, and phone number of the management.

NOTE: If the vehicle misses any of the steps mentioned, that vehicle fails the testing procedure and must re-schedule another vehicle of the same attributes for testing.

14. POST TEST REQUIREMENTS

A. Verify all data sheets have been completed and all photographs taken.
B. Complete the Vehicle Condition Report form including a word description of the vehicle's post-test condition.

15. REPORTS

15.1. MONTHLY STATUS REPORTS

The contractor shall submit a monthly Test Status Report and a Vehicle Status Report to the COR. The Vehicle Status report shall be submitted until all vehicles are disposed of. Samples of the required reports are found in the report forms section.

15.2. APPARENT NON-CONFORMANCE

Any indication of an apparent discrepancy or non-conformance shall be communicated by telephone to the COR within 24 hours with written notification mailed within 48 hours (Saturdays and Sundays excluded). A Notice of Non-conformance (see report forms section) with a copy of the particular test data sheet(s) and the preliminary data shall be included.

15.3 FINAL TEST REPORTS

15.3.1 COPIES

In the case of an apparent discrepancy or non-conformance, two paper copies and electronic copies in both Word and PDF formats of the Final Test Report shall be submitted to the COR for acceptance within three weeks of test completion. The Final Test Report format to be used by all contractors can be found in the "Report Section".

Where there has been no indication of an apparent non-conformance, one paper copy and electronic copies in both Word and PDF formats of each Final Test Report shall be submitted to the COR for acceptance within three weeks of test completion. No payment of contractor's invoices for conducting compliance tests will be made prior to the Final Test Report acceptance by the COR. Contractors are requested to NOT submit invoices before the COR is provided with copies of the Final Test Report.

Contractors are required to submit the first Final Test Report in draft form within one week after the compliance test is conducted. The contractor and the COR will then be able to discuss the details of both test conduct and report content early in the compliance test program.

Contractors are required to PROOFREAD all Final Test Reports before submittal to the COR. The OVSC will not act as a report quality control office for contractors. Reports containing a significant number of errors will be returned to the contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

15.3.2 REQUIREMENTS

The Final Test Report and associated documentation (including photographs) are relied upon as the chronicle of the test verification. The Final Test Report will be released to the public domain after review and acceptance by the COR. For these reasons, each final report must be a complete document capable of standing by itself. The contractor should use DETAILED descriptions of all test validation events. Any events that are not directly associated with the regulation but are of technical interest should also be included. The contractor should include as much DETAIL as possible in the report. Instructions for the preparation of the first three pages of the final test report are provided for standardization.

15.3.3 FIRST THREE PAGES

A. FRONT COVER

A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

(1) Report Number such as 523-ABC-XX-001, where –

523 is the Regulation tested
ABC are the initials for the laboratory
XX is the Fiscal Year of the test program
001 is the Group Number (001 for the 1st test, 002 for the 2nd test, etc.)

(2) Final Report Title and Subtitle such as

CONFORMANCE TESTING FOR 49 CFR 523
Vehicle Classification
* * * * * * * * * * * * * * * *
ABC Motor Company
20XX Saferider 4-door sedan
NHTSA No. CX0401

(3) Contractor's Name and Address such as

TESTING LABORATORIES, INC.
4335 West Dearborn Street
Detroit, Michigan 48090-1234

NOTE: DOT SYMBOL WILL BE PLACED BETWEEN ITEMS (3) AND (4)

(4) Date of Final Report completion

(5) The words "FINAL REPORT"

(6) The sponsoring agency's name and address as follows

U. S. Department of Transportation
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NEF-200
1200 New Jersey Ave., SE
Washington, DC 20590

B. FIRST PAGE AFTER FRONT COVER

When a contract test laboratory is reporting, a disclaimer statement and an acceptance signature block for the COR shall be provided as follows:

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Prepared By: _____

Approved By: _____

Accepted By: _____

Acceptance Date: _____

C. SECOND PAGE AFTER FRONT COVER

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523-ABC-XX-001

Block 2 — GOVERNMENT ACCESSION NUMBER

Leave blank

Block 3 — RECIPIENT'S CATALOG NUMBER

Leave blank

Block 4 — TITLE AND SUBTITLE

Final Report of 49 CFR Part 523 Conformance Validation of 200X Saferider 4-door sedan, NHTSA No. CX0401

Block 5 — REPORT DATE

Month Day, 20XX

Block 6 — PERFORMING ORGANIZATION CODE

ABC

Block 7 — AUTHOR(S)

John Smith, Project Manager
Bill Doe, Project Engineer

Block 8 — PERFORMING ORGANIZATION REPORT NUMBER

ABC-DOT-20-XXX-001

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories
405 Main Street
Detroit, MI 48070-1234

Block 10 — WORK UNIT NUMBER

Leave blank

Block 11 — CONTRACT OR GRANT NUMBER

DTNH22-XX-D-12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS

United States Department of Transportation
National Highway Traffic Safety Administration
Office of Vehicle Safety Compliance
Mail Code: NVS-220
1200 New Jersey Avenue, SE
Washington, DC 20590

Block 13 — TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Month Day to Month Day, 20XX

Block 14 — SPONSORING AGENCY CODE

NEF-200

Block 15 — SUPPLEMENTARY NOTES

Leave blank

Block 16 — ABSTRACT

Conformance validations were conducted on the subject 200X Saferider 4-door sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-523-0X to verify the vehicle classification based on 49 CFR 523 versus the manufacturer's data in its report submitted pursuant to 49 CFR 537 Automotive Fuel Economy Reports. The test non-conformances identified were as follows:

None

NOTE: Above wording must be shown with appropriate changes made for a particular compliance test. Any questions should be resolved with the COR.

Block 17 — KEY WORDS

Conformance Validation
Safety Engineering
49 CFR Part 523

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from the following:

National Highway Traffic Safety Administration
Technical Information Services Division, NPO-411
1200 New Jersey Avenue, SE (ROOM E12-100)
Washington, DC 20590

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Block 19 — SECURITY CLASSIFICATION OF REPORT

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Block 20 — SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 — NUMBER OF PAGES
Add appropriate number

Block 22 — PRICE

Leave blank

15.3.4 TABLE OF CONTENTS

Final test report Table of Contents shall include the following:

Section 1 — Purpose of Conformance Validation

Section 2 — Test Procedure and Discussion of Results

Section 3 — Test Data

Section 4 — Test Equipment List and Calibration Information

Section 5 — Photographs

Section 6 — Other Documentation

Section 7 — Notice of Test Non-conformance (if applicable)

Sample Report Layout

<table>
<tr><td>1. Report No.
523-ABC-XX-001</td><td>2. Government Accession No.
(Leave Blank)</td><td>3. Recipient's Catalog No.
(Leave Blank)</td></tr>
<tr><td colspan="2">4. Title and Subtitle

Final Report of 49 CFR Part 523 Conformance Validation of 20XX Saferider 4-door sedan, NHTSA No. CX0401</td><td>5. Report Date
Month Day, 20XX
6. Performing Organization Code STF</td></tr>
<tr><td colspan="2">7. Author(s)

John Smith, Project Manager
Bill Doe, Project Engineer</td><td>8. Performing Organization Report Number

ABC-DOT-20-XXX-001</td></tr>
<tr><td colspan="2">9. Performing Organization Name and Address

ABC Laboratories
405 Main Street
Detroit, MI 48070-1234</td><td>10. Work Unit No. (TRAIS)
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DTNH22-XX-D-12345</td></tr>
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United States Department of Transportation
National Highway Traffic Safety Administration
Office of Vehicle Safety Compliance,
Mail Code: NEF-200
1200 New Jersey Avenue, SE
Washington, DC 20590</td><td>13. Type of Report and Period Covered

Final Test Report
Month Day to Month Day, 20XX
14. Sponsoring Agency Code

NEF-200</td></tr>
<tr><td colspan="3">15. Supplementary Notes
(Leave Blank)</td></tr>
<tr><td colspan="3">16. Abstract
Conformance validations were conducted on the subject 200X Saferider 4-door sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP- 523 -0X to verify the vehicle classification based on 49 CFR 523 versus the manufacturer's data in its report submitted pursuant to 49 CFR 537 Automotive Fuel Economy Reports. The test non-conformances identified were as follows: NONE.

NOTE: Above wording must be shown with appropriate changes made for a particular compliance test. Any questions should be resolved with the COR.</td></tr>
<tr><td colspan="2">17. Key Words

Conformance Validation
Safety Engineering
49 CFR Part 523</td><td>18. Distribution Statement

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UNCLASSIFIED</td></tr>
</table>

16. TEST DATA

49 CFR 523 – TEST DATA SUMMARY

TEST DATE: **Month Day, 20XX** LAB: _____

VEHICLE NHTSA NUMBER: _____ MY/MAKE/MODEL: _____

DATASHEET – 1 of 4 Test Vehicle Manufacturer's Reported Information

Field Data			
MY			
Make			
Model			
Body Type			
VIN			
Stock No.			
Engine Type/Displacement			
Transmission Class			
Drive System			
		Front and Rear Axles	
Tire Manufacturer/Model			
Tire Size			
Mileage			
Fuel			
Adjusted Tire Pressure to conform (Y/N)			
Label Data			
Monroney Label		Front Axle	Rear Axle
Tire Size			
Manufacturer Certification Label		Front Axle	Rear Axle
Tire Size			
GAWR (kg) *(Converted from lbs.)			
GVWR (kg) *(Converted from lbs.)			
Tire Placard	Total	Front	Rear
Seat Capacity			
Tire Size			
Required Tire Pressure (kPa)			
Vehicle Capacity Weight (kg)			
Dealer Information			
Dealer Name			
Address			

49 CFR 523 – TEST DATA SUMMARY

TEST DATE: **Month Day, 20XX** LAB: _____

VEHICLE NHTSA NUMBER: _____ **MY/MAKE/MODEL:** _____

DATASHEET – 2 of 4 Test Data

Attributes			Test 1	Test 2	Test 3
Approach Angle (degree)	**Passenger side**				
	Driver side				
Departure Angle (degree)	**Passenger side**				
	Driver side				
Breakover Angle (degree)	**Front**	**Passenger side**			
		Driver side			
	Rear	**Passenger side**			
		Driver side			
Ground Clearance (cm)					
Front Axle Clearance (cm)					
Rear Axle Clearance (cm)					
Wheelbase Calculation			Test 1	Test 2	Test 3
Left Side OUT-OUT (mm)					
Left Side IN-IN (mm)					
Calculated Left Side Wheelbase (cm)					
Right Side OUT-OUT (mm)					
Right Side IN-IN (mm)					
Calculated Right Side Wheelbase (cm)					
Average Left/Right Wheelbase (cm)					

49 CFR 523 – TEST DATA SUMMARY

TEST DATE: **Month Day, 20XX** LAB: _____

VEHICLE NHTSA NUMBER: _____ MY/MAKE/MODEL: _____

DATASHEET – 3 of 4 Manufacturer's Setup Information (per Part 523) and Surface Measurements

Surface Measurement (less than 2 degrees)			
Front Bumper		Rear Bumper	
Left Sill		Right Sill	

Manufacturer's Setup Information (per Part 523)	**Measurements**
Base Tire Size	
Approach Angle	
Breakover Angle	
Departure Angle	
Running Clearance	
Front Axle Clearance	
Rear Axle Clearance	
Same configuration as test vehicle (Y/N)	

49 CFR 523– TEST DATA SUMMARY

TEST DATE: _____ LAB: _____

VEHICLE NHTSA NUMBER: _____ MY/MAKE/MODEL: _____

DATASHEET – 4 of 4 Manufacturer's Reported Information and Test Results

Comparison Chart (Test Values ± 0.15)	**Y/N**
Does test 1 indicate conformance?	
If No:	
Are tests 1 & 2 comparable?	
Are tests 2 & 3 comparable?	
Are tests 1 & 3 comparable?	
Are test(s) in tolerance with the manufacturer's reported information?	

	Test 1	**Test 2**	**Test 3**
Approach Angle			
Breakover Angle			
Departure Angle			
Running Clearance (cm)			
Front and Rear Axle Clearance (cm)			

Tolerances[1]	
Approach Angle	+ 0.5° of the rounded measured angle
Breakover Angle	+ 0.5° of the rounded measured angle
Departure Angle	+ 0.5° of the rounded measured angle
Running Clearance	+ 0.5 cm/+5 mm of the rounded measured distance
Front and Rear Axle Clearance	+ 0.5 cm/+5 mm of the rounded measured distance

The tolerances include the manufacturer's design and manufacturing tolerances. If the manufacturer has not provided tolerances, OVSC may assign default values based upon the result of measured vehicles. If the OVSC measured values are above OEM supplied data, then the vehicle is compliant. If the OVSC measured values are below OEM supplied data even after considering tolerances, then the vehicle is non-compliant.

Test Conductor: _____ Date: _____

Approval: _____

To be compliant with the CAFE Program, all manufacturer-submitted footprint dimensions must be less than or equal to the OVSC-measured test value. If a manufacturer's reported information value is larger than the corresponding test value, the difference between the two must be less than or equal to the associated program tolerance. If not, the test may represent a non-conformance.

SECTION 4

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

EQUIPMENT	DESCRIPTION	MODEL/SERIAL NO	CAL. DATE	NEXT CAL. DATE
AIR PRESSURE GAUGE				
HAND HELD LASER DISTANCE METER				
DIGITAL LEVEL MEASURING DEVICE				
DIGITAL ANGLE MEASURING DEVICE				
TAPE MEASURE				
TRAM GUAGE				
ELEVATION GAUGE				
SUPPLEMENTAL JACKS				
RIGID 3/8" (9.5 MM)-THICK CARBON FIBER DEVICE (FLAT SHEET)				
ROLLING JACK DEVICE				
BREAKOVER ANGLE PLATE ASSEMBLY				
90^0 – ANGLE BRACKETS				

17. FORMS

LABORATORY NOTICE OF TEST NON-COMFORMANCE TO OVSC

FMVSS or REGULATION NO.: _____ TEST DATE:_____

LABORATORY:_____

CONTRACT NO.: _____ DELV. ORDER NO.:_____

LABORATORY PROJECT ENGINEER'S NAME:_____

TEST SPECIMEN DESCRIPTION:_____

VEHICLE NHTSA NO.: _____ VIN:_____

MFR:_____

NON-CONFORMANCE DESCRIPTION: _____

_____

_____

_____

FMVSS or REGULATION REQUIREMENT, PARAGRAPH S _____:

_____

_____

_____

NOTIFICATION TO NHTSA (COR): _____

DATE: _____ BY: _____

REMARKS:

MONTHLY TEST STATUS REPORT
49 CFR Part 523
DATE OF REPORT:

NO.	VEHICLE NHTSA NO., MAKE & MODEL	COMPLIANCE TEST DATE	PASS/ FAIL	DATE REPORT SUBMITTED	DATE INVOICE SUBMITTED	INVOICE PAYMENT DATE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

MONTHLY VEHICLE STATUS REPORT
49 CFR Part 523
DATE OF REPORT:

NO.	VEHICLE NHTSA NO., MAKE & MODEL	DATE OF DELIVERY	ODOMETER READING	TEST COMPLETE DATE	VEHICLE SHIPMENT DATE	ODOMETER READING
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						