TP-126-02
November 19, 2008

(For vehicles manufactured before September 1, 2011)

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

FMVSS 126, Electronic Stability Control Systems

ENFORCEMENT
Office of Vehicle Safety Compliance
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OVSC LABORATORY TEST PROCEDURE NO. 126
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PREFACE

On April 6, 2007, NHTSA published a final rule establishing a new Federal motor vehicle safety standard requiring light vehicles to be equipped with electronic stability control (ESC) systems. The final rule was established as part of a comprehensive plan to reduce the high percentage of rollover crashes and the serious risk of death or injury involved in these crashes. In response, several petitions for reconsideration were received and various changes made to the final rule including the allowance of a two-part telltale that identifies an ESC system malfunction and an ESC Off indication. Also, the standard added definitions for “drive configuration” and “mode” and clarified that, with some exceptions, all combinations of drive configurations and modes that do not activate the ESC Off telltale must meet the stability and lateral displacement performance requirements of the standard.

This test procedure is revised from the previous version to account for the changes made to the final rule based upon the agency’s response to the petitions for reconsideration. Changes include provisions to allow a two-part malfunction and ESC-Off telltale and to account for the phase-in of telltale and control requirements that have been delayed until September 1, 2011. Additionally, definitions have been added for drive configuration and mode to identify the selected vehicle test setup condition. A subsequent test procedure will be issued to address the inclusion of the telltale requirements which become effective on or after September 1, 2011.

REVISION CONTROL LOG

FOR OVSC LABORATORY TEST PROCEDURES

TP-126
Electronic Stability Control Systems

TEST PROCEDURE		FMVSS 126		DESCRIPTION
REV. No.	DATE	AMENDMENT	EFFECTIVE DATE	
00	Preliminary 4/06/07	72FR17236 04/06/07	6/5/07	Final Rule
01	Original 4/10/08	72FR34409 06/22/07	6/22/07	Miscellaneous editorial changes. Corrections for amendments made to the standard and changes to adopt a standardized format for the OVSC test procedures.[1]
02	11/19/08	73FR54526 9/22/08	10/22/08	Final Rule - Response to petitions for reconsideration.
03				
04				
05				
06				

1 The Office of Vehicle Safety Compliance is updating its laboratory test procedures, to the extent practicable, with a standardized format.

1. PURPOSE AND APPLICATION

This document is a laboratory test procedure provided by the National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) for the purpose of presenting guidelines for a uniform testing data and information recording format, and providing suggestions for the use of specific equipment and procedures for contracted testing laboratories. The data correspond to specific requirements of the Federal Motor Vehicle Safety Standard(s) (FMVSS). The OVSC test procedures include requirements that are general in scope to provide flexibility for contracted laboratories to perform compliance testing and are not intended to limit or restrain a contractor 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 Technical Representative (COTR) to demonstrate concurrence with the OVSC laboratory test procedure and the applicable FMVSS. If any contractor views any part of an OVSC laboratory test procedure to be in conflict with a FMVSS or observes deficiencies in a laboratory test procedure, the contractor is required to advise the COTR 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 the in-house test procedures shall be obtained from the COTR 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 FMVSS. The laboratory test procedures are not intended to limit the requirements of the applicable FMVSS(s). In some cases, the OVSC laboratory test procedures do not include all of the various FMVSS 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 standard. In addition, the laboratory test procedures may be modified by the OVSC at any time without notice, and the COTR 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

FMVSS No. 126 establishes performance and equipment requirements for Electronic Stability Control (ESC) Systems installed in motor vehicles. The purpose of this standard is to reduce the number of deaths and injuries that result from crashes in which the driver loses directional control of the vehicle. It is applicable to passenger cars, multipurpose passenger vehicles, trucks and buses with a gross vehicle weight rating of 4,536 kilograms or less, according to the phase-in schedule shown below.

PHASE-IN REQUIREMENTS

Manufacturer Type	Percentage Complying[1]	Period of Production Vehicles Manufactured:
Large Volume	≥ 55%	On or after September 1, 2008 and before September 1, 2009
	≥ 75%	On or after September 1, 2009 and before September 1, 2010
	≥ 95%	On or after September 1, 2010 and before September 1, 2011
	100%	On or after September 1, 2011
Small Volume[2]	0%	On or after September 1, 2008 and before September 1, 2011
	100%	On or after September 1, 2011
Final-stage and Alterers[3]	0%	On or after September 1, 2008 and before September 1, 2012
	100%	On or after September 1, 2012

Vehicles to which this standard applies must be equipped with an ESC system that is capable of applying brake torques individually to all four wheels and has a control algorithm that utilizes this capability, is operational during all phases of driving including acceleration, coasting, and deceleration (including braking), except when the driver has disabled ESC, the vehicle speed is below 20 km/h (12.4 mph), the vehicle is being driven in reverse or during system initialization, and remains capable of activation even if the antilock brake system or traction control system is activated. Vehicles to which this standard applies must meet specific lateral stability and responsiveness performance requirements.

[1] The percentage complying requirement is calculated as follows: number of complying vehicles in the period of production / either (total number in that period) or (average production in 3 previous periods) x 100.

[2] Produced fewer than 5,000 vehicles for the U.S. market, September 1, 2008 – August 31, 2011.

[3] See 49 CFR 567, Certification.

2. GENERAL REQUIREMENTS....Continued

Yaw rate thresholds are used to assess a vehicle's lateral stability. At 1.0 second after completion of a required sine with dwell steering input, the yaw rate of a vehicle must not exceed 35 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks during the same test run). At 1.75 seconds after completion of a required sine with dwell steering input, the yaw rate of the same vehicle must not exceed 20 percent of the first peak value of yaw rate recorded after the steering wheel angle changes sign (between first and second peaks during the same test run).

Lateral displacement is used to assess a vehicle's responsiveness. The lateral displacement of the vehicle center of gravity with respect to its initial straight path must be at least 1.83 m (6 feet) for vehicles with a GVWR of 3,500kg (7,716 lb) or less, and 1.52 m (5 feet) for vehicles with a GVWR greater than 3,500 kg (7,716 lb) when computed at specified commanded steering wheel angles 1.07 seconds after the Beginning of Steer (BOS).

An ESC system must have the capability to identify and warn of system malfunctions.

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.

2. GENERAL REQUIREMENTS....Continued

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 COTR) 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 COTR, unless specifically authorized by the COTR or the COTR'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 or test dummy calibration unless specifically authorized by the COTR.

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 COTR 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 that 1 week intervals unless otherwise specified by the COTR.

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 COTR in order to allow monitoring by the COTR

5. TEST SCHEDULING AND MONITORING….Continued

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 COTR. 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 vehicle preliminary compliance test data available to the COTR on location within 30 minutes after the test. Final test data, including digital printouts and computer generated plots (if applicable) shall be available to the COTR 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 COTR.

All backup data sheets, strip charts, recordings, plots, technicians' notes, etc., shall be either sent to the COTR 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 telephone, within 24 hours of the test and send written notice to the COTR within 48 hours or the test completion.

C. RETEST NOTIFICATION

The Contracting Officer 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 Contracting Officer that a retest is required.

6. TEST DATA DISPOSITION….Continued

D. WAIVER OF RETEST

NHTSA, in its sole discretion, reserves the right to waive the retest requirement. This provision shall not constitute a basis for dispute over the NHTSA's waiving or not waiving any requirement.

E. TEST VEHICLE

NHTSA shall furnish only one vehicle for each test ordered. The Contractor shall furnish the test vehicle required for the retest. 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 COTR 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 COTR. The report and other required deliverables for the retest vehicle are required to be submitted to the COTR within 3 weeks after completion of the retest.

G. DEFAULT

The Contractor is subject to the default and subsequent reprocurement costs for nondelivery 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 consist of test vehicles, test equipment and instrumentation. 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.
7. Spare tire, jack, lug wrench and tool kit (if applicable) is 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 COTR.

A Vehicle Condition form will be supplied to the contractor by the COTR 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 COTR 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 COTR.

7. GOVERNMENT FURNISHED PROPERTY (GFP)….Continued

B. TEST EQUIPMENT AND INSTRUMENTATION

The contractor has the responsibility of accepting GFP test equipment and instrumentation delivered to the contractor. The contractor acts on behalf of the OVSC when signing an acceptance of the GFP test equipment and instrumentation delivery order. When GFP test equipment and instrumentation is delivered, the contractor must:

1. Verify all partial and sub-component quantities as per the packaging document
2. Verify physical condition of all equipment and instrumentation (inspect for damage)
3. Verify functional condition of all equipment and instrumentation
4. Store in a clean, organized, secure, and environmentally controlled area

C. NOTIFICATION OF COTR

The COTR must be notified within 24 hours after a vehicle (and/or equipment item) 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 COTR immediately.

8. CALIBRATION OF TEST INSTRUMENTS

Before the contractor initiates the safety compliance test program, a test instrumentation calibration system will 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.

8. CALIBRATION OF TEST INSTRUMENTS….Continued

Inertial sensing systems shall be calibrated every twelve months or after a test failure or after any indication from calibration checks that there may be a problem with the inertial sensing systems whichever occurs sooner.

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 COTR. The calibration system shall need the acceptance of the COTR 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.

8. CALIBRATION OF TEST INSTRUMENTS….Continued

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 COTR's discretion and will be performed without additional cost.

9. SUGGESTED TEST EQUIPMENT

A. Portable tire pressure gage with an operating pressure of at least 700kPa (100 psi), graduated increments of 1 kPa (0.1 psi) and an accuracy of at least ± 2.0% of the applied pressure.

B. Platform scales to measure individual wheel, axle and vehicle loads. Platform scales shall have a maximum graduation of 0.5 kg (1.0 lb) and have an accuracy of at least ± 1% of the measured reading.

C. Automated steering machine with steering angle encoder for controlling steering wheel angle input and output. Automated steering machine is used to generate steering inputs for all test maneuvers. The automated steering machine shall be capable of supplying steering torques between 40 to 60 Nm (29.5 to 44.3 lb-ft). The steering machine must be able to apply these torques when operating with steering wheel velocities up to 1200 deg/sec. The steering machine must be able to move the vehicle's steering system through its full range, accept vehicle speed sensor feedback input to initiate steering programs at a preset road speeds, and have the convenience of changing the steering program during test sessions. Handwheel angle resolution is 0.25 deg and accuracy is ± 0.25 deg (ATI Model Spirit 3 or equivalent).

D. Multi-Axis Inertial Sensing System for measuring longitudinal, lateral and vertical accelerations as well as roll, yaw and pitch rates. Accelerometer range + 2g, resolution < 10µg, and accuracy < 0.05% of full range. Angular rate sensors range + 100 deg/sec, resolution < 0.004 deg/sec and accuracy 0.05% of full range (BEI Motion PAK or equivalent).

E. Radar speed sensor with dashboard display for vehicle speed with a range of 0-201km/h (0-125 mph), resolution 0.014 km/h (.009 mph) and accuracy ± 0.25% of full

9. SUGGESTED TEST EQUIPMENT….Continued

scale (DEUTA- WERKE Model DRS-6 or equivalent).

F. Two ultrasonic distance measuring system sensors, to determine vehicle displacements that will be used to calculate roll angle, with a range of 10- 102 cm (4-40 inches), resolution 0.25 mm (0.01 inches) and accuracy ± 0.25% of maximum distance (MASSA Model M-5000/220 or equivalent).

G. Data acquisition system to record time, velocity, roll height, lateral, longitudinal and vertical accelerations, roll, yaw and pitch rates, and steering wheel angles from vehicle installed sensors. All data is to be sampled at 200 Hz. Signal conditioning must consist of amplification, anti-alias filtering, and digitizing. Amplifier gains are selected to maximize the signal-to-noise ratio of the digitized data. Filtering is performed with two-pole low-pass Butterworth filters with nominal cutoff frequencies selected to prevent aliasing. (Dewetron Sidehand model DA-121-16 with A/D card Orion-1616-100, and amplification/anti-aliasing card MDAQ-FILT-10-S).

H. Load cell to monitor brake pedal force with a range of 0-136 kg (0-300 lb) and accuracy ± 0.05% full scale (Interface Model BPL 300 or equivalent).

I. Outriggers must be used for testing trucks, multipurpose passenger vehicles, and buses. Vehicles with a baseline weight under 2,722 kg (6,000 lbs) must be equipped with “standard” outriggers and vehicles with a baseline weight equal to or greater than 2,722 kg (6,000 lbs) must be equipped with “heavy” outriggers. A vehicle’s baseline weight is the weight of the vehicle delivered from the dealer, fully fueled, with a 73 kg (160 lb) driver. Standard outriggers shall be designed with a maximum weight of 32 kg (70 lb) and a maximum roll moment of inertia of 35.9 kg-m² (26.5 ft-lb-sec²). Heavy outriggers shall be designed with a maximum weight of 39 kg (86 lb) and a maximum roll moment of inertia of 40.7 kg-m² (30.0 ft-lb-sec²) (NHTSA titanium outrigger system, Docket No. NHTSA 2007-27662-11, or equivalent)[2].

J. Real time digital video camera for documenting sine with dwell maneuver.

10. PHOTOGRAPHIC DOCUMENTATION

DIGITAL PHOTOGRAPHS

The contractor shall take digital photographs of the pretest, test execution and post test conditions. Photographs shall be taken in color and contain clear images. A tag, label or placard identifying the test item, NHTSA number (if applicable) and date shall appear in each photograph and must be legible. Each photograph shall be labeled as to the

2 See http://www.regulations.gov/fdmspublic/component/main?main=DocumentDetail&o=09000064802b7406

10. PHOTOGRAPHIC DOCUMENTATION….Continued

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 and in a JPG format. Glare or light from any illuminated or reflective surface shall be minimized while taking photographs. The test setup and equipment used in all tests shall be photographed for the record before and at prescribed time periods during testing.

The test reports shall include enough photographs to describe the testing in detailed and shall be organized in a logical succession of consecutive pictures. The digital photographs shall be included in the test report as 203 mm x 254 mm or 215.9 mm x 279 mm (8 x 10 or 8½ x 11 inch) pictures. All photographs are required to be included in the test report in the event of a test failure. Any failure must be photographed at various angles to assure complete coverage. Upon request, the photographs shall be sent to the COTR 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. 3/4 frontal view from left side of vehicle
B. Vehicle Certification Label
C. Vehicle Placard (titled, "Tire and Loading Information")
D. Tire Inflation Pressure Label (optional label if provided)
E. Close-up view of ESC Malfunction Telltale
F. Close-up view of "ESC OFF" Telltale (if provided)
G. Close-up view of ESC off control (if provided)
H. Close-up view of other controls that have an ancillary effect on ESC (if provided)
I. Close-up view(s) of test instrumentation mounted on outside of vehicle
J. Close-up view(s) of test instrumentation mounted on inside of vehicle
K. Close-up view of tire/rim and track as appropriate depicting rim-to-pavement contact or tire debeading (if present)
L. View of loss of pavement contact of tire(s) as documented by still photograph from video camera (if present)
M. Any other damage or apparent test failure that cannot be seen in the above photographs.

10. PHOTOGRAPHIC DOCUMENTATION….Continued

REALTIME CAMERA

The contractor shall document every sine with dwell maneuver test executed using a "real time" color digital camera that minimally operates at 24 frames per second. The sine with dwell maneuvers should be videotaped from a viewpoint that facilitates observation of the front of the vehicle or the inboard side of the vehicle so as to best record instances of wheel lift, if it occurs. During each maneuver the zoom of the camera should be adjusted such that the vehicle fills the view frame to the greatest extent possible.

The video footage shall be transferred to a compact disc (CD) or DVD as AVI or MPEG files with any standard or generally available "codec" compatible to Microsoft Windows. All video footage should be saved in a "read only" format before sending to the COTR to verify that the evidence has not been altered from its original condition. Video footage may only be saved using other types of file formats if approved by the COTR.

11. DEFINITIONS

The contractor shall check the Code of Federal Regulations for the most recent definitions. A citation is provided after each definition not specified in Standard 126.

ACKERMAN STEER ANGLE
The angle whose tangent is the wheelbase divided by the radius of the turn at a very low speed.

COMMON SPACE
An area on which more than one telltale, indicator, identifier, or other message may be displayed, but not simultaneously.

DRIVE CONFIGURATION
The driver-selected, or default, condition for distributing power from the engine to the drive wheels (examples include, but are not limited to, 2-wheel drive, front-wheel drive, rear-wheel drive, all-wheel drive, 4-wheel drive high gear with locked differential, and 4-wheel drive low gear).

ELECTRONIC STABILITY CONTROL SYSTEM
A system that has all the following attributes: (1) That augments vehicle directional stability by applying and adjusting the vehicle brake torques individually to induce a correcting yaw moment to a vehicle; (2) That is computer controlled with the computer using a closed-loop algorithm to limit vehicle oversteer and to limit vehicle understeer; (3) That has a means to determine the vehicle's yaw rate and to estimate its side slip or side

11. DEFINITIONS….Continued

slip derivative with respect to time; (4) That has a means to monitor driver steering inputs; (5) That has an algorithm to determine the need, and a means to modify engine torque, as necessary, to assist the driver in maintaining control of the vehicle, and (6) That is operational over the full speed range of the vehicle (except at vehicle speeds less than 20 km/h (12.4 mph), when being driven in reverse, or during system initialization).

LATERAL ACCELERATION
The component of the vector acceleration of a point in the vehicle perpendicular to the vehicle's x axis (longitudinal) and parallel to the road plane.

LOW-RANGE FOUR-WHEEL DRIVE CONFIGURATION
A drive configuration that has the effect of locking the drive gears at the front and rear axles together and providing an additional gear reduction between the engine speed and vehicle speed of at least 2.0.

MODE
An ESC performance algorithm, whether driver-selected or not (examples include, but are not limited to, standard (default) mode, performance mode, snow or slippery road mode, or OFF mode).

OVERSTEER
A condition in which the vehicle's yaw rate is greater than the yaw rate that would occur at the vehicle's speed as result of the Ackerman Steer Angle.

SIDE SLIP OR SIDE SLIP ANGLE
The arctangent of the lateral velocity of the center of gravity of the vehicle divided by the longitudinal velocity of the center of gravity.

UNDERSTEER
A condition in which the vehicle's yaw rate is less than the yaw rate that would occur at the vehicle's speed as a result of the Ackerman Steer Angle.

UVW
The Unloaded Vehicle Weight (UVW) is the weight of a vehicle with maximum capacity of all fluids necessary for vehicle operation, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use. (See 49 CFR 571.3)

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.

11. DEFINITIONS….Continued

YAW RATE
The rate of change of the vehicle's heading angle measured in degrees/second of rotation about a vertical axis through the vehicle's center of gravity.

12. TEST VEHICLE INSPECTION AND TEST PREPARATION (Data Sheet 1)

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

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. Verify the calibration status of test equipment.

F. 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's 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.

G. Document vehicle default and selectable drive configurations and modes (see Section 11, Definitions).

H. Identify safety systems installed on vehicle that are intended to improve vehicle stability.

I. Verify outriggers are available for testing. Outriggers must be used for testing trucks, multipurpose passenger vehicles, and buses. Passenger cars will not be tested with outriggers. Vehicles with a baseline weight under 2,722 kg (6,000 lbs) must be equipped with "standard" outriggers and vehicles with a baseline weight equal to or greater than 2,722 kg (6,000 lbs) must be equipped with "heavy" outriggers. Inner-tubes, if available, will be used in test vehicle wheels when outriggers are required on

12. TEST VEHICLE INSPECTION AND TEST PREPARATION….Continued

test vehicle.

J. All tests must be performed with automatic transmissions in "Drive." If the test vehicle is equipped with a manual transmission, the highest gear capable of sustaining the desired test speeds shall be used. Manual transmission clutches are to remain engaged during all maneuvers.

K. Data collection is initiated in one of two manners: (1) manually by the test driver immediately before the start of the maneuver, or (2) automatically by using the output signal from the vehicle speed sensor and a closed feedback loop programmed into the steering machine.

L. Brake pedal force is measured with a load cell transducer attached to the face of the brake pedal. While brake pedal force is not explicitly required for determining vehicle compliance, the load cell gives the test laboratory a way of confirming the driver has not unintentionally applied the brakes during execution of the maneuvers. If the driver applies force to the brake pedal before completion of a maneuver, that test is not valid, and should not be considered in further analyses. Monitoring the state of a brake light or brake light switch as a surrogate for brake pedal force is not recommended. For some vehicles, the brake lights are illuminated during ESC intervention, regardless of whether the driver has applied force to the brake pedal. This may cause an otherwise valid test to be incorrectly deemed unacceptable.

M. Calibration data shall be collected prior to each maneuver test series to assist in resolving uncertain test data. The following data should be recorded at the beginning of each test day for each test vehicle. The distance measured by the speed sensor along a straight line between the end points of a surveyed linear roadway standard of 1000 feet or more (observed and recorded manually from the speed sensor display). Five to fifteen seconds of data from all instrument channels as the configured and prepared test vehicle is driven in a straight line on a level, uniform, solid-paved road surface with a vehicle speed of 97 km/h (60 mph).

13. COMPLIANCE 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 FMVSS and this Laboratory Test Procedure.

13. COMPLIANCE TEST EXECUTION ....Continued

13.1 ESC SYSTEM TECHNICAL DOCUMENTATION (Data Sheet 2)

Using information provide by the COTR from the vehicle manufacturer and the owner's manual, verify that the vehicle is equipped with an ESC system that meets the definition of "ESC SYSTEM" by providing the following:

A. Identify each of the components of the vehicle's ESC system that are used to determine its yaw rate, estimated side slip or the side slip derivative, driver steering inputs, and any other inputs to the ESC system computer, and to generate brake torques at each wheel and other countermeasures (i.e., modifying engine torque) to maintain vehicle stability.

B. Verify an explanation was provided that describes the logic illustrating how the vehicle's ESC system mitigates understeer and oversteer conditions. The explanation must include the pertinent inputs to the ESC system computer, a description of how the inputs are used, and the pertinent outputs to vehicle components (i.e., brakes, engine, etc.) that mitigate vehicle understeer and oversteer conditions. The description must also identify the vehicle speed range and the driving phases (acceleration, deceleration, coasting, during activation of the ABS or traction control) under which the ESC system can activate.

13.2 ESC MALFUNCTION AND "ESC OFF" TELLTALES (Data Sheet 3)

A. Verify the vehicle is equipped with an ESC malfunction telltale. Describe the telltale location, color and symbol, abbreviation or message used.

B. Identify if the malfunction telltale is located in a common space. Make note if telltale is also used to indicate activation of the ESC system.

C. Determine if the vehicle is equipped with an "ESC OFF" telltale. Make note if the "ESC OFF" telltale is combined with the ESC malfunction telltale. If provided, describe the "ESC OFF" telltale location, color and symbol, abbreviation or message used. Identify if the telltale is located in a common space.

13.3 "ESC OFF" CONTROL – IF APPLICABLE (Data Sheet 4)

A. Determine if vehicle has a control or controls whose purpose is to deactivate the ESC system or to place the ESC system in a mode or modes that may no longer satisfy the performance requirements set forth in FMVSS No. 126.

13. COMPLIANCE TEST EXECUTION ....Continued

B. Make note of each type of control identified. Identify if a control is a dedicated ESC "On/Off" control or an ESC system related multi-functional control, or other. Describe each controls location, labeling and selectable modes.

C. Make note of vehicle standard or default drive configuration and ensure this drive configuration is selected.

D. For vehicles equipped with a dedicated "ESC OFF" control or multi-functional control that has an "ESC Off" mode, with the vehicle stationary and the ignition locking system in the "Lock" or "Off" position, activate the ignition locking system to the "On" ("Run") position. Activate the dedicated "ESC OFF" control, or select the "ESC Off" mode, and verify that the "ESC OFF" telltale is illuminated and remains illuminated.

E. Turn the ignition locking system to the "Lock" or "Off" position. Again activate the ignition locking system to the "On" ("Run") position and verify that the "ESC OFF" telltale extinguishes indicating that the ESC system has been reactivated.

F. For vehicles equipped with an ESC system related multi-functional control, with the vehicle stationary and the ignition locking system in the "Lock" or "Off" position, activate the ignition locking system to the "On" ("Run") position. Cycle the control through each mode and make note of which modes activate the "ESC OFF" telltale.

G. For each control mode selection that illuminates the "ESC Off" telltale, while in that mode, turn the ignition locking system to the "Lock" or "Off" position. Again activate the ignition locking system to the "On" ("Run") position and verify that the "ESC OFF" telltale extinguishes indicating that the ESC system has been reactivated.

13.4 OTHER SYSTEM CONTROLS – IF APPLICABLE (Data Sheet 4)

A. Determine if vehicle is equipped with controls for other systems, for example alternate drive configuration selection controls, that may have an ancillary effect on ESC system operation. Review owners manual and other system documentation provided by vehicle manufacturer. List and describe each control.

B. With the vehicle stationary and the ignition locking system in the "Lock" or "Off" position, activate the ignition locking system to the "On" ("Run") position. Activate one of the ancillary system controls and make note of "ESC Off" telltale illumination and of any warnings or messages provided regarding the ESC system.

13. COMPLIANCE TEST EXECUTION ....Continued

C. For any control that activates the “ESC Off” telltale, turn the ignition locking system to the “Lock” or “Off” position. Again activate the ignition locking system to the “On” (“Run”) position and verify that the “ESC Off” telltale extinguishes indicating that the ESC system has been reactivated. If the selected control placed the vehicle in a low-range four-wheel drive configuration on the previous ignition cycle, reactivation of the ESC system and extinguishment of the “ESC Off” telltale is not required upon cycling the ignition.

D. Repeat paragraphs B. and C. for each ancillary system control and note results.

13.5 VEHICLE AND TEST TRACK DATA (Data Sheet 5)

A. Document the test track peak friction coefficient (PFC). The road test surface must produce a PFC of at least 0.9 when measured using an American Society for Testing and Materials (ASTM) E1136 standard reference test tire, in accordance with ASTM Method E 1337-90, at a speed of 64.4 km/h (40 mph), without water delivery.

B. Verify that the test track being used is dry and uniform with a solid-paved surface. Surfaces with irregularities and undulations, such as dips and large cracks, are unsuitable. The test surface must have a consistent slope between level and 1%.

C. Inflate the vehicle’s tires to the recommended cold inflation pressure as specified on the vehicle placard or optional tire inflation pressure label. Record the measured pressure in each tire.

D. Fill the fuel tank and other reservoirs of fluids necessary for operation of the vehicle prior to executing this test.

E. Measure vehicle’s wheelbase and front track width.

F. Weigh unloaded vehicle. Document unloaded vehicle weight (UVW).

G. For vehicles other than passenger cars, install outriggers on vehicle. To determine outrigger size required for test vehicle, add weight of test driver (73 kg (160lb)) to the UVW determined in F to calculate vehicle baseline weight. The vehicle baseline weight should be used to determine the size of outriggers to use as discussed in paragraph 9.I.

13. COMPLIANCE TEST EXECUTION ....Continued

H. On vehicles equipped with outriggers install suitable inner tubes and return tire/wheel assemblies in original positions on the test vehicle. Use OEM torque on lugs. With outriggers and inner tubes installed, again determine and document vehicle weight.

I. Remove steering wheel air bag and vehicle center console when necessary.

J. Manufacture and install inertial sensing system mounting plate. (Mounting plate should be installed as close as possible to the perceived vehicle CG.)

K. Install Data Acquisition system (DAS) into front passenger seat.

L. Install inertial sensing system.

M. Install ultra sonic distance sensors and brake pedal force load cell.

N. Install vehicle speed sensor onto front outrigger or bumper assembly along vehicle centerline. Install vehicle speed dashboard display.

O. Install automatic steering controller. Insure controller is centered onto vehicle steering wheel.

P. Power up DAS and verify all channels are activated by viewing real time signal input data and observing normal data drift. Verify DAS set-up for 200 Hz sampling rate, filtering using two-pole low-pass Butterworth filter with nominal cut-off frequencies at 25 Hz to prevent aliasing, and amplifier gains selected to maximize signal-to-noise ratio. Verify DAS displays accurate calibrated sensor outputs.

Q. Verify calibration of steering controller encoder by confirming 1 full rotation of the steering controller wheel results in a reading of 360 degrees on the DAS.

R. Verify the steering controller triggers a steering maneuver at the correct vehicle speed by injecting a voltage into the speed sensor connection to simulate speed.

S. Weigh vehicle with test equipment and test driver. Calculate the required ballast so the total interior load is 168 kg (370 lb) comprising the test driver, test equipment and ballast as required to account for the differences in the weight of test drivers and test equipment.

13. COMPLIANCE TEST EXECUTION ....Continued

T. Place calculated amount of ballast on the floor behind the passenger front seat or if necessary in the front passenger foot well area. Weigh the vehicle and verify a total vehicle interior load of 168 kg (370 lb). Secure ballast in a way that prevents it from becoming dislodged during test conduct. Document loaded vehicle weight.

U. Using a coordinate measurement machine (CMM), measure the coordinates of the inertial sensing system and the vehicle's maximum roof height.

V. Determine the loaded vehicle's longitudinal and lateral center of gravity (CG) coordinates. The vertical CG coordinate is estimated to be 38% of the vehicle's maximum roof height. Document CG coordinates for the vehicle's loaded configuration.

W. Readjust location of ultrasonic distance measuring sensors to align with the vehicle's measured longitudinal center of gravity position. Measure and record distance between sensors.

X. Verify the data acquisition system is energized and conduct on-track calibration checks for speed, distance and inertial sensing system sensor output.

13.6 BRAKE CONDITIONING (Data Sheet 6)

A. Verify and if necessary inflate tires to the vehicle manufacturer's recommended cold inflation pressures. Record the measured pressure in each tire.

B. Measure and record ambient temperature and wind speed. Verify wind speed and ambient temperature are within required test conditions.

C. Energize the data acquisition system. Set data acquisition system so vehicle longitudinal acceleration can be observed on the system's display by the test driver.

D. Execute ten stops from a speed of 56 km/h (35 mph), with an average deceleration of approximately 0.5g. During each brake application the test driver will visually monitor the actual measured longitudinal acceleration on the data acquisition system display and attempt to maintain the target of 0.5g deceleration over the entire brake event. Record the deceleration rates observed.

13. COMPLIANCE TEST EXECUTION ….Continued

E. Immediately following the series of 56 km/h (35 mph) stops, execute 3 stops from a speed of 72 km/h (45 mph). During the 72 km/h (45 mph) stops, brake pedal force should be great enough to activate the vehicle's antilock brake system (ABS) for the majority of each braking event. During each stop the test driver should be able to identify activation of the ABS (by feel or sound). Record deceleration rates observed. If during a brake application the ABS does not activate the brake application should be repeated with increased brake pedal force. If the driver experiences any wheel lock-up he/she should confer with the COTR before proceeding.

F. Following completion of the final 72 km/h (45 mph) stop, the vehicle shall be driven at a speed of 72 km/h (45 mph) for at least five minutes to cool the brakes.

13.7 TIRE CONDITIONING (Data Sheet 6)

Tire conditioning is required to wear away mold sheen and achieve tire operating temperatures immediately before executing the test maneuvers of sections 13.8 and 13.9.

A. Verify and if necessary inflate tires to the vehicle manufacturer's recommended cold inflation pressures. Record the measured pressure in each tire.

B. Measure and record ambient temperature and wind speed. Verify if the wind speed and ambient temperature are within required test conditions.

C. Energize the data acquisition system. Configure the data acquisition system so the vehicle's measured lateral acceleration can be observed on the system's display by the test driver.

D. Drive the vehicle around a 30 meter (100 feet) diameter circle at a speed that produces a lateral acceleration of approximately 0.5 to 0.6 g for three clockwise laps followed by three counterclockwise laps. During each lap the test driver will visually monitor the actual measured lateral acceleration on the data acquisition system display and attempt to maintain the target of 0.5 to 0.6 g lateral acceleration over the entire 30 meter (100 feet) diameter circle. Record the observed vehicle speed and lateral accelerations.

E. Energize the automatic steering controller. Program the controller to produce 5 cycles of a 1Hz, sinusoidal steering pattern with a steering wheel angle that corresponds to a peak lateral acceleration of 0.5-0.6 g at a constant vehicle speed of 56 km/h (35 mph). To determine the appropriate steering wheel angle required several preliminary steering maneuvers must be conducted. Using a target

13. COMPLIANCE TEST EXECUTION ….Continued

steering wheel angle of 30 degrees execute the sinusoidal steering maneuver at 56 km/h (35 mph) while observing the lateral acceleration. Adjust the target steering wheel angle as necessary and repeat the steering maneuver until a peak lateral acceleration of 0.5-0.6 g is obtained at the programmed steering wheel angle. Document the steering wheel angle required that corresponds to a peak lateral acceleration of 0.5-0.6 g.

F. Program the steering controller to execute 10 cycles of a 1HZ sinusoidal steering pattern using the steering wheel angle for a peak lateral acceleration of 0.5-0.6 g determined in step E. Execute three steering maneuvers while maintaining a vehicle speed of 56 km/h (35 mph).

G. Modify the steering controller program used in step F (10 cycle, 1Hz sinusoidal steering pattern). The steering wheel angle for the first nine cycles should be the same as used in step F. The steering wheel angle for the tenth cycle should be twice that of the other cycles. Execute one steering maneuver while maintaining a vehicle speed of 56 km/h (35 mph).

NOTE: The maximum time permitted between all laps and passes executed in section 13.7 is five minutes.

13.8 SLOWLY INCREASING STEER (SIS) MANEUVER (Data Sheet 7)

The SIS maneuver is used to characterize the lateral dynamics of each vehicle. The maneuver is used to provide the data necessary for determining the steering wheel angle capable of producing a lateral acceleration of 0.3 g. This steering wheel angle is then used to determine the magnitude of steering required during the sine with dwell maneuver executed in section 13.9.

A. The SIS maneuver should be executed immediately following the tire conditioning of section 13.7.

B. Verify tires are properly inflated to at least the vehicle manufacturer's recommended cold inflation pressures. If this activity follows any dynamic testing maneuvers, including brake conditioning and/or tire conditioning, expect the tire pressure to be somewhat above the recommended cold inflation pressures. In this case, do not decrease tire pressures.

C. Measure and record ambient temperature and wind speed. Verify if the wind speed and ambient temperature are within required test conditions.

13. COMPLIANCE TEST EXECUTION ….Continued

D. Document vehicle drive configuration and mode for testing as specified by the COTR. Generally, the first test executed on a test vehicle will be executed with the drive configuration and mode set to the manufacturer's standard or default settings. Subsequent tests, as directed by the COTR, may be executed under different drive configurations and modes. Any drive configuration and mode selected, except for a 4-wheel drive high-gear configuration that locks the drive gears at the front and rear axles together, that does not illuminate the "ESC Off" telltale is required to meet the lateral stability and responsiveness requirements of sections 13.9 and 13.10 of this test procedure. The 4-wheel drive high-gear configuration that has locked gears at the front and rear axles, that does not illuminate the "ESC Off" telltale is required to meet only the lateral stability requirements of the standard.

E. Energize the data acquisition system and the automatic steering controller. Program the steering controller so at time zero the steering wheel angle is linearly increased from zero to 30 degrees at a rate of 13.5 degrees per second.

F. On the test course, position the test vehicle to face the direction in which the SIS maneuvers will be executed. Collect fifteen seconds of data from all instrument channels with the test vehicle at rest, the engine running, the transmission in "Park" (automatic transmission) or neutral with the parking brake applied (manual transmission), and the front of the test vehicle pointing in the direction testing will occur. The static data file will be used in post processing to establish a datum for each instrument channel.

G. Execute a preliminary left steer maneuver and measure the lateral acceleration at the 30 degree steering wheel angle. To begin, the vehicle is driven in a straight line at 80 $\pm$ 2 km/h (50 $\pm$ 1 mph). While maintaining a vehicle speed of 80 $\pm$ 2 km/h (50 $\pm$ 1 mph) using smooth throttle modulation, the driver should activate the steering controller. The driver must attempt to maintain a vehicle speed of 80 $\pm$ 2 km/h (50 $\pm$ 1 mph) during and briefly after the steering maneuver is executed by the steering controller. The 30 degree steering wheel angle must be held constant for two seconds after which the maneuver is concluded. The steering wheel is then returned to zero degrees. Document the measured lateral acceleration at the 30 degree steering wheel angle.

13. COMPLIANCE TEST EXECUTION ….Continued

H. Assuming a linear relationship exists between the steering wheel angle and lateral acceleration, calculate the steering angle required to achieve a 0.55 g lateral acceleration using equation 1. See note below.

Equation 1:

$$\frac{30\,\text{degrees}}{a_{\text{y,30 degrees}}} = \frac{\delta_{SIS}}{0.55\,\text{g}}$$

where,

$a_{y,30\ degrees}$ is the raw lateral acceleration produced with a constant SWA of 30 degrees during a test performed at 50 mph

δ_{SIS} is the steering wheel angle, if the relationship of SWA and lateral acceleration was linear, would produce a lateral acceleration of 0.55 g during a test performed at 50 mph

NOTE: The 30 degree steering wheel angle was selected by NHTSA because it is believed to be capable of producing a steady state lateral acceleration within the linear range for any light vehicle. The measured lateral acceleration ($a_{y,30\ degrees}$) is "raw" data, not corrected for the effects of roll, pitch, and yaw. NHTSA acknowledges the relationship of the steering wheel angle and *corrected* lateral acceleration data is often not linear at 0.55 g. However, previously collected data indicates the magnitude of raw 0.55 g acceleration data is typically reduced by approximately 9.6 percent to 0.50 g, when corrected for roll, pitch, and yaw, just outside of the linear range for most vehicles. Removing the effect of accelerometer offset (error due to the accelerometer not being positioned at the vehicle's actual center of gravity) typically reduces the magnitude of these data by an additional 0.07 percent. The importance of the above equation is that it simply provides test laboratories with a direct, "in-the-field" way of determining an appropriate steering input for which to proceed with SIS test for a given vehicle.

I. Re-program the steering controller so at time zero the steering wheel angle is linearly increased from zero degrees to δ_{SIS} at a rate of 13.5 degrees per second, rounded to the nearest 10 degrees.

J. Execute a SIS maneuver to the left using the techniques in step G. and record the steering wheel angle and lateral acceleration data. If the lateral acceleration is below 0.50g, then increase the steering angle by 10 degrees. If the lateral acceleration is above 0.60g, then decrease the steering angle by 10 degrees.

K. Repeat step J. until three SIS maneuvers to the left have been completed where the lateral acceleration falls within 0.50g to 0.60g, the vehicle speed was 80$\pm$ 2 km/h (50 $\pm$ 1 mph), and the maximum steering angle was held constant for two seconds after which the maneuver was concluded. The maximum time permitted between each test run maneuver is five minutes. Figure 1 presents a description of the SIS steering profile. For each of the three test runs document the time, steering wheel angle and lateral acceleration.

13. COMPLIANCE TEST EXECUTION ….Continued

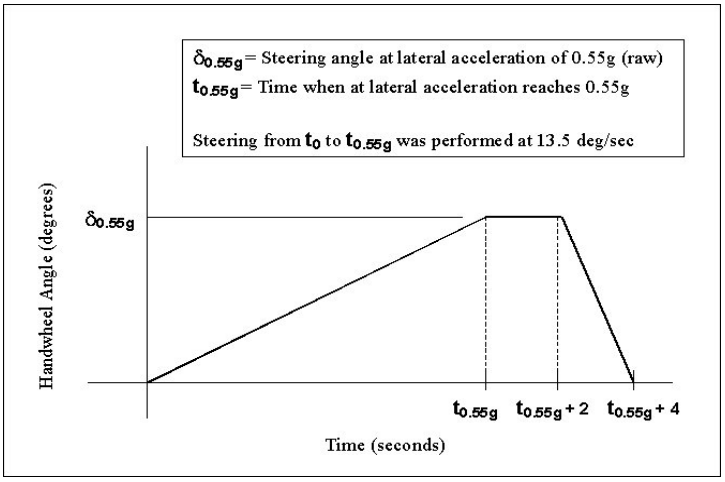


Figure 1. Slowly Increasing Steer steering profile.

L. Repeat step I. through K. until three SIS maneuvers to the right have been completed where the lateral acceleration falls within 0.50g to 0.60g, the vehicle speed was 80± 2 km/h (50 ± 1 mph), and the maximum steering angle was held constant for two seconds after which the maneuver was concluded. The maximum time permitted between each test run maneuver is five minutes. For each of the three test runs document the time, steering wheel angle and lateral acceleration.

M. Obtain raw lateral acceleration data by filtering with a 12-pole phaseless Butterworth filter and a cutoff frequency of 6Hz. The filtered data is then zeroed to remove sensor offset utilizing static pretest data. The lateral acceleration data at the vehicle CG is determined by removing the effects caused by vehicle body roll and by correcting for sensor placement via use of coordinate transformation. For data collection, the lateral accelerometer shall be located as close as possible to the position of the vehicle's longitudinal and lateral CG.

N. Using linear regression techniques, determine the "best-fit" linear line for each of the six completed SIS maneuvers. When lateral acceleration data collected during SIS tests are plotted with respect to time, a first order polynomial (best-fit line) accurately describes the data from 0.1 to 0.375 g. NHTSA defines this as the linear range of the lateral acceleration response. A simple linear regression is used to determine the best-fit line, as shown in Figure 2.

13. COMPLIANCE TEST EXECUTION ….Continued

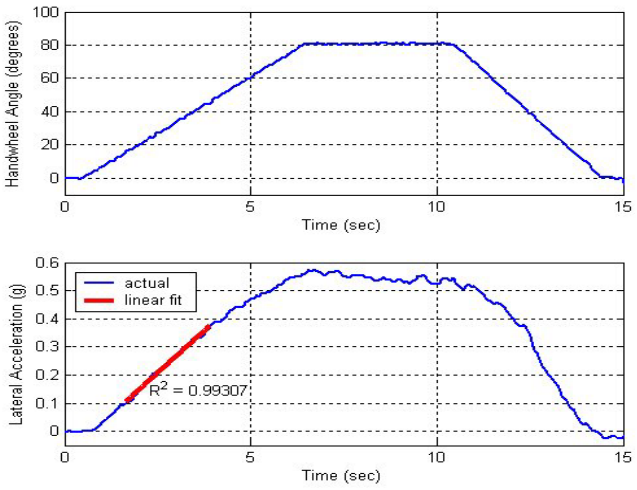


Figure 2. Sample steering wheel angle and lateral acceleration data recorded during a Slowly Increasing Steer test. The linear range used to define the lateral acceleration regression line is highlighted.

O. Using the best-fit line equation for each of the six SIS maneuvers, determine the steering wheel angle, to the nearest 0.1 degree, at 0.3 g for each respective maneuver. Using equation 2 calculate the average overall steering wheel angle, rounded to the nearest 0.1 degree, at 0.3 g using the absolute value data from each of the six SIS maneuvers.

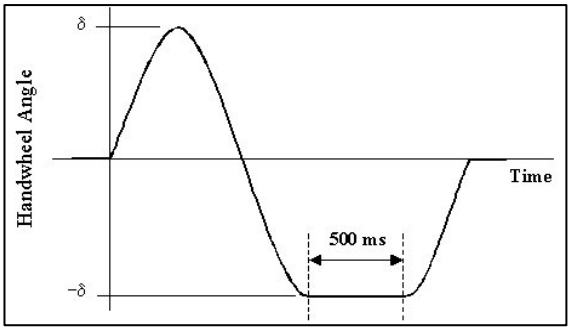
Equation 2:

$$\delta_{0.3\ g,\ overall} = (|\delta_{0.3\ g,\ left\ (1)}| + |\delta_{0.3\ g,\ left\ (2)}| + |\delta_{0.3\ g,\ left\ (3)}| + \delta_{0.3\ g,\ right\ (1)} + \delta_{0.3\ g,\ right\ (2)} + \delta_{0.3\ g,\ right\ (3)}) / 6$$

13.9 VEHICLE LATERAL STABILITY AND RESPONSIVENESS (SINE WITH DWELL MANEUVER) (Data Sheet 8)

The vehicle is subjected to two series of test runs using a steering pattern of a sine wave at 0.7 Hz frequency with a 500ms delay beginning at the second peak amplitude as shown in Figure 3 (the sine with dwell test). During the test runs, one series uses counterclockwise steering for the first half cycle, and the other series uses clockwise steering for the first half cycle. A stationary vehicle cool-down period must be provided between each test run with a target range from 90 seconds minimum to five minutes maximum. Ensure the sine with dwell test series begins within two hours after the completion of the SIS tests.

13. COMPLIANCE TEST EXECUTION ….Continued



A. Repeat the tire conditioning procedure specified in section 13.7 and record on data sheet 6. Tire conditioning must be executed immediately prior to executing the sine with dwell maneuvers.

B. Verify vehicle drive configuration and mode selected are the same as determined for testing in section 13.8., paragraph D. Prior to testing, drive configuration and mode for testing must be specified by the COTR.

C. Verify that the ESC system is enabled, by ensuring that the ESC malfunction and "ESC OFF" (if provided) telltales are not illuminated.

D. At the completion of the tire conditioning procedure and before the start of a test series, fifteen seconds of data are collected from all instrument channels with the test vehicle at rest, the engine running, the transmission in "Park" (automatic transmission) or in neutral with the parking brake applied (manual transmission), and the front of the test vehicle facing in the direction the vehicle will be tested on the track. The static data files are used in post processing to establish a datum for each instrument channel.

E. Energize the programmable steering controller. Program the controller to execute the sine with dwell maneuver using an initial counterclockwise steering direction. The first maneuver should be programmed with a steering wheel angle magnitude equal to 1.5 times $\delta_{0.3\ g,\ overall.}$ as determined in section 13.8 O.

F. Depress the steering controller's program switch and then accelerate the vehicle to 87 $\pm$ 2 km/h (54$\pm$1 mph). Release the throttle, and when vehicle speed reaches the target speed of 80 $\pm$ 2 km/h (50 $\pm$ 1 mph) the steering controller will execute the programmed sine with dwell maneuver.

13. COMPLIANCE TEST EXECUTION ….Continued

G. During the maneuver, test personnel must observe for loss of pavement contact of tires, rim-to-pavement contact and tire debeading. Rim-to-pavement contact will be verified by visual observation and identified by marks left on the pavement. Debeading will be verified by visual observation and a corresponding loss of tire inflation pressure. Loss of pavement contact of tires will be verified by visual observation and documented by video camera. If any of these events are observed or if the test driver experiences a vehicle loss of control or spinout the test should be terminated and the test laboratory must consult with the COTR before proceeding.

H. Safety outrigger height adjustment may be required during a test series. If an outrigger skid pad contacts the road surface during a test run wherein there is no spinout or wheel lift, the outrigger at the effected end of the vehicle is raised 19 mm (0.75 in) and the test run is repeated. If both outriggers make contact with the test surface during at test run wherein there is no spinout or wheel lift, both outriggers are raised 19 mm (0.75 in) and the test run is repeated.

I. Using the data from step F. plot the steering wheel angle, vehicle speed, lateral acceleration and yaw rate. Confirm the maneuver entrance speed was within $\pm$ 3 km/h (1mph) of desired speed, the steering wheel angle maximums were accurate, and both lateral acceleration and yaw rate seem reasonable. If any of the above conditions are not met, stop test and correct problem. If all conditions are met, then continue the test series.

J. Provide a cool-down period between each test run of 90 seconds to 5 minutes, with the engine running, vehicle stationary and positioned at the maneuver starting point.

K. Continue to execute the counterclockwise steering maneuvers, each time increasing the steering wheel angle magnitude by multiples of $0.5*\delta_{0.3\ g,\ overall}$. Maneuver execution should continue until a steering wheel angle magnitude factor of $6.5*\delta_{0.3\ g,\ overall}$ or 270 degrees is utilized, whichever is greater, provided the calculated magnitude of $6.5*\delta_{0.3\ g,\ overall}$ is less than or equal to 300 degrees. If $6.5*\delta_{0.3\ g,\ overall}$ is less than 270 degrees maneuver execution should continue by increasing the steering wheel angle magnitude by multiples of $0.5*\delta_{0.3\ g,\ overall}$ without exceeding the 270 degree steering wheel angle. If any $0.5*\delta_{0.3\ g,\ overall}$ increment, up to $6.5*\delta_{0.3\ g,\ overall}$, is greater than 300 degrees, the steering amplitude of the final run shall be 300 degrees.

L. Repeat paragraphs E. through I. using an initial clockwise steering direction.

13. COMPLIANCE TEST EXECUTION ….Continued

13.10 CALCULATIONS OF PERFORMANCE METRICS – POST DATA PROCESSING (Data Sheet 8)

NHTSA uses MATLAB program routines for post data processing. These routines are available on line at www.nhtsa.dot.gov. Upon entering the web site proceed to "Vehicle Safety Research," then to "Databases and Software," then to "NVS Software Applications," and finally to "FMVSS No. 126, Electronic Stability Control Systems." Yaw rate and lateral displacement measurements and calculations are processed utilizing the following techniques:

A. Filter raw steering wheel angle data with a 12-pole phaseless Butterworth filter and a cutoff frequency of 10 Hz. Zero the filtered data to remove sensor offset utilizing static pretest data.

B. Filter raw yaw, pitch and roll rate data with a 12-pole phaseless Butterworth filter and a cutoff frequency of 6 Hz. Zero the filtered data to remove sensor offset utilizing static pretest data.

C. Filter raw lateral, longitudinal and vertical acceleration data with a 12-pole phaseless Butterworth filter and a cutoff frequency of 6 Hz. Zero the filtered data to remove sensor offset utilizing static pretest data.

D. Filter raw speed data with a 12-pole phaseless Butterworth filter and a cutoff frequency of 2 Hz.

E. Filter left side and right side ride height data with a 12-pole phaseless Butterworth filter and a cutoff frequency of 6 Hz. Zero the filtered data to remove sensor offset utilizing static pretest data.

F. Determine the roll, yaw and pitch accelerations by differentiating the filtered and zeroed roll and yaw rate data.

G. Determine the lateral acceleration at the vehicle center of gravity by correcting for sensor placement via use of coordinate transformation. The multi-axis inertial sensing system is used to measure linear accelerations and roll, pitch, and yaw angular rates. The position of the multi-axis inertial sensing system must be accurately measured relative to the C.G. of the vehicle in its loaded configuration. These data are required to translate the motion of the vehicle at the measured location to that which occurred at the actual C.G to remove roll, pitch, and yaw effects. The following equations are used to correct the accelerometer data in post-processing. They were derived from equations of general relative acceleration for a translating reference frame and use the SAE Convention for

13. COMPLIANCE TEST EXECUTION ….Continued

Vehicle Dynamics Coordinate Systems. The coordinate transformations are:

Equation 3: $x''_{corrected} = x''_{accel} - (\Theta'^{2} + \Psi'^{2})x_{disp} + (\Theta'\Phi' - \Psi'')y_{disp} + (\Psi'\Phi' + \Theta'')z_{disp}$

Equation 4: $y''_{corrected} = y''_{accel} + (\Theta'\Phi' + \Psi'')x_{disp} - (\Phi'^{2} + \Psi'^{2})y_{disp} + (\Psi'\Theta' - \Phi'')z_{disp}$

Equation 5: $z''_{corrected} = z''_{accel} + (\Psi'\Phi' - \Theta'')x_{disp} + (\Psi'\Theta' + \Phi'')y_{disp} - (\Phi'^{2} + \Theta'^{2})z_{disp}$

Where;

$x''_{corrected}$, $y''_{corrected}$, and $z''_{corrected}$ = longitudinal, lateral, and vertical accelerations, respectively, at the vehicle's center of gravity

x''_{accel}, y''_{accel}, and z''_{accel} = longitudinal, lateral, and vertical accelerations, respectively, at the accelerometer location

x_{disp}, y_{disp}, and z_{disp} = longitudinal, lateral, and vertical displacements, respectively, of the center of gravity with respect to the accelerometer location

Φ' and Φ'' = roll rate and roll acceleration, respectively

Θ' and Θ'' = pitch rate and pitch acceleration, respectively

Ψ' and Ψ'' = yaw rate and yaw acceleration, respectively

13. COMPLIANCE TEST EXECUTION ...Continued

H. Correct lateral acceleration at the vehicle center of gravity by removing the effects caused by vehicle body roll. NHTSA does not use inertially stabilized accelerometers for this test procedure. Therefore, lateral acceleration must be corrected for vehicle roll angle during data post processing. The ultrasonic distance measurement sensors are used to collect left and right side vertical displacements for the purpose of calculating vehicle roll angle. One ultrasonic ranging module is mounted on each side of a vehicle, and is positioned at the longitudinal center of gravity. With these data, roll angle is calculated during post-processing using trigonometry.

Equation 6: $a_{yc} = a_{ym}\cos \Phi - a_{zm}\sin \Phi$

Where;

a_{yc} is the corrected lateral acceleration (i.e., the vehicle's lateral acceleration in a plane horizontal to the test surface)

a_{ym} is the measured lateral acceleration in the vehicle reference frame

a_{zm} is the measured vertical acceleration in the vehicle reference frame

Φ is the vehicle's roll angle

Note: The z-axis sign convention is positive in the downward direction for both the vehicle and test surface reference frames.

I. Determine steering wheel velocity by differentiating the filtered and corrected steering wheel angle data. Filter the steering wheel velocity data using a moving 0.1 second running average filter.

J. Zero lateral acceleration, yaw rate and steering wheel angle data channels utilizing a defined "zeroing range." The methods used to establish the zeroing range are as follows:

1. Using the steering wheel velocity data calculated using the methods described in I., the first instant steering wheel rate exceeds 75 deg/sec is identified. From this point, steering wheel rate must remain greater than 75 deg/sec for at least 200 ms. If the second condition is not met, the next instant steering wheel rate exceeds 75 deg/sec is identified and the 200 ms validity check applied. This iterative process continues until both conditions are ultimately satisfied.

2. The "zeroing range" is identified as the 1.0 seconds time period prior to the instant the steering wheel rate exceeds 75 deg/sec (i.e., the instant the steering wheel velocity exceeds 75 deg/sec defines the end of the "zeroing range").

13. COMPLIANCE TEST EXECUTION ...Continued

K. Determine the "Beginning of Steer" (BOS) which is defined as the first instance filtered and zeroed steering wheel angle data reaches -5 degrees (when the initial steering input is counterclockwise) or +5 degrees (when the initial steering input is clockwise) after time defining the end of the "zeroing range." The value for time at the BOS is interpolated.

L. Determine the "Completion of Steer" (COS) which is defined as the time the steering wheel angle returns to zero at the completion of the sine with dwell steering maneuver. The value for time at the zero degree steering wheel angle is interpolated.

M. Determine the second peak yaw rate ($\dot{\psi}_{Peak}$) which is defined as the first local yaw rate peak produced by the reversal of the steering wheel. Refer to figure 4.

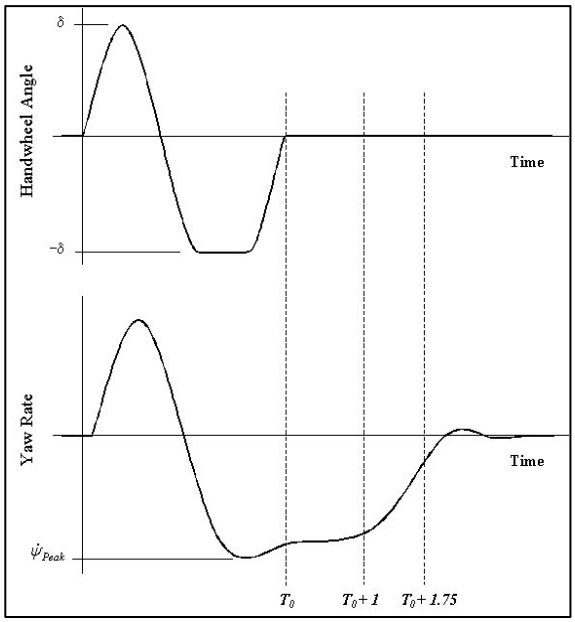


Figure 4. Steering wheel position and yaw velocity information used to assess lateral stability.

Note: In figure 4, $\dot{\psi}_{Peak}$ is the <u>first</u> local peak yaw rate resulting from the sine with dwell steering reversal. In some situations, the yaw rate produced by the steering reversal may reach a peak ($\dot{\psi}_{Peak}$), decay slightly, then increase to a level beyond a $\dot{\psi}_{Peak}$. Even though the overall peak magnitude of the yaw rate response may exceed $\dot{\psi}_{Peak}$, only $\dot{\psi}_{Peak}$ shall be used in the calculation process.

13. COMPLIANCE TEST EXECUTION ...Continued

N. Determine the yaw rates at 1.000 and 1.750 seconds after COS are determined by interpolation for each counterclockwise and clockwise steering maneuvers.

O. For each of the steering maneuvers calculate the yaw rate ratio (YRR) at 1.00 second. The yaw rate measured one second after COS must not exceed 35 percent of the second peak value of the yaw velocity recorded ($\dot{\psi}_{Peak}$) during the same test run. The YRR is expressed as a percentage as shown in equation 7 below.

Equation 7:

$$\mathrm{YRR} = 100 * \left(\frac{\dot{\psi}(\text{at time } t)}{\dot{\psi}_{Peak}} \right)$$

P. Using equation 7 above, calculate yaw rate ratio (YRR) at 1.75 seconds for each of the steering maneuvers. The yaw rate measured 1.75 seconds after COS must not exceed 20 percent of the second peak value of the yaw velocity recorded ($\dot{\psi}_{Peak}$) during the same test run.

Q. For each of the steering maneuvers executed in sections 13.9 E., J., and K., with a steering wheel angle of $5*\delta_{0.3\ g,\ overall}$ or greater, determine lateral velocity by integrating corrected, filtered and zeroed lateral acceleration data. Zero lateral velocity at BOS event.

R. Determine lateral displacement by integrating zeroed lateral velocity. Zero lateral displacement at BOS event.

S. Determine lateral displacement at 1.07 seconds from BOS event using interpolation. The lateral displacement of the vehicle center of gravity with respect to its initial straight path must be at least 1.83 m (6 feet) for vehicles with a GVWR of 3,500 kg (7,716 lb) or less, and 1.52 m (5 feet) for vehicles with GVWR greater than 3,500 kg (7,716 lb) when computed 1.07 seconds after the BOS.

13.11 ESC PERFORMANCE IN ALTERNATE DRIVE CONFIGURATIONS AND MODES (Data Sheets 6, 7 and 8)

A. Repeat test sections 13.7 – 13.10 at each additional drive configuration and mode as directed by the COTR.

13. COMPLIANCE TEST EXECUTION ….Continued

NOTE: Any drive configuration and mode selected, except for a 4-wheel drive high-gear configuration that has the front and rear axles locked together, that does not illuminate the "ESC Off" telltale is required to meet the lateral stability and responsiveness requirements of the standard. The 4-wheel drive high-gear configuration that has the front and rear axles locked together, that does not illuminate the "ESC Off" telltale is required to meet only the lateral stability requirements of the standard.

13.12 ESC MALFUNCTION WARNING (Data Sheet 9)

A. As directed by the COTR, simulate one or more ESC malfunctions by disconnecting the power source to any ESC component, or disconnecting any electrical connection between ESC components (with the vehicle power off). When simulating an ESC malfunction, the electrical connections for the telltale lamp(s) or the "ESC OFF" control are not to be disconnected.

B. With the vehicle initially stationary and the ignition locking system in the "Lock" or "Off" position, activate the ignition locking system to the "Start" position and start the engine. Place the vehicle in a forward gear and obtain a vehicle speed of 48 $\pm$ 8 km/h (30 $\pm$ 5 mph). Drive the vehicle for at least two minutes including at least one left and one right turning maneuver, and at least one service brake application. Verify that within two minutes of obtaining this vehicle speed the ESC malfunction indicator illuminates. Prior to September 1, 2011, a disconnection of the power to the ESC electronic control unit may be indicated by the ABS malfunction telltale instead of the ESC malfunction telltale.

C. Stop the vehicle and deactivate the ignition locking system to the "Off" or "Lock" position. Restore the ESC system to normal operation and repeat paragraph B. above. Verify that the malfunction telltale extinguishes.

D. Repeat steps A.-C. using another method of malfunction simulation as directed by the COTR.

14. POST TEST REQUIREMENTS

After the required tests are completed, the contractor shall:

A. Verify all data sheets complete and photographs taken,

B. Complete Data Summary Sheets,

14. POST TEST REQUIREMENTS….Continued

C. Complete the Vehicle Condition report form including a word description of its post test condition,

D. Copy applicable pages of the vehicle Owner's Manual for attachment to the final test report,

E. Remove all instrumentation from vehicle. Return vehicle to its pretest condition.

F. Move the test vehicle to a secure area,

G. Place all original records in a secure and organized file awaiting test data disposition.

15. REPORTS

15.1. MONTHLY STATUS REPORTS

The contractor shall submit a monthly Test Status Report and a Vehicle Status Report to the COTR. 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 NONCOMPLIANCE

Any indication of a test failure shall be communicated by telephone to the COTR within 24 hours with written notification mailed within 48 hours (Saturdays and Sundays excluded). A Notice of Test Failure (see report forms section) with a copy of the particular compliance test data sheet(s) and preliminary data plot(s) shall be included. In the event of a test failure, a post test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional costs to the OVSC.

15.3 FINAL TEST REPORTS

15.3.1 COPIES

In the case of an apparent test failure, seven paper copies and electronic copies in both Word and pdf formats of the Final Test Report shall be submitted to the COTR 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".

15. REPORTS ...Continued

Where there has been no indication of an apparent noncompliance, three paper copies and electronic copies in both Word and pdf formats of each Final Test Report shall be submitted to the COTR 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 COTR. Contractors are requested to NOT submit invoices before the COTR 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 COTR 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 PROOF READ all Final Test Reports before submittal to the COTR. 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 compliance test. The Final Test Report will be released to the public domain after review and acceptance by the COTR.

For these reasons, each final report must be a complete document capable of standing by itself. The contractor should use DETAILED descriptions of all compliance test events. Any events that are not directly associated with the standard 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) Final Report Number such as 126-ABC-XX-001, where –

126 is the FMVSS tested
ABC are the initials for the laboratory

15. REPORTS ...Continued

XX is the last two numbers of 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

SAFETY COMPLIANCE TESTING FOR FMVSS 126
Electronic Stability Control Systems
* * * * * * * * * * * * * * * * *
ABC Motor Company
20XX Saferider 4-door sedan
NHTSA No. CX0401

(3) Contractor's Name and Address such as

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

NOTE: DOT SYMBOL SHALL 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: NVS-220
1200 New Jersey Avenue, SE
Washington, DC 20590

15. REPORTS ...Continued

B. FIRST PAGE AFTER FRONT COVER

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

> This publication is distributed by the National Highway Traffic Safety Administration in the interest of information exchange. Opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof.
>
> If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement.

Prepared By: _____

Approved By: _____*

Approval Date: _____*

FINAL REPORT ACCEPTANCE BY OVSC:*

Accepted By: _____

Acceptance Date: _____

* These lines not required when OVSC staff writes the Test Report

15. REPORTS....Continued

C. SECOND PAGE AFTER FRONT COVER

A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

Block 1 — REPORT NUMBER

126-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 FMVSS 126 Compliance Testing of 20XX 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-XXX-001

15. REPORTS....Continued

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

NVS-220

Block 15 — SUPPLEMENTARY NOTES

Leave blank

15. REPORTS....Continued

Block 16 — ABSTRACT

Compliance tests 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-126-0X for the determination of FMVSS 126 compliance. Test failures 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 COTR.

Block 17 — KEY WORDS

Compliance Testing
Safety Engineering
FMVSS 126

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from —

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

e-mail: tis@nhtsa.dot.gov
FAX: 202-493-2833

Block 19 — SECURITY CLASSIFICATION OF REPORT

Unclassified

Block 20 — SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 — NUMBER OF PAGES
Add appropriate number

15. REPORTS....Continued

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 Compliance Test

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 Failure (if applicable)

16. DATA SHEETS

DATA SUMMARY SHEET (1 of 2)

VEHICLE MAKE/MODEL/BODY STYLE:_____

VEHICLE NHTSA NO.: _____ VIN: _____

VEHICLE TYPE: _____ DATE OF MANUFACTURE: _____

LABORATORY:_____

REQUIREMENTS	PASS/FAIL
ESC Equipment and Operational Characteristics (Data Sheet 2)	
The vehicle is be equipped with an ESC system that meets the equipment and operational characteristics requirements. (S126, S5.1, S5.6)	_____
ESC Malfunction Telltale (Data Sheet 3)	
Vehicle is equipped with a telltale that indicates one or more ESC system malfunctions. (S126, S5.3)	_____
"ESC Off" and other System Controls and Telltale (Data Sheet 3 & 4)	
Vehicle is equipped with an ESC off telltale indicating the vehicle has been put into a mode that renders the ESC system unable to satisfy the performance requirements of the standard, if such a mode exists. (S5.5.1)	_____

16. DATA SHEETS….continued

DATA SUMMARY SHEET (2 of 2)

REQUIREMENTS	**PASS/FAIL**
If provided, off control and other system controls as well as the ESC off telltale meets the operational requirements (S126, S5.4, S5.4.1, S5.4.2, S5.5.4, and S5.5.9)	_____
Vehicle Lateral Stability (Data Sheet 8)	
Yaw Rate Ratio at 1 second after COS is less than 35% of peak value. (S126, S5.2.1)	_____
Yaw Rate Ratio at 1.75 seconds after COS is less than 20% of peak value. (S126, S5.2.2)	_____
Vehicle Responsiveness (Data Sheet 8)	
Lateral displacement at 1.07 seconds after BOS is at least 1.83 m (6 feet) for vehicles with a GVWR of 3,500kg (7,716 lb) or less, and 1.52 m (5 feet) for vehicles with a GVWR greater than 3,500 kg (7,716 lb). (S126 S5.2.3)	_____
ESC Malfunction Warning (Data Sheet 9)	
Warning is provided to driver after malfunction occurrence. (S126. S5.3)	_____
Malfunction telltale stayed illuminated as long as malfunction existed and must extinguished after malfunction was corrected. (S126, S5.3.7)	_____

16. DATA SHEETS....continued

DATA SHEET 1 (Sheet 1 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

VEHICLE MAKE/MODEL/BODY STYLE:_____

NHTSA No.:_____ TEST DATE:_____

VIN:_____ MANUFACTURE DATE:_____

GVWR:_____KG FRONT GAWR:_____ KG REAR GAWR_____KG

SEATING POSITIONS: FRONT_____ MID _____ REAR _____

ODOMETER READING AT START OF TEST: _____ Miles (Kilometers)

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front Axle_____ Rear Axle _____

INSTALLED TIRE SIZE(S) ON VEHICLE:

From Tire Sidewall	Front Axle	Rear Axle
Manufacturer & Tire Name	_____	_____
Tire Size Designation	_____	_____

TIN Front Left _____ Front Right_____

Rear Left _____ Rear Right_____

Are installed tire sizes same as labeled tire sizes? _____ Yes _____ No
If no, contact COTR for further guidance.

DRIVE CONFIGURATION(S): (mark all that apply)

_____ Two Wheel Drive (2WD): ( ) Front Wheel Drive ( ) Rear Wheel Drive
_____ All Wheel Drive (AWD)
_____ Four Wheel Drive Automatic – differential not locked full time (4WD Automatic)
_____ Four Wheel Drive High Gear Locked Differential (4WD HGLD)
_____ Four Wheel Drive Low Gear (4WD Low)
_____ Other (define _____)

16. DATA SHEETS....continued

DATA SHEET 1 (Sheet 2 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

DRIVE CONFIGURATIONS AND MODES: (ex. default, performance, off)
(For each of the vehicle's drive configurations identify available operating modes)

Drive Configuration_____
Mode(s) _____

Drive Configuration_____
Mode(s) _____

Drive Configuration_____
Mode(s) _____

VEHICLE STABILITY SYSTEMS (Check applicable technologies):

_____ESC _____ Traction Control _____ Roll Stability Control

_____Active Suspension _____Electronic Throttle Control _____ Active Steering

_____ABS

List other systems; _____

REMARKS:

RECORDED BY: _____ DATE:_____
APPROVED BY: _____

16. DATA SHEETS….continued

DATA SHEET 2 (Sheet 1 of 2)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

VEHICLE MAKE/MODEL/BODY STYLE:_____

NHTSA No.:_____ TEST DATE:_____

ESC SYSTEM IDENTIFICATION:
Manufacturer/Model _____

ESC SYSTEM HARDWARE (Check applicable hardware):
_____ Electronic Control Unit _____ Hydraulic Control Unit
_____ Wheel Speed Sensors _____ Steering Angle Sensor
_____ Yaw Rate Sensor _____ Lateral Acceleration Sensor

List other components; _____

ESC SYSTEM OPERATIONAL CHARACTERISTICS:

System is capable of generating brake torques at each wheel _____ Yes (PASS)
_____ No (FAIL)
List and describe component(s):_____

System is capable of determining yaw rate _____ Yes (PASS)
_____ No (FAIL)
List and describe component(s):_____

System is capable of monitoring driver steering input _____ Yes (PASS)
_____ No (FAIL)
List and describe component(s):_____

System is capable of estimating side slip or side slip derivation _____ Yes (PASS)
_____ No (FAIL)
List and describe component(s):_____

16. DATA SHEETS....continued

DATA SHEET 2 (Sheet 2 of 2)
ESC SYSTEM HARDWARE AND OPERATIONAL CHARACTERISTICS

ESC SYSTEM OPERATIONAL CHARACTERISTICS (continued):

System is capable of modifying engine torque during ESC activation. _____ Yes(PASS) _____ No (FAIL)
Method used to modify engine torque:_____

System is capable of activation at speeds of 20 km/h (12.4 mph) and higher. _____ Yes (PASS) _____ No (FAIL)

Speed system becomes active:_____

System is capable of activation during the following driving phases (acceleration, deceleration, coasting, and during activation of ABS or traction control). _____ Yes (PASS) _____ No (FAIL)

Driving phases ESC system is capable of activation:_____
_____

Vehicle manufacturer submitted documentation explaining how the ESC system mitigates understeer? _____ Yes (PASS) _____ No (FAIL)

DATA INDICATES COMPLIANCE PASS/FAIL _____

REMARKS:

RECORDED BY: _____ DATE:_____
APPROVED BY: _____ DATE:_____

16. DATA SHEETS....continued

DATA SHEET 3 (Sheet 1 of 2)
ESC MALFUNCTION AND OFF TELLTALES

VEHICLE MAKE/MODEL/BODY STYLE:_____

VEHICLE NHTSA NO. _____ TEST DATE:_____

ESC Malfunction Telltale

Vehicle is equipped with malfunction telltale? _____Yes (Pass) _____No (Fail)

Telltale Location _____

Telltale Color _____

Telltale symbol or abbreviation used.

Or **ESC**

_____Vehicle uses this symbol
_____Vehicles uses this abbreviation
_____Neither symbol or abbreviation is used

If different than identified above, make note of any message, symbol or abbreviation used.

_____

_____

Is telltale part of a common space? _____ Yes _____ No

Is telltale also used to indicate activation of the ESC system? _____Yes _____No

If yes, explain telltale operation during ESC activation: _____

16. DATA SHEETS....continued

DATA SHEET 3 (Sheet 2 of 2)
ESC MALFUNCTION AND OFF TELLTALES

“ESC OFF” Telltale (if provided)

Vehicle is equipped with “ESC Off” telltale? _____Yes _____No

Is “ESC OFF” telltale combined with “ESC Malfunction” telltale utilizing a two part telltale
_____Yes _____No

Telltale Location _____

Telltale Color _____

Telltale symbol or abbreviation used.

Or **ESC OFF**

_____Vehicle uses this symbol
_____Vehicle uses this abbreviation
_____Neither symbol or abbreviation is used

If different than identified above, make note of any message, symbol or abbreviation used.

_____

Is telltale part of a common space? _____ Yes _____ No

DATA INDICATES COMPLIANCE PASS/FAIL _____
(Vehicle is compliant if equipped with a malfunction telltale)

REMARKS:

RECORDED BY: _____ DATE:_____
APPROVED BY: _____ DATE:_____

16. DATA SHEETS....continued

DATA SHEET 4 (Sheet 1 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

"ESC OFF" Controls Identification and Operational Check:

Is the vehicle equipped with a control or controls whose purpose is to deactivate the ESC system or place the ESC system in a mode or modes that may no longer satisfy the performance requirements of the standard?

_____ Yes _____ No

Type of control or controls provided? (mark all that apply)

_____ Dedicated "ESC Off" control
_____ Multi-functional control with an "ESC Off" mode
_____ Other (describe)

Identify each control location, labeling and selectable modes.

First Control: Location_____
Labeling_____
Modes_____

Second Control: Location_____
Labeling_____
Modes_____

Identify standard or default drive configuration _____

Verify standard or default drive configuration selected. _____ Yes _____ No

Does the "ESC Off" telltale illuminate upon activation of the dedicated ESC off control or selection of the "ESC Off" mode on the multi-function control?

_____ Yes _____ No (fail)

Does the "ESC Off" telltale extinguish when the ignition is cycled from "On" ("Run") to "Lock" or "Off" and then back again to the "On" ("Run") position?

_____ Yes _____ No (fail)

If no, describe how the off control functions:

_____

_____

16. DATA SHEETS....continued

DATA SHEET 4 (Sheet 2 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

If a multi-function control is provided, cycle through each mode setting on the control and record which modes illuminate the "ESC Off" telltale. Also, for those modes that illuminate the ESC Off" telltale identify if the telltale extinguishes upon cycling the ignition system.

Control Modes	"ESC Off" telltale illuminates upon activation of control? (Yes/No)	"ESC Off" telltale extinguishes upon cycling ignition? (Yes/No)

For each mode that illuminates the "ESC Off" telltale, did the telltale extinguish when the ignition was cycled from "On" ("Run") to "Lock" or "Off" and then back again to the "On" ("Run") position?

_____ Yes _____ No (fail)

Other System Controls that have an ancillary effect on ESC Operation:

Is the vehicle equipped with any ancillary controls that upon activation may deactivate the ESC system or place the ESC system in a mode or modes that may no longer satisfy the performance requirements of the standard?

_____ Yes _____ No

List and describe each control (i.e. alternate drive configuration selection controls):

Ancillary Control: System_____
Control Description_____
Labeling_____

Ancillary Control: System_____
Control Description_____
Labeling_____

16. DATA SHEETS....continued

DATA SHEET 4 (Sheet 3 of 3)
ESC AND ANCILLARY SYSTEM CONTROLS

Activate each control listed above and record whether the control illuminates the "ESC Off" telltale. Also, record warnings or messages provided regarding the ESC system.

Ancillary Control	Control Activates "ESC Off" Telltale? (Yes/No)	Warnings or Messages Provided

For those controls that illuminate the "ESC Off" telltale above identify if the "ESC Off" telltale extinguishes upon cycling the ignition system.

Ancillary Control	"ESC Off" telltale extinguishes upon cycling ignition? (Yes/No)

For each control that illuminates the "ESC Off" telltale, did the telltale extinguish when the ignition is cycled from "On" ("Run") to "Lock" or "Off" and then back again to the "On" ("Run") position? If the control activated places the vehicle into a low-range four-wheel drive configuration designed for low-speed, off–road driving, the ESC system may remain turned off after the ignition has been cycled off and then back on and therefore the "ESC Off" telltale may not extinguish.

_____ Yes _____ No (fail)

DATA INDICATES COMPLIANCE: PASS/FAIL _____

REMARKS:

RECORDED BY:_____ DATE: _____
APPROVED BY:_____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 5 (Sheet 1 of 3)
TEST TRACK AND VEHICLE DATA

VEHICLE MAKE/MODEL/BODY STYLE:_____

VEHICLE NHTSA NO. _____ TEST DATE:_____

Test Track Requirements: Test Surface Slope (0-1 %) _____%

Peak Friction Coefficient (at least 0.9) _____

Test Track Data Meets Requirements: Yes/No _____
If no, explain: _____

Full Fluid Levels: Fuel _____ Coolant _____ Other Fluids _____(specify)

Tire Pressures: Required; Front Axle_____KPA Rear Axle_____KPA

Actual; LF_____ KPA LR_____KPA
RF_____ KPA RR_____KPA

Vehicle Dimensions: Track Width_____cm Wheelbase _____cm

Vehicle Weight Ratings: GAWR Front_____KG GAWR Rear_____KG

Unloaded Vehicle Weight (UVW)

Front Axle_____KG Right Front_____KG Left Front _____KG
Rear Axle_____KG Right Rear_____KG Left Rear _____KG
Total UVW_____KG

Baseline Weight and Outrigger Selection (only for MPVs, Trucks, Buses)

Calculated Baseline Weight (UVW + 73kg) _____KG

Outrigger size required ("Standard" or "Heavy") _____
Standard – Baseline weight under 2,722 kg (6,000 lb)
Heavy – Baseline weight equal to or greater than 2,722 kg (6,000 lb)

16. DATA SHEETS....continued

DATA SHEET 5 (Sheet 2 of 3)
TEST TRACK AND VEHICLE DATA

UVW with Outriggers (only for MPVs, Trucks, Buses)

Front Axle_____KG Right Front_____KG Left Front _____KG

Rear Axle_____KG Right Rear_____KG Left Rear _____KG

Total UVW w/Outriggers_____KG

Loaded Vehicle Weight w/Driver and Instrumentation (no Ballast)

Front Axle_____KG Right Front_____KG Left Front _____KG

Rear Axle_____KG Right Rear_____KG Left Rear _____KG

Vehicle Weight_____KG

Ballast Required = Total UVW with Outriggers (if applicable) + 168 KG – Loaded Weight w/ Driver and instrumentation

= _____KG + 168 KG - _____KG

= _____KG

Total Loaded Vehicle Weight w/Driver, Instrumentation and Ballast

Front Axle_____KG Right Front_____KG Left Front _____KG

Rear Axle_____KG Right Rear_____KG Left Rear _____KG

Total Loaded Vehicle Weight_____KG

16. DATA SHEETS....continued

DATA SHEET 5 (Sheet 3 of 3)
TEST TRACK AND VEHICLE DATA

Center of Gravity and Inertial Sensing System Location at Loaded Vehicle Condition:

x-distance (longitudinal)	Point of reference is the front axle centerline. (Positive from front axle toward rear of vehicle.)
y-distance (lateral)	Point of reference is the vehicle centerline. (Positive from the center toward the right.)
z-distance (vertical)	Point of reference is the ground plane. (Positive from the ground up.)

Locations:

	Center of Gravity	Inertial Sensing System
x-distance	_____cm	_____cm
y-distance	_____cm	_____cm
z-distance	_____cm	_____cm

Roof Height: _____cm

Distance Between Ultrasonic Sensors: _____cm

REMARKS:

RECORDED BY:_____ DATE: _____
APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 6 (Sheet 1 of 3)
BRAKE AND TIRE CONDITIONING

VEHICLE MAKE/MODEL/BODY STYLE:_____

VEHICLE NHTSA NO. _____

Measured Cold Tire Pressures: LF_____ KPA LR_____KPA
RF_____ KPA RR_____KPA

Wind Speed _____ m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) _____ °C

Brake Conditioning Time;_____ Date;_____

56 km/h (35 mph) Brake Stops

Number of stops executed (10 required) _____ stops

Observed deceleration rate range (.5g target) _____ g

72 km/h (45 mph) Brake Stops

Number of stops executed (3 required) _____ stops

Number of stops ABS activated (3 required) _____ stops

Observed deceleration rate range _____ g

72 km/h (45 mph) Brake Cool Down Period

Duration of cool down period (5 minutes min.) _____ minutes

16. DATA SHEETS....continued

DATA SHEET 6 (Sheet 2 of 3)
BRAKE AND TIRE CONDITIONING

Tire Conditioning Series No. 1 Time:_____ Date:_____

Measured Tire Pressures: LF_____ KPA LR_____KPA
RF_____ KPA RR_____KPA

Wind Speed _____ m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) _____ °C

30 meter (100 ft) Diameter Circle Maneuver				
Test Runs	Steering Direction	Target Lateral Acceleration (g)	Observed Lateral Acceleration (g)	Observed Vehicle Speed
1-3	Clockwise	0.5-0.6		
4-6	Counterclockwise	0.5-0.6		

5 - 1 Hz Cycle Sinusoidal Steering Maneuver to Determine Steering Wheel Angle For 0.5-0.6g Lateral Acceleration				
Test Runs	Vehicle Speed Km/h(mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1	56±2 (35±1)	30	0.5-0.6	
2	56±2 (35±1)		0.5-0.6	
3	56±2 (35±1)		0.5-0.6	
4	56±2 (35±1)		0.5-0.6	

Steering wheel angle that corresponds to a peak 0.5–0.6g lateral acceleration; _____degrees

10 - 1 Hz Cycle Sinusoidal Steering Maneuver				
Test Runs	Vehicle Speed Km/h (mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1 - 3	56±2 (35±1)	(cycles 1-10)	0.5-0.6	
4	56±2 (35±1)	(cycles 1-9)	0.5-0.6	
		(cycle 10)*	NA	

* The steering wheel angle used for cycle 10 should be twice the angle used for cycles 1-9.

16. DATA SHEETS....continued

DATA SHEET 6 (Sheet 3 of 3)
BRAKE AND TIRE CONDITIONING

Tire Conditioning Series No. 2 Time:_____ Date:_____

Measured Tire Pressures: LF_____ KPA LR_____KPA
RF_____ KPA RR_____KPA

Wind Speed _____ m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) _____ °C

30 meter (100 ft) Diameter Circle Maneuver				
Test Runs	Steering Direction	Target Lateral Acceleration (g)	Observed Lateral Acceleration (g)	Observed Vehicle Speed
1-3	clockwise	0.5-0.6		
4-6	counterclockwise	0.5-0.6		

5 - 1 Hz Cycle Sinusoidal Steering Maneuver to Determine Steering Wheel Angle For 0.5-0.6g Lateral Acceleration				
Test Runs	Vehicle Speed Km/h (mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1	56±2 (35±1)	30	0.5-0.6	
2	56±2 (35±1)		0.5-0.6	
3	56±2 (35±1)		0.5-0.6	
4	56±2 (35±1)		0.5-0.6	

Steering wheel angle that corresponds to a peak 0.5–0.6g lateral acceleration; _____degrees

10 - 1 Hz Cycle Sinusoidal Steering Maneuver				
Test Runs	Vehicle Speed (mph)	Steering Wheel Angle (degrees)	Target Peak Lateral Acceleration (g)	Observed Peak Lateral Acceleration (g)
1 - 3	56±2 (35±1)	(cycles 1-10)	0.5-0.6	
4	56±2 (35±1)	(cycles 1-9)	0.5-0.6	
		(cycle 10)*	NA	

* The steering wheel angle used for cycle 10 should be twice the angle used for cycles 1-9.

REMARKS:

RECORDED BY:_____ DATE: _____
APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 7 (1 of 2)
SLOWLY INCREASING STEER (SIS) MANEUVER

VEHICLE MAKE/MODEL/BODY STYLE:_____

VEHICLE NHTSA NO. _____ TEST DATE:_____

Measured Tire Pressures: LF_____ KPA LR_____KPA
RF_____ KPA RR_____KPA

Wind Speed _____ m/sec
(10m/sec (22mph) max for passenger cars; 5m/s (11mph) max. for MPVs and Trucks)

Ambient Temperature (7°C (45°F) - 40°C (104°F)) _____ °C

Selected Drive Configuration: _____

Selected Mode: _____

Preliminary Left Steer Maneuver:
Lateral Acceleration measured at 30 degrees steering wheel angle ($a_{y,30\ degrees}$)

$a_{y,30\ degrees}$ =_____g

Assuming a linear relationship the following ratio should be used to calculate the steering wheel angle at .55g.

$$\frac{30\,\text{degrees}}{a_{\text{y,30 degrees}}} = \frac{\delta_{SIS}}{0.55\,\text{g}}$$

δ_{SIS} = _____ degrees (@ .55g)
δ_{SIS} = _____ degrees (rounded)

Steering Wheel Angle at Corrected 0.3 g Lateral Acceleration:

Maneuver #	Initial Steer Direction	Time Clock (5 min max between runs)	Steering Wheel Angle to nearest 0.1 degree (degrees)
1	Left		
2	Left		
3	Left		
1	Right		
2	Right		
3	Right		

16. DATA SHEETS....continued

DATA SHEET 7 (2 of 2)
SLOWLY INCREASING STEER (SIS) MANEUVER

Average Overall Steering Wheel Angle:

$$\delta_{0.3\ g,\ overall} = (|\delta_{0.3\ g,\ left\ (1)}| + |\delta_{0.3\ g,\ left\ (2)}| + |\delta_{0.3\ g,\ left\ (3)}| + \delta_{0.3\ g,\ right\ (1)} + \delta_{0.3\ g,\ right\ (2)} + \delta_{0.3\ g,\ right\ (3)}) / 6$$

$\delta_{0.3\ g,\ overall}$ = _____ degrees
[to nearest 0.1 degree]

REMARKS:

RECORDED BY:_____ DATE: _____

APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 8 (1 of 3)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS

VEHICLE MAKE/MODEL/BODY STYLE:_____
VEHICLE NHTSA NO. _____ TEST DATE:_____

Tire conditioning completed _____ Yes _____ No
ESC system is enabled _____ Yes _____ No
On track calibration checks have been completed _____ Yes _____ No
On track static data file for each sensor obtained _____ Yes _____ No

Selected Drive Configuration: _____
Selected Mode: _____

Overall steering wheel angle ($\delta_{0.3\ g,\ overall}$) _____ degrees

Lateral Stability Test Series No. 1 – Counterclockwise Initial Steer Direction

Maneuver #	Clock Time (1.5 – 5.0 min max between runs)	Commanded Steering Wheel Angle[1] (degrees)		Yaw Rates (degrees/sec)			YRR at 1.0 sec after COS [≤ 35%]		YRR at 1.75 sec after COS [≤ 20%]	
		Scalar	Angle	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0sec}$	$\dot{\psi}_{1.75sec}$	%	Pass/Fail	%	Pass/Fail
1		1.5* $\delta_{0.3\ g}$								
2		2.0* $\delta_{0.3\ g}$								
3		2.5* $\delta_{0.3\ g}$								
4		3.0* $\delta_{0.3\ g}$								
5		3.5* $\delta_{0.3\ g}$								
6		4.0* $\delta_{0.3\ g}$								
7		4.5* $\delta_{0.3\ g}$								
8		5.0* $\delta_{0.3\ g}$								
9		5.5* $\delta_{0.3\ g}$								
10		6.0* $\delta_{0.3\ g}$								
11		6.5* $\delta_{0.3\ g}$								
12										
13										
14										
15										
16										

1. Maneuver execution should continue until a steering wheel angle magnitude factor of 6.5*$\delta_{0.3\ g,\ overall}$ or 270 degrees is utilized, whichever is greater provided the calculated magnitude of 6.5*$\delta_{0.3\ g,\ overall}$ is less than or equal to 300 degrees. If 6.5*$\delta_{0.3\ g,\ overall}$ is less than 270 degrees maneuver execution should continue by increasing the steering wheel angle magnitude by multiples of 0.5*$\delta_{0.3\ g,\ overall}$ without exceeding the 270 degree steering wheel angle.

16. DATA SHEETS....continued

DATA SHEET 8 (2 of 3)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS

LATERAL STABILITY TEST SERIES NO. 2 – Clockwise Initial Steer Direction

Maneuver #	Clock Time (1.5 – 5.0 min max between runs)	Commanded Steering Wheel Angle[1] (degrees)		Yaw Rates (degrees/sec)			YRR at 1.0 sec after COS [≤ 35%]		YRR at 1.75 sec after COS [≤ 20%]	
		Scalar	Angle	$\dot{\psi}_{Peak}$	$\dot{\psi}_{1.0sec}$	$\dot{\psi}_{1.75sec}$	%	Pass/Fail	%	Pass/Fail
1		1.5* $\delta_{0.3\ g}$								
2		2.0* $\delta_{0.3\ g}$								
3		2.5* $\delta_{0.3\ g}$								
4		3.0* $\delta_{0.3\ g}$								
5		3.5* $\delta_{0.3\ g}$								
6		4.0* $\delta_{0.3\ g}$								
7		4.5* $\delta_{0.3\ g}$								
8		5.0* $\delta_{0.3\ g}$								
9		5.5* $\delta_{0.3\ g}$								
10		6.0* $\delta_{0.3\ g}$								
11		6.5* $\delta_{0.3\ g}$								
12										
13										
14										
15										
16										

1. Maneuver execution should continue until a steering wheel angle magnitude factor of 6.5*$\delta_{0.3\ g,\ overall}$ or 270 degrees is utilized, whichever is greater provided the calculated 6.5*$\delta_{0.3\ g,\ overall}$ is less than or equal to 300 degrees. If 6.5*$\delta_{0.3\ g,\ overall}$ is less than 270 degrees maneuver execution should continue by increasing the steering wheel angle magnitude by multiples of 0.5*$\delta_{0.3\ g,\ overall}$ without exceeding the 270 degree steering wheel angle.

During execution of the sine with dwell maneuvers were any of the following events observed?

Rim-to-pavement contact _____ Yes _____ No
Tire debeading _____ Yes _____ No
Loss of pavement contact of vehicle tires _____ Yes _____ No
Did the test driver experience any vehicle loss of control or spinout? _____ Yes _____ No

If "Yes" explain the event and consult with the COTR. _____

_____

_____

16. DATA SHEETS....continued

DATA SHEET 8 (3 of 3)
VEHICLE LATERAL STABILITY AND RESPONSIVENESS

Responsiveness – Lateral Displacement

Maneuver #	Initial Steer Direction	Commanded Steering Wheel Angle ($5.0*\delta_{0.3\,g,\,overall}$ or greater)		Calculated Lateral Displacement[1]	
		Scalar	Angle (degrees)	Distance (m)	Pass/Fail
	Counter Clockwise	$5.0*\delta_{0.3\,g}$			
	Counter Clockwise	$5.5*\delta_{0.3\,g}$			
	Counter Clockwise	$6.0*\delta_{0.3\,g}$			
	Counter Clockwise	$6.5*\delta_{0.3\,g}$			
	Counter Clockwise				
	Counter Clockwise				
	Counter Clockwise				
	Counter Clockwise				
	Clockwise	$5.0*\delta_{0.3\,g}$			
	Clockwise	$5.5*\delta_{0.3\,g}$			
	Clockwise	$6.0*\delta_{0.3\,g}$			
	Clockwise	$6.5*\delta_{0.3\,g}$			
	Clockwise				
	Clockwise				
	Clockwise				
	Clockwise				

1. Lateral displacement should be $\geq$ 1.83 m (6 ft) for vehicle with a GVWR of 3,500 kg (7,716 lb) or less; and $\geq$ 1.52 m (5 ft) for vehicles with GVWR greater than 3,500 kg (7,716 lb).

DATA INDICATES COMPLIANCE: PASS/FAIL _____

REMARKS:

RECORDED BY:_____; DATE:_____

APPROVED BY:_____; DATE:_____

16. DATA SHEETS….continued

DATA SHEET 9
MALFUNCTION WARNING TEST
(Test Number ____)

VEHICLE MAKE/MODEL/BODY STYLE:_____

VEHICLE NHTSA NO. _____ TEST DATE:_____

METHOD OF MALFUNCTION SIMULATION:
Describe method of malfunction simulation:_____

_____

MALFUNCTION TELLTALE ILLUMINATION:
Telltale illuminates and remains illuminated after ignition locking system is activated and if necessary the vehicle is driven at least 2 minutes as specified in section 13.12. B.

_____ Yes _____No

Time for telltale to illuminate after ignition system is activated and vehicle speed of 48± 8 km/h (30± 5mph) is reached.
_____ Seconds (must be within 2 minutes) _____ Pass _____ Fail

ESC SYSTEM RESTORATION:
Telltale extinguishes after ignition locking system is activated and if necessary the vehicle is driven at least 2 minutes as specified in section 13.12. B.

_____ Yes _____No

Time for telltale to extinguish after ignition system is activated and vehicle speed of 48± 8 km/h (30± 5mph) is reached.
_____ Seconds (must be within 2 minutes) _____ Pass _____ Fail

DATA INDICATES COMPLIANCE: PASS/FAIL _____

REMARKS:
RECORDED BY:_____; DATE:_____

APPROVED BY:_____; DATE:_____

17. FORMS

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.: 126 TEST DATE: _____

LABORATORY: _____

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

LABORATORY PROJECT ENGINEER'S NAME: _____

TEST SPECIMEN DESCRIPTION: _____

VEHICLE NHTSA NO.: _____ VIN: _____

MFR: _____

TEST FAILURE DESCRIPTION: _____

_____

_____

_____

FMVSS REQUIREMENT, PARAGRAPH S _____:

_____

_____

_____

NOTIFICATION TO NHTSA (COTR): _____

DATE: _____ BY: _____

REMARKS:

17. FORMS....Continued

MONTHLY TEST STATUS REPORT
FMVSS 126
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						

17. FORMS....Continued

MONTHLY VEHICLE STATUS REPORT
FMVSS 126
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						