TP-111V-01
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U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

FMVSS 111

Rear Visibility
(Other than School Buses**)**

ENFORCEMENT
Office of Vehicle Safety Compliance
Mail Code: NEF 210
1200 New Jersey Avenue, SE
Washington, DC 20590

OVSC LABORATORY TEST PROCEDURE NO. 111V-01
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REVISION CONTROL LOG
FOR OVSC LABORATORY TEST PROCEDURES
TP111V – Rear Visibility
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Test Procedure		FMVSS 111		Description
Rev. No.	Date	Amendment	Effective Date	
00	10/28/1999	63FR51000	5/27/99	Revised Table 1 – Conversions
01	02/08/2018	79FR19178 (4/7/2014)	06/06/2014	Final Rule- Incorporation of rearview image Requirements. FMVSS 111 renamed "REAR VISIBILITY"

PREFACE

On April 7, 2014. the National Highway Traffic Safety Administration (NHTSA) issued a final rule to upgrade Federal Vehicle Motor Safety Standard (FMVSS) No. 111, “Rearview Mirrors” (79FR19178). The final rule, renamed “Rear Visibility”, sets forth new performance requirements to improve a driver’s ability to see areas to the rear of a motor vehicle in order to mitigate fatalities and injuries associated with back-over incidents. The new requirements for a rearview image are applicable to passenger cars, multipurpose passenger vehicles, low-speed vehicles, trucks, buses and school buses with a gross vehicle weight rating of 4,536 kg or less. This test procedure is organized first with the existing rearview mirror testing requirements followed by a new section for rearview image testing requirements. The effective dates for the requirements are identified in the applicable procedural sections.

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

Federal Motor Vehicle Safety Standard (FMVSS) No. 111 establishes requirements for rear visibility devices and systems which includes requirements for rearview mirrors and a rearview image. The purpose of the rearview mirrors is to reduce the number of deaths and injuries that occur when the driver of a motor vehicle does not have a clear and reasonably unobstructed view to the rear. The purpose of a rearview image is to improve a driver’s ability to see areas to the rear of a motor vehicle in order to mitigate fatalities and injuries associated with back-over incidents.

A. REARVIEW MIRRORS

FMVSS 111 specifies requirements for the performance and location of rearview mirrors.

REQUIREMENTS FOR PASSENGER CARS

Each passenger car shall have an inside rearview mirror of unit magnification with the required field-of-view and a driver's side outside rearview mirror of unit magnification with the required field-of-view. If the inside rearview mirror does not meet the field-of-view requirements, an outside rearview mirror of unit magnification or a convex mirror (with required markings) is required on the passenger's side. The average radius of curvature of the convex mirror shall be not less than 889 millimeters (mm) and not more than 1,651 mm. All the required mirrors must be adjustable in both the vertical and horizontal directions and have a stable mounting.

REQUIREMENTS FOR MULTIPURPOSE PASSENGER VEHICLES, TRUCK AND BUS (OTHER THAN A SCHOOL BUS) WITH A GVWR 4,536 KILOGRAMS OR LESS

1. Mirrors that conform to passenger cars requirements, or

2. Unit magnification outside mirrors on both sides of the vehicle with stable supports, adjustable in both the vertical and horizontal directions, and with reflective surface of at least 126 square centimeters (cm^2).

REQUIREMENTS FOR MULTIPURPOSE PASSENGER VEHICLES, TRUCKS, AND BUSES (OTHER THAN A SCHOOL BUS), WITH A GVWR OF MORE THAN 4,536 KG

Each vehicle shall have outside mirrors of unit magnification, each with not less than 323 cm^2 of reflective surface, installed with stable supports on both sides of the vehicle. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the vehicle and shall be adjustable both in the horizontal and vertical directions to view the rearward scene.

REQUIREMENTS FOR SCHOOL BUSES

Refer to the latest version of TP-111SB-00 for testing school bus mirror systems.

REQUIREMENTS FOR MOTORCYCLES

Each motorcycle shall have either a mirror of unit magnification with not less than 8065 mm^2 of reflective surface, or a convex mirror with not less than 6450 mm^2 of reflective surface and an average radius of curvature not less than 508 mm and not greater than 1524 mm, installed with a stable support, and mounted so that the horizontal center of the reflective surface is at least 279 mm outward of the longitudinal centerline of the motorcycle. The mirror shall be adjustable by tilting in both the horizontal and vertical directions.

B. REARVIEW IMAGE

FMVSS 111 specifies requirements for a rearview image detected by a single source, of the area directly behind a vehicle that is provided in a single location to the vehicle operator and by means of indirect vision.

Requirements apply to passenger cars, multi-purpose passenger vehicles, low-speed vehicles, trucks, buses and school buses (tested under TP-111-SB) with a GVWR of 4,536 kg or less. During the phase-in period for vehicles manufactured on or after May 1, 2017 and before May 1, 2018 the only requirement that must be met is Field-of-View as specified in the rule S5.5.1 or S6.2.1.

Each vehicle shall display a rearview image displaying a specified field-of-view and test object image size. The response time for image display must be within 2 seconds of the vehicle's direction selector being placed in reverse. The image cannot be displayed after the backing event is completed. The image shall remain visible unless the driver modifies the view, or the vehicle direction selector is removed from the

reverse position. The rear visibility system must default to the rearview image required at the beginning of each backing event regardless of any modifications to the field-of-view the driver previously selected. Lastly, the rear visibility system must meet the field-of-view and test object image size requirements after specified Corrosion, Humidity, and Temperature exposure.

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.

All final compliance test reports are required to include metric measurements for standards using metrication.

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.”
METRIC UNITS

In this Laboratory Test Procedure, metric values maybe followed by English units only for reference purposes (not necessarily equal). If test equipment 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 5 significant digits before rounding consistent with the specified metric requirement.

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, 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 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 preliminary compliance test data available to the COTR if 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.

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 re-procurement costs for non-delivery of valid or conforming test (pursuant to the Termination For Default clause in the contract).

H. NHTSA'S RIGHTS

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

7. GOVERNMENT FURNISHED PROPERTY (GFP)

GFP consists of test vehicles. The handling and disposition of GFP is governed by contractual agreement. The Contractor is responsible for the following:

A. ACCEPTANCE OF VEHICLE

The Contractor has the responsibility of accepting the test vehicle from either a dealer or a vehicle transporter. In both instances, the contractor acts in the OVSC's behalf when signing an acceptance of the test vehicle. If the vehicle is delivered by a dealer, the contractor must check to verify the following:

1. Tires and wheel rims are new and the same as listed.

2. There are no dents or other interior or exterior flaws in the vehicle body.

3. The vehicle has been properly prepared and is in running condition.

4. An owner's manual, warranty document, consumer information, and extra set of keys are included with the vehicle.

5. Proper fuel filler cap is supplied on the test vehicle.

6. Spare tire, jack, lug wrench and tool kit (if applicable) is included with the vehicle.

7. The VIN (vehicle identification number) on the vehicle matches that supplied by the COTR.

8. Seats and, if applicable, restraining barriers are not deformed.

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.

B. 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 vehicle safety compliance test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices (See Section 17 - Forms). 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.

Accelerometers 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 accelerometer 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.

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 shall be performed without additional cost.

9. SUGGESTED TEST EQUIPMENT

Equipment for test conduct is detailed in applicable compliance test execution section 13.

10. PHOTOGRAPHIC DOCUMENTATION

DIGITAL PHOTOGRAPHS

The contractor shall take digital photographs of the test execution procedures. 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 subject matter. The required resolution for digital photographs is a minimum of 1,600 x 1,200 pixels. Digital photographs are required to be created in color and in a JPG format. Glare or light from any illuminated or reflective surface shall be minimized while taking photographs.

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 should 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 (or for equipment testing -- 125 mm x 175 mm (5 x 7 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 photographs shall be included in each final test report, where applicable:

3/4 frontal view from left side of vehicle

3/4 rear view from right side of vehicle

Close-up view of vehicle's certification label

Close-up view of vehicle's tire information placard or label

REARVIEW MIRROR TESTING SPECIFIC -

All rearview mirrors and mirror mountings

Field-of-view test setups, including viewing instrument

Reflectance test setup

Breakaway test setup

Photos required to document test results including those specified in test procedure

Photos to document any apparent test failure

REARVIEW IMAGE TESTING SPECIFIC -

Field-of-View Test cylinder set-up

J826 Manikin positioned in vehicle

Viewing instrument in place for field-of-view and test object image size testing.

Photograph(s) of the rearview image display with the ruler included in the frame which was used to determine test object size.

Close-up of interior rearview image visual display.

Rearview camera mounted on vehicle.

Rearview camera and associated wiring and connectors removed from vehicle.

Rearview camera environmental test fixture.

Rearview camera and hardware installed in/on environmental test fixture.

Rearview camera and hardware pre and post durability testing.

Photos required to document test results including those specified in test procedure for field-of-view and test object image size.

Photos to document any apparent test failure.

Video available (if used) for recording of response time and linger time procedure.

11. DEFINITIONS (S4)

BACKING EVENT
means an amount of time which starts when the vehicle's direction selector is placed in reverse, and ends at the manufacture's choosing, when the vehicle forward motion reaches:

- a speed of 10 mph,
- a distance of 10 meters traveled, or
- a continuous duration of 10 seconds.

CONVEX MIRROR
means a mirror having a curved reflective surface whose shape is the same as that of the exterior surface of a section of a sphere.

EFFECTIVE MIRROR SURFACE
means the portions of a mirror that reflect images, excluding the mirror rim or mounting brackets.

ENVIRONMENTAL TEST FIXTURE
means a device designed to support the external components of the rear visibility system for testing purposes, using any factory seal which would be used during normal vehicle operation, in a manner that simulates the on-vehicle component orientation during normal vehicle operation, and prevents the exposure of any test conditions to portions of the external component which are not exposed to the outside of the motor vehicle.

EXTERNAL COMPONENT
means any part of the rear visibility system which is exposed to the outside of the motor vehicle.

KEY
means a physical device or an electronic code which, when inserted into the starting system (by physical or electronic means), enables the vehicle operator to activate the engine or motor.

LIMITED LINE MANUFACTURER
means a manufacturer that sells three or fewer carlines, as that term is defined in 49 CFR583.4, in the United States during a production year, as that term is defined in S15.

PROJECTED EYE POINT
means a point on a horizontal plane forward of the mirror at a distance equal to the true distance from the eye to the mirror.

REARVIEW IMAGE
means a visual image, detected by means of a single source, of the area directly behind a vehicle that is provided in a single location to the vehicle operator and by means of indirect vision.

REAR VISIBILITY SYSTEM
means the set of devices or components which together perform the function of producing the rearview image as required under this standard.

SEATING REFERENCE POINT (SRP)
means a vehicle manufacturer's design H-point with the seat in the rearmost driving position, which for purposes of this procedure simulates the position of the pivot center of the human torso and thigh.

SMALL MANUFACTURER
means a small manufacturer means an original vehicle manufacturer that produces or assembles fewer than 5,000 vehicles annually for sale in the United States.

STANDARD PRODUCTION ITEMS
means items installed during the assembly of the test vehicle.

STARTING SYSTEM
means the vehicle system used in conjunctjon with the key to activate the engine or motor.

UNIT MAGNIFICATION MIRROR
means a plane or flat mirror with a reflective surface through which the angular height and width of the image of an object is equal to the angular height and width of the object when viewed directly at the same distance, except for flaws that do not exceed normal manufacturing tolerances. For the purposes of this regulation a prismatic day night adjustment rearview mirror, one of whose positions provides unit magnification, is considered a unit magnification mirror.

95TH PERCENTILE EYELLIPSE CONTOUR
means a passenger car driver's eye range in the form of contours developed by analyzing statistical data of eye point locations.

12. PRETEST REQUIREMENTS

Prior to conducting a compliance test, the contractor shall:

Verify COTR approval of contractor’s In-house Test Procedure,

Verify the training of technicians for performance of this test,

Verify the calibration status of test equipment,

Review applicable revision of FMVSS 111

VEHICLE PREPARATION

A. Clean all mirrors and both sides of all glazing involved in the testing with a non-abrasive cleaner.

B. Clean interior visual display and external rear camera lens with a non-abrasive cleaner.

C. The fuel tank shall be full.

D. All tire pressures shall be set cold according to the vehicle manufacturer's recommendation.

REARVIEW MIRROR TESTING SPECIFIC -

TEST AREA

The compliance test area must be flat, level and approximately 6 to 12 meters wide and 15 to 67 meters long. The test area floor should be marked to aid in locating the test vehicles on axes that are perpendicular to a screen or wall.

To reduce the required length, the test area may include a vertical screen or wall behind the test vehicle that is approximately 2.4 meters high and 4.5 to 6 meters wide, and marked with a square grid of vertical over horizontal intervals every 15 to 30 centimeters (6 inches to 12 inches), or other marker devices that provide for accurate measurement of the field-of-view. Unless specified otherwise, all tests shall be performed within a temperature range of 15.6C to 37.8C (60F to 100F) and a relative humidity of not more than 90 percent.

REARVIEW IMAGE TESTING SPECIFIC -

TEST AREA

For field-of-view and test object image size testing, the compliance test area must be flat, level and sufficiently sized to position test cylinders at the correct locations as described in Section 13.2 of this procedure. The test area floor should be grid-marked with 1-foot squares to aid in locating the test vehicles and cylinders. A solid, light-colored (or white) background beyond the cylinders should be considered to achieve a contrast level with the cylinder markings to ensure measurement accuracy. The vehicle can be driven onto the floor grid and positioned with the rear bumper flush with a 0.0-foot line and the vehicle centerline directly above the longitudinal axis of the floor test grid. The vehicle's position on the test grid can be confirmed using a plumb bob hung from the trunk or rear hatch latching mechanism at the vehicle's centerline as a reference point. For some vehicles, wheeled jacks can be used to lift the vehicle off the surface and pushed accurately into position.

For response time, linger time, deactivation, and default view testing, a sufficiently sized test area is required to allow for unobstructed vehicle movement in both forward and reverse directions.

Unless specified otherwise, all tests shall be performed within a temperature range of 15.6C to 37.8C (60F to 100F) and a relative humidity of not more than 90 percent. Note that image response time testing requires the inside of the vehicle temperature to be between 15C to 25C (59F to 77F) and a relative humidity of not more than 90 percent.

LIGHTING

The ambient illumination conditions in which testing is conducted requires that light be evenly distributed from above and at an intensity of between 7,000 lux and 10,000 lux, as measured at the center of the exterior surface of the vehicle's roof. Light intensity measurement should also be made on the top surface of Cylinder B for information purposes.

PERMANENT RECORDING OF DATA

Where permanent trace recording is not required, data shall be recorded on standard report forms. Changes or corrections shall be made by drawing a line through the original entry, which must remain legible, adding the change above or alongside, and initialed.

13. COMPLIANCE TEST EXECUTION

13.1 REARVIEW MIRROR TESTING

Passenger cars shall be tested to sections A thru G of this procedure as listed below. Multipurpose passenger vehicles, trucks, and buses (other than a school bus) will be tested to section H, and motorcycles tested to section I.

A. Inspection

B. Mounting Adequacy Test

C. Field-of-View Test, Inside rearview Mirror

D. Field-of-View Test, Driver's Side Outside Mirror

E. Reflectance Test /Mirror construction
Note: If the rearview image is displayed and incorporated into the interior rearview mirror, then this test and the Break-Away test that follows for the interior mirror is to be performed after completion of the 13.2 rearview image testing below.

F. Break-Away Test

G. Unit Magnification and Convex Mirror Tests

H. Multipurpose passenger vehicle, truck, bus (other than a school bus)

I. Motorcycle

A. INSPECTION (Data Sheet 1)

Inspect the installation of the inside and outside rearview mirrors. Note any evidence of defects or imperfections which could influence the test. Operate the inside and outside rearview mirrors in all modes and directions to verify that the devices meet the manufacturer's specifications in the Vehicle Owner's Manual.

Note: A passenger car is not required to have an outside mirror on the passenger's side unless its inside rearview mirror does NOT meet the field-of-view requirements of S5.1.1

B. MOUNTING ADEQUACY TEST (Data Sheet 2)

INSIDE MIRROR (S5.1.2):

Determine that the mirror is securely mounted and determine the positive and negative angles

of adjustment for both the vertical and horizontal directions as shown in **Figure 1**.

OUTSIDE DRIVER AND PASSENGER SIDE MIRROR(S) (S5.2.2 and S5.3):

Determine that the driver's side mirror can be tilted in both horizontal and vertical directions from the driver's seated position. Determine that the passenger's side mirror, if so equipped, is capable of adjustment by tilting in both the horizontal and vertical directions. Determine the positive and negative angles of adjustment for both horizontal and vertical directions for all outside mirrors. Determine that all outside mirrors are free of sharp points or edges that could contribute to pedestrian injury.

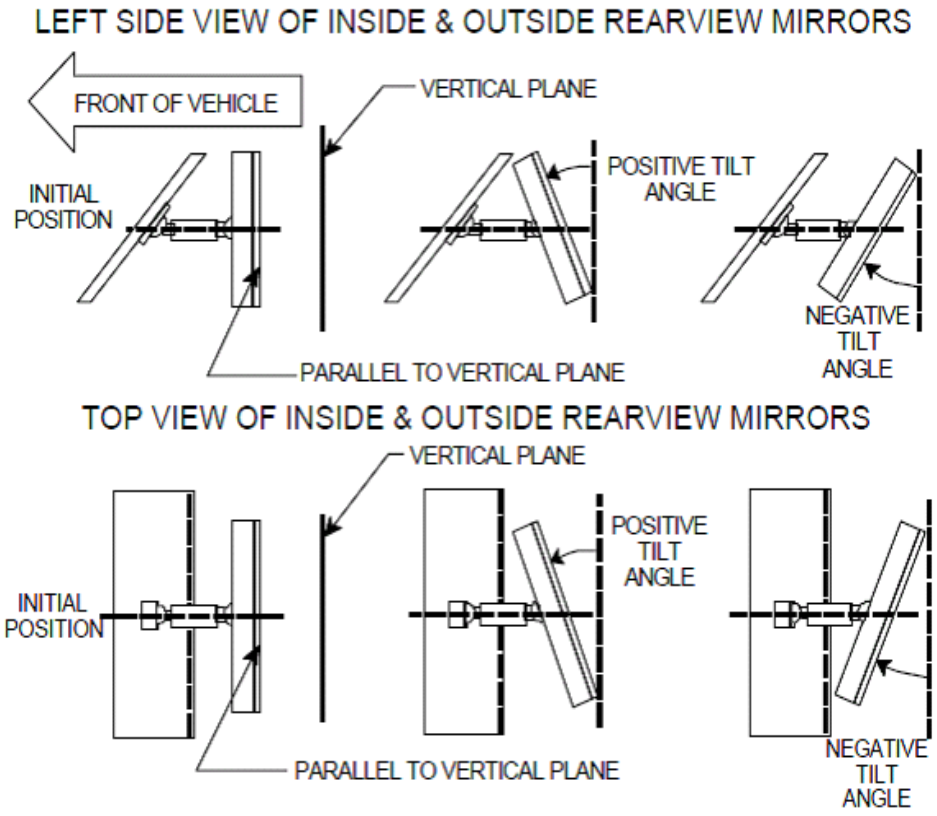


FIGURE 1

Determine that the mirror(s) is(are) securely mounted and that the driver side mirror and mounting do not protrude farther than the widest part of the vehicle body except to the extent necessary to produce a field of view meeting or exceeding the requirements of S5.2.1. Determine that the driver side mirror is not obscured by the un-wiped portion of the windshield.

C. FIELD-OF-VIEW TEST – INSIDE REARVIEW MIRROR (Data Sheet 3)

REQUIREMENTS (S5.1.1)

Mirror shall provide a field of view with an included horizontal angle measured from the projected eye point of at least 20 degrees, and sufficient vertical angle to provide a view of a level road surface extending to the horizon beginning at a point not greater than 61m (200 feet) to the rear of the vehicle when the vehicle is occupied by the driver and four passengers or the designated occupant capacity, if less. The line of sight may be partially obscured by seated occupants or by head restraints.

Each passenger car whose inside mirror does not meet the field of view requirements of S5.1.1 shall have an outside mirror of unit magnification or a convex mirror installed on the passenger's side. (S5.3). The mirror mounting shall provide a stable support and be free of sharp points or edges that could contribute to pedestrian injury. The mirror need not be adjustable from the driver's seat but shall be capable of adjustment by tilting in both horizontal and vertical directions.

PROCEDURE

The general procedure is to position the viewing instrument using an appropriate fixture at the left and right eye point locations respectively and to view the field-of-view grid and markers placed at a specified distance behind the vehicle. The required field-of-view measurements are then made and calculations performed as required to evaluate compliance with the standard. Refer to **Figure 2**.

1. Maneuver the vehicle onto a predetermined location on the level floor of the test laboratory. This location will also be used for the driver side and passenger side outside mirror testing.

2. Establish a vertical longitudinal plane tangent to the widest point of the test vehicle on the driver's side (parallel to the centerline of the vehicle) and locate its intersection with the floor.

3. Measure 10.7 meters (35 feet) to rear of the driver's eye location provided by the COTR and set up a field-of-view test screen perpendicular to the tangent plane. Screen should be grid format with lines equally spaced and delineated with letters and numbers for reference purposes.

4. Load the vehicle to simulate the driver and four passengers (unless capacity is less) with ballast of 68 kilograms (150 pounds) per occupant.

5. Block and secure the vehicle in place to eliminate vertical or horizontal motion during the test and to maintain vehicle position when the load is removed. Measure and record in the general test log the vehicle orientation for future reference.

INSIDE REARVIEW MIRROR FIELD OF VIEW
TEST GRID AND MARKER SETUP

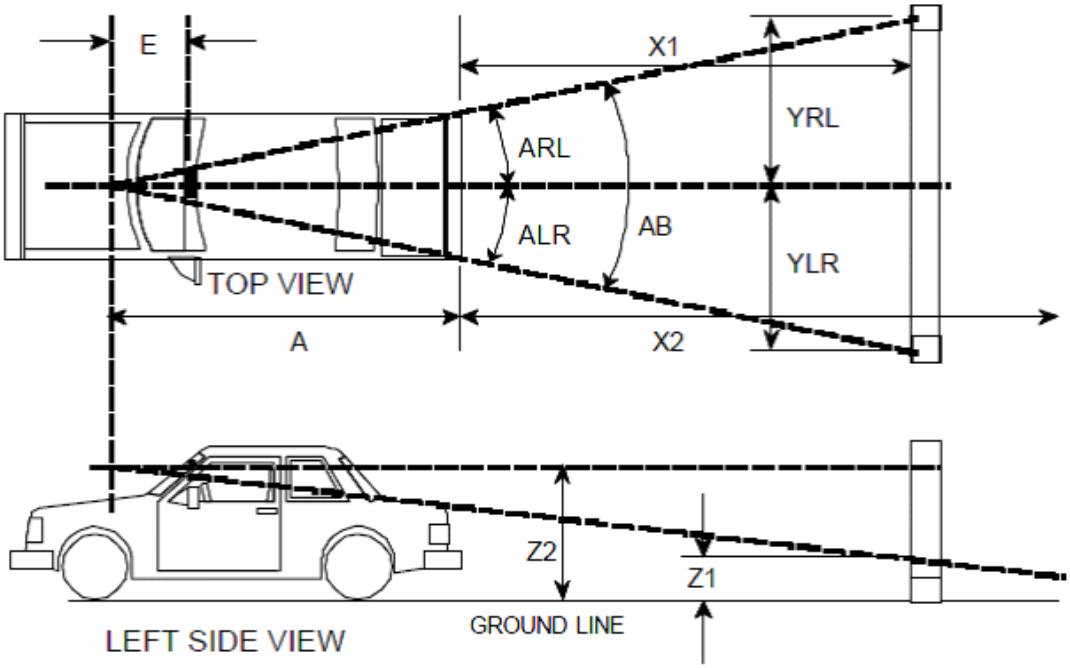


FIGURE 2

WHERE –

E = Distance from center of the mirror to the projected eye point. The distance to this imaginary point is equal to the distance from the mid-point between the driver eye locations to the center of the mirror surface.

X1= Distance to field-of-view grid from rear of vehicle.

X2= CALCULATED distance where a 95th percentile male driver would first see a level road surface behind vehicle (calculated as shown on Data Sheet 3). Must be 61 meters (200 feet) or less.

AB= Included horizontal am-binocular angle. Must be at least 20 degrees.

Z1= Vertical distance to lowest target on field-of-view grid.

Z2= Height of center of mirror.

6. Remove the front seat(s) and install the viewing instrument positioning fixture. The viewing instrument shall be located using the fixture such that the focal point of the instrument is in the position of the driver eye point location provided by the COR. These locations are obtained from the manufacturer based on the nominal location appropriate for any 95th percentile male driver. The location is provided using an x,y,z coordinate system measured from a fixed body point. The viewing instrument and fixture shall be designed such that the viewing instrument can be rotated about the vertical axis.

7. Measure the vertical height of the center of the mirror Z2. Place a target on the field-of view grid at this height at the centerline of the vehicle.

8. While observing through the viewing instrument, adjust the inside mirror both horizontally and vertically such that the Z2 target is visible on the TOP EDGE of the mirror on the mirror centerline. Once the mirror is adjusted it should not be altered until the end of the inside mirror test.

9. While observing through the viewing instrument, have an assistant place a target on the vehicle centerline on the field-of-view screen at a vertical height Z1 at a location where the target appears at the LOWER edge of the mirror. This point will be used to calculate the distance at which the level road surface would be first visible.

10. While observing through the instrument in the driver's left eye location, have an assistant place markers on the field-of-view screen at the extreme left and right sides of the mirror view. Repeat while observing from the driver's right eye location. Take photographs of the left and right eye views through the viewing instrument. In addition, photograph the field-of-view grid with all markers shown.

    Record the following on Data Sheet 3.

    YRR The maximum lateral distance to the driver's right of the center line that is viewed on the grid with the instrument in the right eye location.

    YLL The maximum lateral distance to the driver's left of the center line that is viewed on the grid with the instrument in the left eye location.

    YRL The maximum lateral distance to the driver's right of the center line that is viewed on the grid with the instrument in the left eye location.

    YLR The maximum lateral distance to the driver's left that is viewed with the instrument in the right eye location.

        Note: The YRL and YLR lateral distances provide the widest field-of-view.

11. With the positioning fixture still in position, measure the distance from the midpoint between the driver eye point locations to the center of the mirror surface. Establish the location of the imaginary projected eye point on a horizontal plane forward of the mirror surface at a distance E equal to the measured distance.

12. Calculate distance X2 using the formula on Data Sheet 3. Measure and record other variables.

13. Inspect outside mirror on passenger's side of car, if installed either by requirement S5.3 or by manufacturer's option. Record the results on Data Sheet 3.

D. FIELD-OF-VIEW TEST: DRIVER'S SIDE OUTSIDE REARVIEW MIRROR (Data Sheet 3)

REQUIREMENTS (S5.2)

Each passenger car shall have an outside mirror of unit magnification. The mirror shall provide the driver a view of a level road surface extending to the horizon from a line, perpendicular to a longitudinal plane tangent to the driver's side of the vehicle at the widest point, extending 2.4 meters (8 feet) out from the tangent plane 10.7 meters (35 feet) behind the driver's eyes, with the seat in the rearmost position. The line of sight may be partially obscured by rear body or fender contours. (S5.2.1)

Neither the mirror nor the mounting shall protrude farther than the widest part of the vehicle body except to the extent necessary to produce a field of view meeting or exceeding the requirements of S5.2.1. The mirror shall not be obscured by the un-wiped portion of the windshield. (S5.2.2)

PROCEDURE (Refer to **Figures 3A, 3B, 3C, and 3D**)

1. Maintain the vehicle, field-of-view grid and test equipment positions as established for the inside rearview mirror test.

2. Place a small target disc, approximately 6 millimeters (0.25 inches) in diameter, on upper inboard quadrant of mirror reflecting surface.

3. Measure distance X between the tangent plane at widest point on vehicle and the center of the target on the mirror reflecting surface. Note whether distance is inboard or outboard of tangent plane. Enter result on Data Sheet 3.

4. Measure the height H above ground of the center of the target on the mirror surface.

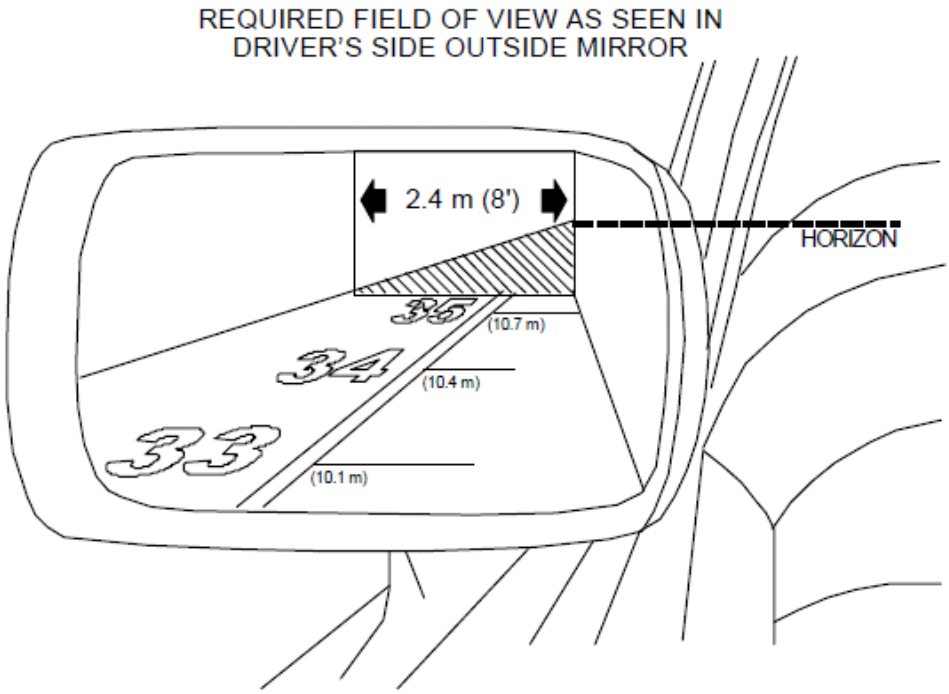


FIGURE 3A

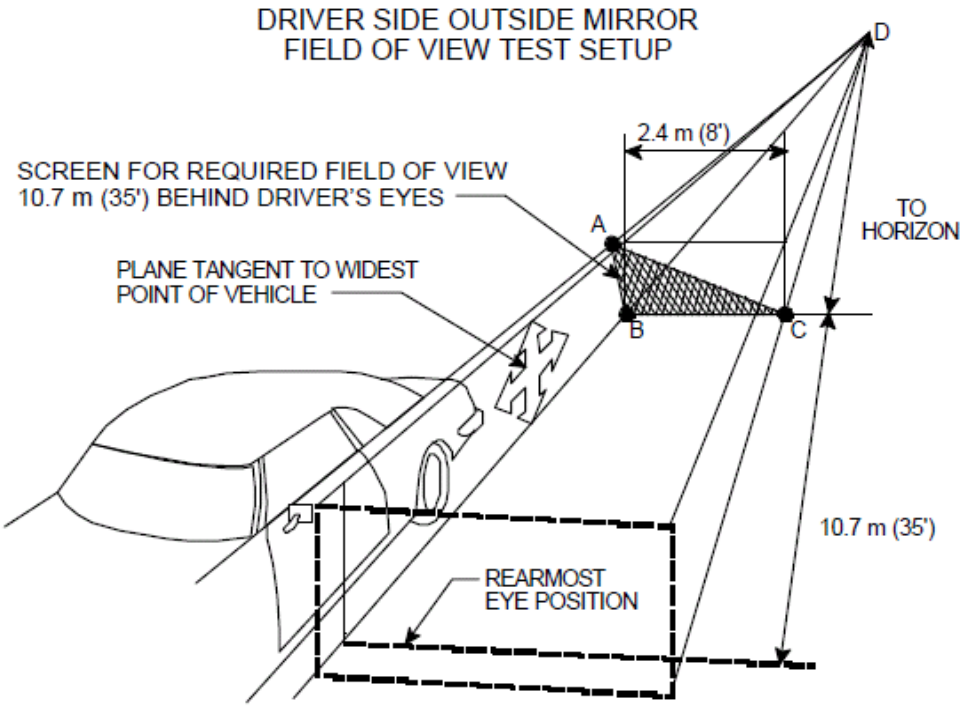


FIGURE 3B

DRIVER SIDE OUTSIDE MIRROR TARGET DISC
LOCATION WITH X AND H DIMENSIONS

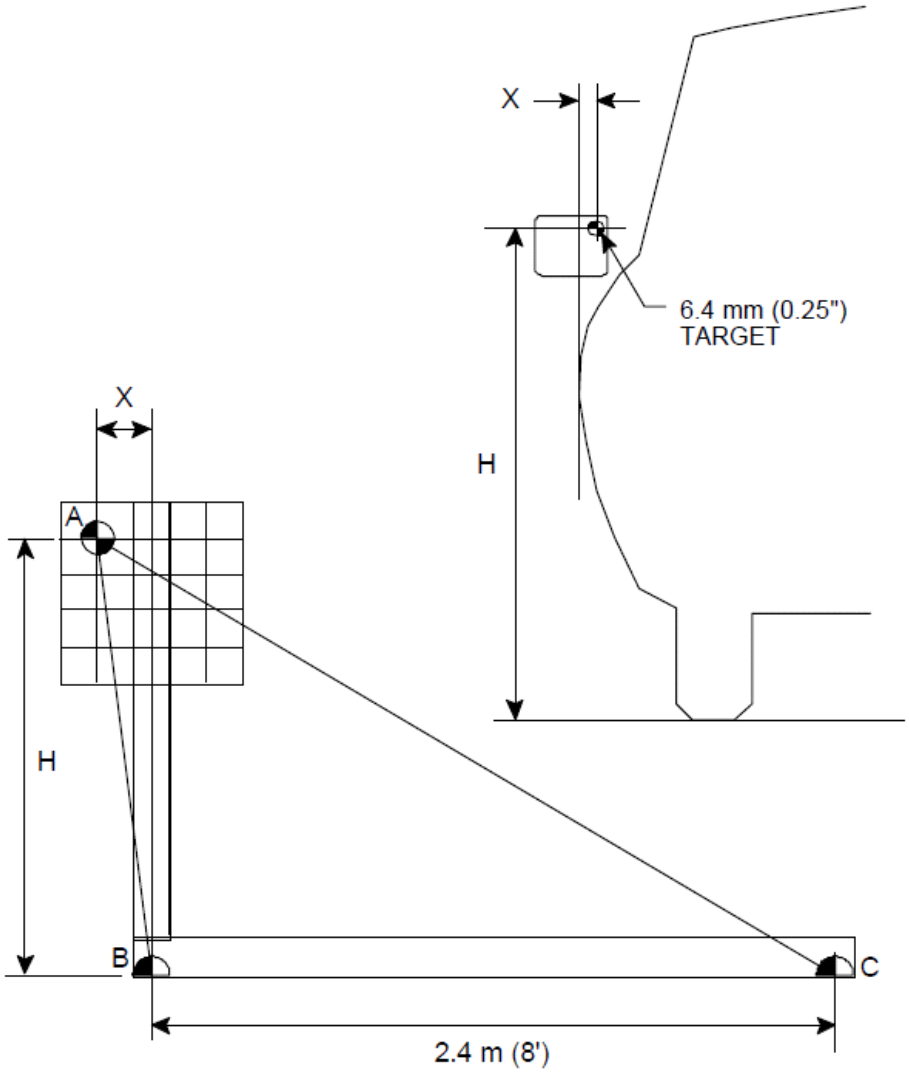


FIGURE 3C

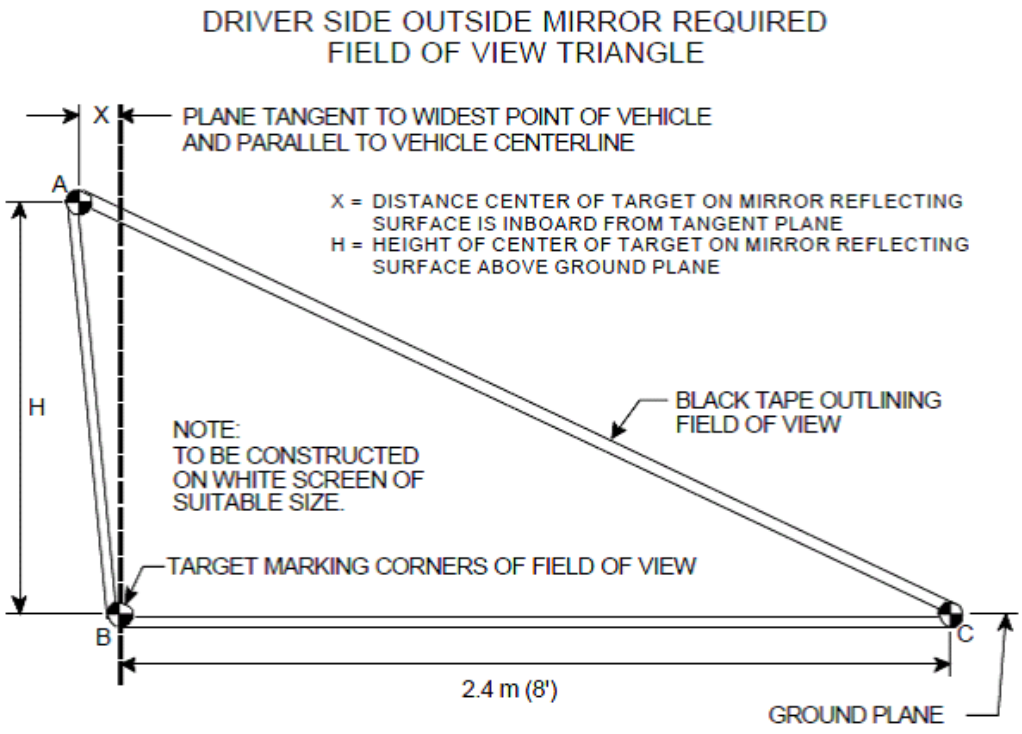


FIGURE 3D

5. Construct a triangular-shaped driver's side view mirror test target area on the field-of-view screen using 3 points (A, B, and C) according to the following:

   Point A: At a vertical height from ground equal to the vertical height of the center of the target on the mirror (dimension H) and a distance (Dimension X) equal to the distance from the center of the target on the mirror to the plane tangent to the widest part of the vehicle on the driver's side,

   Point B: At ground level, on the plane tangent to the driver's side of the vehicle at the widest point, and

   Point C: At ground level, 2.4 m (8 ft) outboard on a plane parallel to the plane tangent to the driver's side of the vehicle at the widest point.

6. Adjust the mirror such that the entire triangle area defined by points A, B, and C is visible with the combined view taken from the left and right eyelipse locations. Initially adjust mirror such that the roadway extending from point B to point C is visible at the mirror base. The field-of-view requirement is met if the triangle is visible in its entirety with the combined left and right eyelipse views.

Note: The right eye sees the widest outboard distance. The left sees the most inboard distance.

7. Photograph the left and right eyelipse views. Record measurements inData Sheet 3 for height of view and lateral distance visible from widest point of the vehicle body.

8. Observe and record if mirror is obscured by unwiped area of windshield.

9. Observe and record any protrusion of the side view mirror or its support beyond a plane tangent to widest part of the vehicle. Record whether the protrusion, if any, is required to meet the field-of-view requirements.

10. Enter results on Data Sheet 3.

E. REFLECTANCE TEST – ALL MIRRORS, ALL VEHICLES (Data Sheet 4)

If the rearview image is displayed and incorporated into the interior rearview mirror, then this test for the rearview mirror is to be performed after completion of the 13.2 rearview image testing as described below.

REQUIREMENT (S11)

All single reflectance mirrors shall have an average reflectance of at least 35 percent. If a mirror is capable of multiple reflectance levels, the minimum reflectance level in the day mode shall be at least 35 percent and the minimum reflectance level in the night mode shall be at least 4 percent. The average reflectance of any mirror required by this standard shall be determined in accordance with SAE Recommended Practice J964, OCT 84.
A multiple reflectance mirror shall either be equipped with a means for the driver to adjust the mirror to a reflectance level of at least 35 percent in the event of electrical failure, or achieve such reflectance level automatically in the event of electrical failure.

APPARATUS DESCRIPTION, SETUP, AND PREPARATION

The apparatus shall consist of a light source, a sample holder, a receiver unit with a photo-detector and an indicating meter as shown in **Figure 4**, and means for negating the effects of extraneous light. The receiver may incorporate a light integrating sphere to facilitate measuring reflectance of non-flat (convex) mirrors as shown in **Figure 5.**

1. Characteristic of Light Source and Photoreceptor

The light source shall consist of an incandescent tungsten filament lamp operating at a nominal color temperature of 2,856 K (CIE Illuminant A) and associated optics to provide a near collimated light beam. A voltage stabilizer

is recommended for maintaining a fixed lamp voltage during instrument operation. The photoelectric receptor shall have a spectral response proportional to the photopic luminosity function of the standard CIE observer. Any other combination of illuminant-filters-receptor which gives the overall equivalent of illuminant A and average visual response may be used.

When an integrating sphere is used in the receiver, the interior surface of the sphere shall be coated with a matt (diffusive) spectrally nonselective white coating.

2. Geometric Conditions

The angle of the incident beam (A1) shall preferably be $25^0 \pm 5$ (0.44 ± 0.09 radian) and shall not exceed 30^0 (0.53 radians) from the perpendicular to the test surface, and the axis of the receptor shall make an angle (A2) with this perpendicular equal to that of the incident beam. The incident beam upon arrival to the test surface, shall have a diameter of 19 mm (0.75 inch) or larger and shall not exceed the sample test area. The reflected beam upon arrival at the photoreceptor, shall not be larger than the photosensitive area and shall not cover less than 50 percent of such area. The reflected beam should strike that area of the photoreceptor used for calibration.

When an integrating sphere is used in the receiver section, the sphere shall have a minimum diameter of 127 millimeters (5 inches). The sample and incident beam apertures in the sphere wall shall be of such a size as to admit the entire incident and reflected light beams. The photodetector shall be so located as not to receive direct light from either the incident or the reflected beams.

3. Receptor Indicator Unit

The photoreceptor output as read on the indicating meter shall be a linear function of the light intensity on the photosensitive area of the receptor. Further, means (electrical and/or optical) shall be provided for calibration and zeroing adjustments. Such means shall not affect the linearity or the spectral characteristics of the instrument. The accuracy of the receptor indicator unit shall be within ± 2 percent of full scale, or ± 10 percent of the magnitude of the reading, whichever is smaller.

4. Sample Holder

The mechanism shall be capable of locating the test sample such that the axes of the source arm and receptor arm intersect at the reflecting surface. The reflecting surface may lie within or at either face of the mirror sample depending on whether it is a first surface, second surface, or prismatic "flip" type mirror.

GENERALIZED REFLECTOMETER SHOWING GEOMETRIES
FOR THE TWO CALIBRATION METHODS

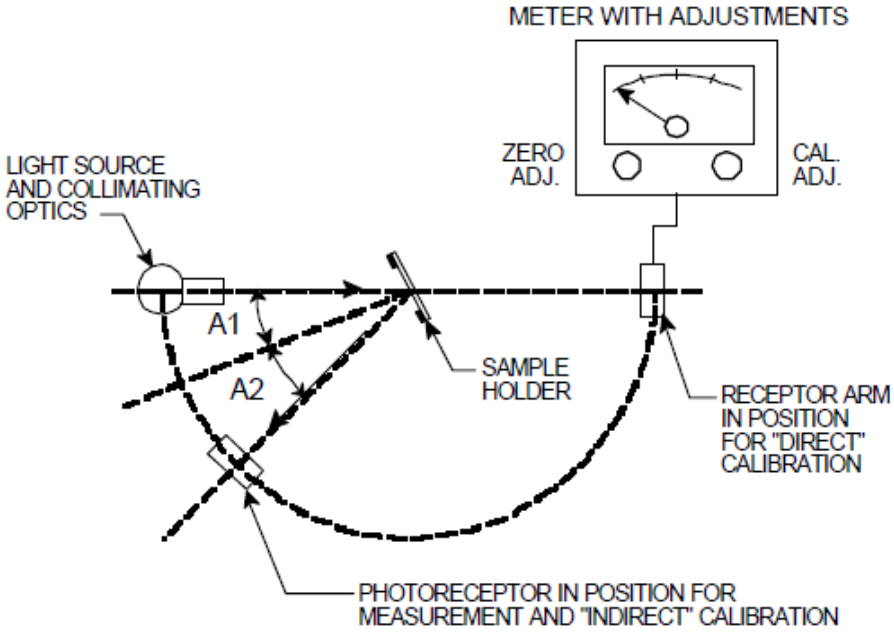


FIGURE 4

GENERALIZED REFLECTOMETER, INCORPORATING
AN INTEGRATING SPHERE IN RECEIVER

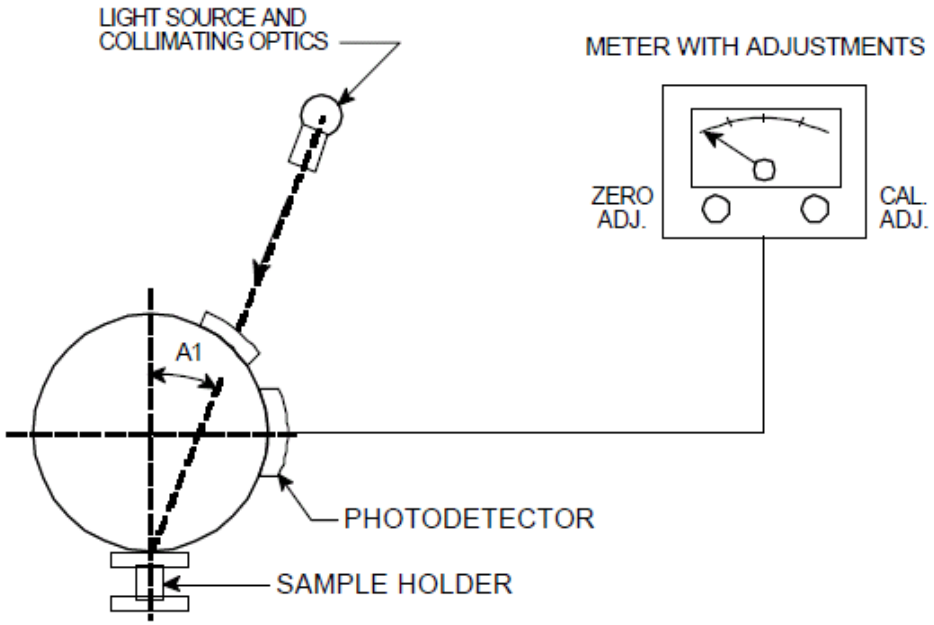


FIGURE 5

5. Direct Calibration Method

The direct calibration method is for those instruments which are so constructed as to permit calibration at the 100% point by swinging the photoreceptor arm to a position directly on the axis of the light source.

It may be desired in some cases (such as, when measuring low reflective surfaces) to use an intermediate calibration point neutral density filter of known transmission value inserted in the optical path. The calibrate control will then be adjusted until the meter reads the percent transmission of the neutral density filter. This filter must be removed before making any reflectivity measurement.

6. Indirect Calibration Method

The indirect calibration method is for those instruments with a fixed photoreceptor arm and thus requires a properly calibrated and maintained reference mirror standard.

7. Flat Mirror Measurement

Reflectance of flat mirror samples is measured on instruments which employ either the direct or indirect calibration method. The reflectance value is read directly from the instrument indicator meter.

8. Non-flat (Convex) Mirror Measurement

Reflectance of non-flat (convex) mirror measurement requires the use of instruments which incorporate an integrating sphere in the receiver unit. The reflectance value is read directly from the instrument indicating meter.

REFLECTANCE TEST PROCEDURE

1. Conduct test with mirror in the day mode.

2. The mirror is mounted in a special holder.

3. The photoreceptor is mounted such that light from the light source is directly received as shown in **Figure 6.**

4. Five measurements are made. After each measurement, the photoreceptor is moved and then realigned such that the meter reading is a maximum.

5. The mirror in the sample holder is placed to receive the light beam as shown in **Figure 4**.

6. The photoreceptor is located such that only light reflected from the mirror is received, normal to the photoreceptor surface.

7. Five measurements are made, each time adjusting the photoreceptor to maximize the reading.

8. The direct light readings are averaged.

9. The reflected light readings are averaged.

10. The percentage of light reflected is computed and the reflectance determined.

11. Repeat test with the mirror in the night mode, if so equipped.

12. If a multiple reflectance mirror remove all electrical power and adjust manually to day mode position, if so equipped. Repeat test for the day mode requirement. (For multiple reflectance mirrors obtain instructions from the COTR concerning the manufacturer's recommended procedure for obtaining "day mode" and "night mode" position settings.)

13. All measurements shall be recorded and calculations performed as called for on Data Sheet 4. An average reflectance value is calculated for each single reflectance mirror and for the daytime and nighttime modes of the inside rearview mirror.

F. BREAKAWAY TEST – INSIDE REARVIEW MIRROR (Data Sheet 5)

Note: If the rearview image for backing maneuvers is displayed in the inside rearview mirror, this test should be conducted after completion of the rearview image Testing as described in 13.2 below.

REQUIREMENTS (S5.1.2)

If the mirror is in the head impact area, the mounting shall deflect, collapse, or break away without leaving sharp edges when the reflective surface of the mirror is subjected to a force of 400 N (90 lb) in any forward direction that is not more than 45 degrees from the longitudinal direction.

SUGGESTED TEST EQUIPMENT

1. Head Form

The head form used shall conform to the specifications shown in Figure 6.

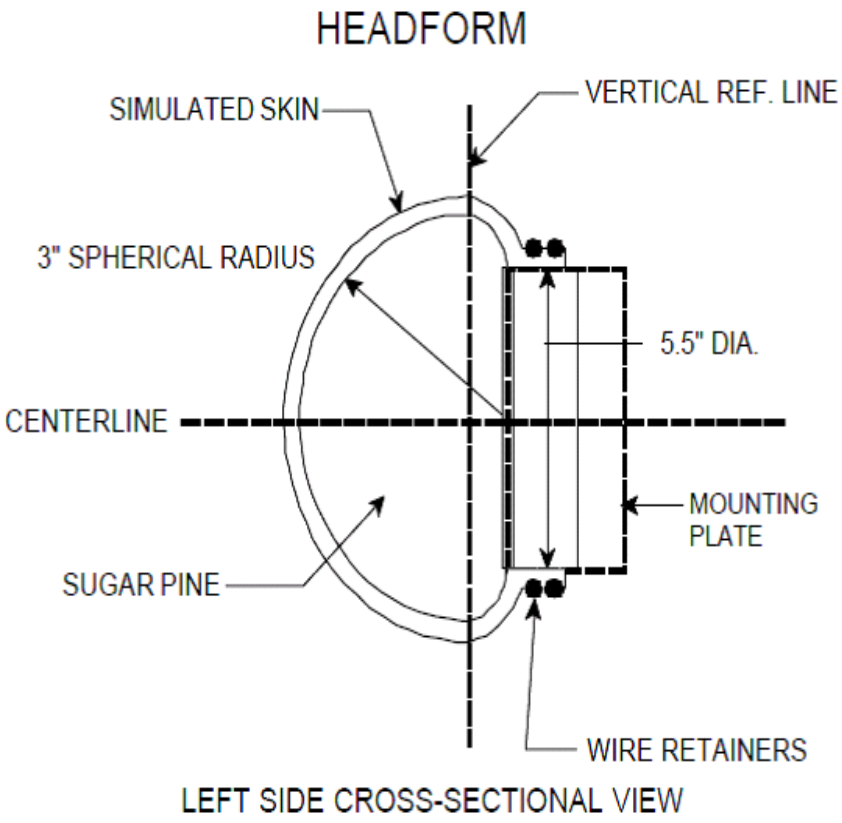


FIGURE 6

Note: Skin and Underlayer Characteristics — Animal skin such as Napa goat skin or wet chamois may be used. When this type of skin is used the skin thickness requirement does not apply. Headform specifications:

Simulated Skin —
Thickness = 0.030 inches, ± 0.003 inches
Tensile Strength = 1,000 psi ± 5 percent
Elongation = 100 percent, ± 5 percent
Penetremeter = 16 to 18

Synthetic Underlayer —
Thickness = 0.250 inches, ± 0.025 inches
Tensile Strength = 250 psi, ± 10 percent
Elongation = 50 percent, ± 10 percent
Penetremeter = Not Applicable

Sugar Pine shall have grain direction perpendicular to base, 4,000 to 5,000 lb on 1 in^2 parallel to grain to appreciable crush.

2. Loading Ram
   The loading ram shall produce a load of up to 534 N (120 pounds) over a stroke length of a minimum of 25.4 cm (10 inches), and provide a displacement rate of 5.08 cm (2 inches) per minute, plus or minus 5.08 mm (0.2 inch) per minute.

3. Displacement Transducer
   Capable of measuring displacement over a range from 0 to at least 30.5 cm (12 inches) of continuous stroke.

4. Force Transducer
   Capable of measuring force over a range from 0 to at least 534 N (120 pounds) with the load continuously applied.

5. Vernier Protractor

6. Recorder
   Oscillograph or computer system capable of permanently recording r force-displacement plots.

BREAK-AWAY TEST PROCEDURE

1. The inside mirror assembly shall be examined for possible modes of failure to be utilized in the breakaway test. Describe on Data Sheet 5, and photograph these positions that differ from the general positions.

2. Mount the attachment plate to a firmly supported rigid plate as shown in Figure 8. The plate will be positioned in a plane that is within ± 1 of the angle of the windshield (at the mirror attach location) relative to a horizontal plane.

3. In conjunction with the COTR, select seven (7) directions for application of the 400 n (90 lb) load. The load directions including the possible failure modes selected from the examination of the mirror assembly will be selected to ensure that the mirror support is evaluated in the most critical mode. If selected directions provide no advantage to the evaluation of compliance, the following general load directions will be used:

   [a] 0 / 90 — vertical angle is 0
   horizontal angle is 90
   through the centerline
   of the support shaft

[b] 45 / 90 — vertical angle is 45
horizontal angle is 90

[c] -45 / 90 — vertical angle is -45
horizontal angle is 90

[d] 45 / 45 — vertical angle is 45
horizontal angle is 45

[e] -45 / 45 — vertical angle is -45
horizontal angle is 45

[f] 45 / -45 — vertical angle is 45
horizontal angle is -45

[g] -45/-45 — vertical angle is -45
horizontal angle is -45

Note: For reference, when the centerline of the ram has a horizontal angle of 90 it parallels with the vehicle's longitudinal center line.

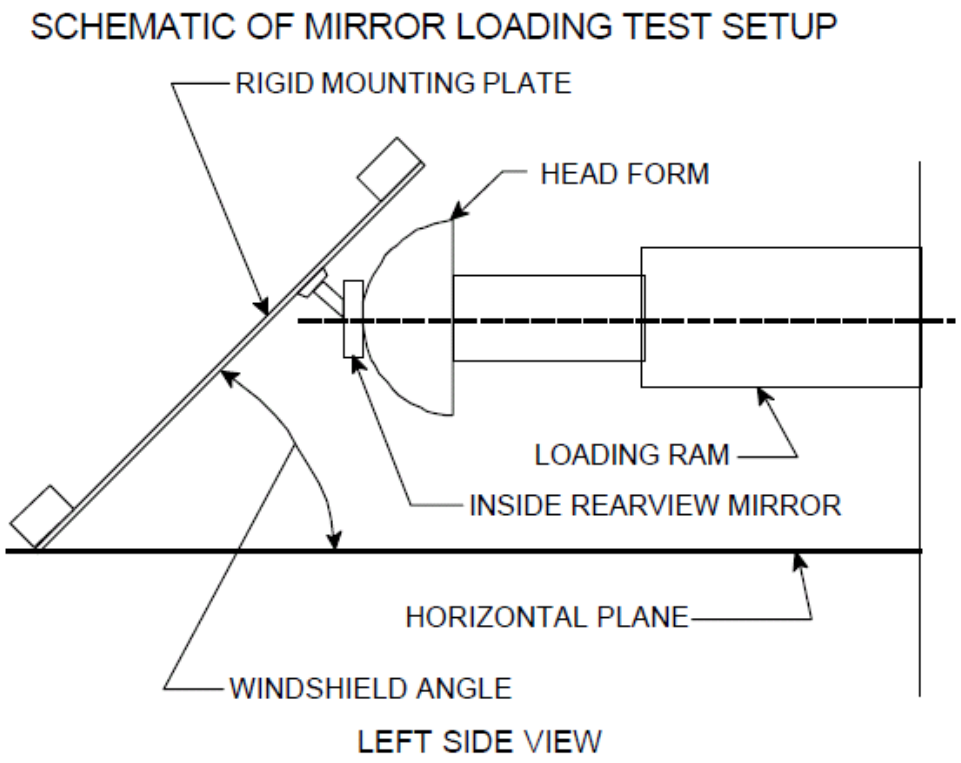


FIGURE 7

4. For each of the 7 selected load directions, apply the load as follows:

[a] Tilt the mirror such that the reflective surface is in a vertical plane perpendicular to the horizontal plane as shown in **Figure 7.** Note that the mirror is not tested in vehicle.

[b] Position the loading ram with the ram centerline in the required direction and place the head form in contact with the reflective surface at the center of the mirror as shown in **Figures 8 and 9.**

[c] Actuate the ram to apply load to the mirror at a rate not to exceed 5.08 cm (2 inches) per minute. Test force is not to exceed 534 n (120 pounds) in the event of a failure i.e. mirror does not break-away. Record the displacement and force as the load is applied.

[d] Display displacement vs time and force vs time, on an oscillograph or computer system. Place the input of the displacement and force time histories to an X-Y plotter for evaluation and reporting purposes as shown in **Figure 10**.

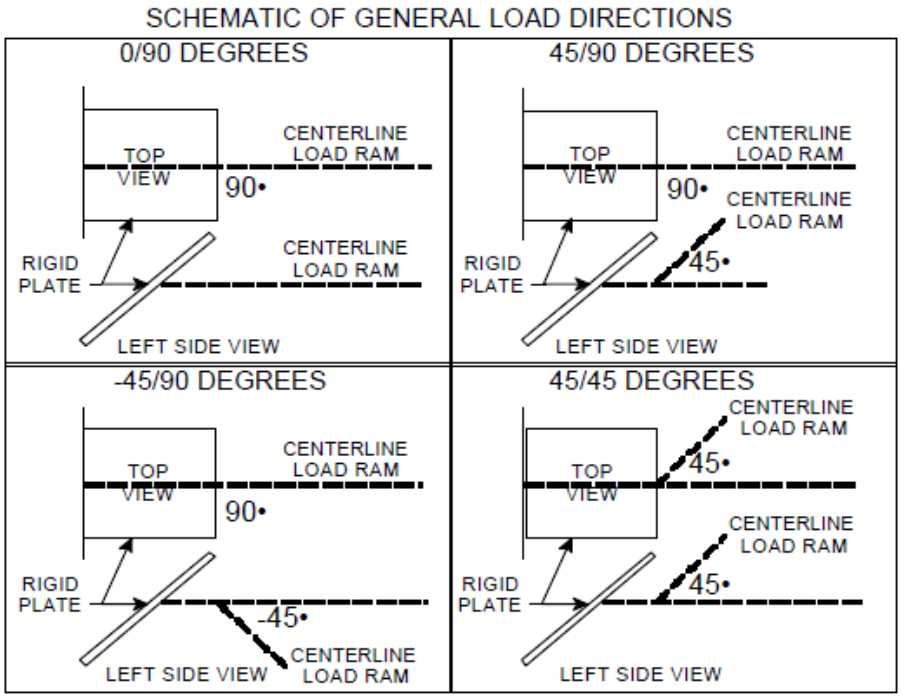


FIGURE 8

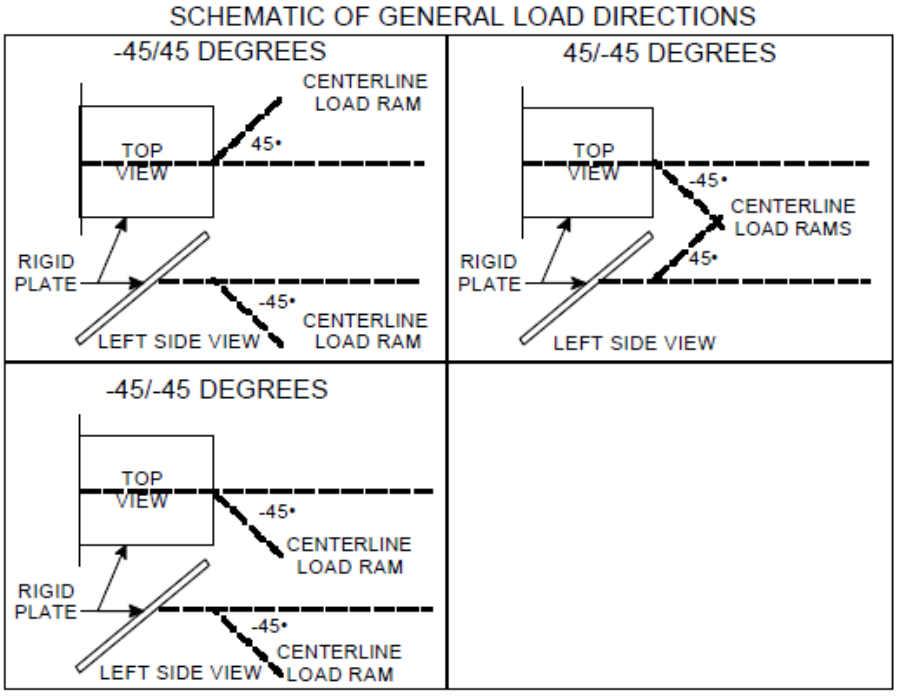


FIGURE 9

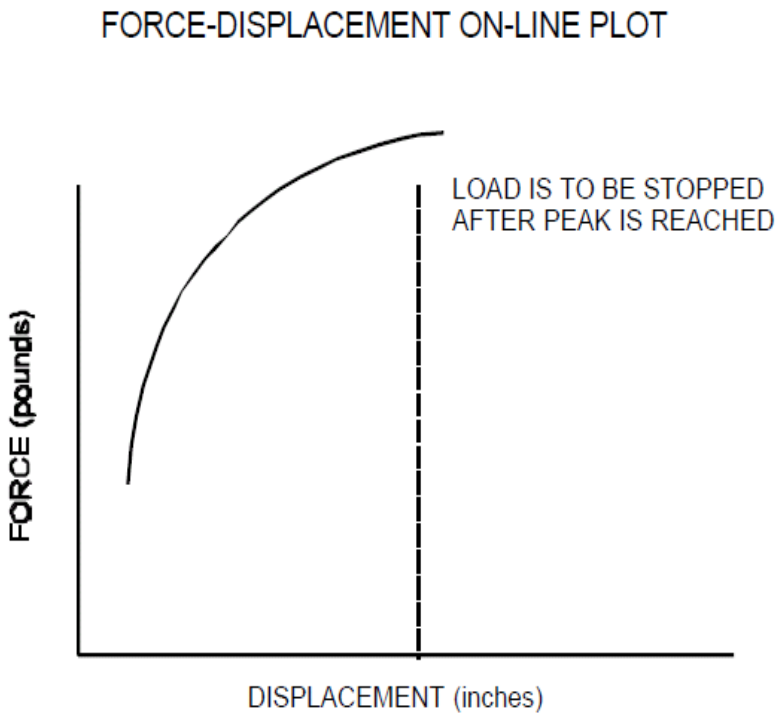


FIGURE 10

[e] Continue to apply the load until a decrease in force with further displacement is noted or until the 400 N (90 pounds) force is exceeded (up to 534N) without the mounting deflecting, collapsing or breaking away.

G. UNIT MAGNIFICATION AND CONVEX MIRROR TESTS: ALL MIRRORS, ALL VEHICLES (Data Sheet 6)

REQUIREMENTS FOR PASSENGER CARS (S5.3 and S5.4)

The driver's side rearview mirror and the inside rearview mirror shall be unit magnification. If the field-of-view requirements are not met with the inside rearview mirror then the passenger's side rearview mirror is required. It can be either unit magnification or convex.

If the passenger's side mirror is convex, the average radius of curvature shall be not less than 889 mm (35 inches) and not more than 1651 millimeters (65 inches) and shall not deviate from the average by more than plus or minus 12.5 percent. The convex mirror shall have permanently and indelibly marked at the lower edge of the mirror's reflective surface in letters not less than 4.8 mm (3/16 inch) nor more than

6.4 mm (0.25 inch) high the words, "**Objects in Mirror Are Closer Than They Appear**."

SUGGESTED TEST EQUIPMENT

A 3-point linear spherometer with two outer fixed legs 38 mm (1.5 inches apart and one inner movable leg at the mid-point. The spherometer should have a dial indicator with a scale that can be read accurately to 0.0025mm (0.0001 inches), with the zero reading being a flat surface.
Note: English units are necessary to enable use of Table 1.

RADIUS OF CURVATURE TEST PROCEDURE (S12.)

1. Visually inspect mirror for any discontinuities.

2. Using a 3-point linear spherometer measure the radius of curvature at the 10 test points indicated in **Figure 11**. The 10 test positions consist of two positions at right angles to each other at each of five locations. The locations are at the center of the mirror, at the left and right ends of a horizontal line that bisects the mirror and at the top and bottom ends of a vertical line that bisects the mirror. None of the readings are within a 6.4 mm (0.25 inch) border on the edge of the image display. At each position, hold the spherometer perpendicular to the mirror surface and record the reading on the dial indicator to the nearest 0.0025 mm (0.0001 inch).

3. Convert the dial reading data for each of the 10 test positions to radius of curvature measurements in millimeters using Table 1 of this procedure. Consider the changes as linear for dial readings that fall between two numbers in Table 1.

   Note: If dial indicator is graduated in metric units, all the radius of curvature values in Table 1 are invalid.

4. Calculate the average radius of curvature by adding the 10 radius of curvature measurements and dividing by 10.

5. Determine the numerical difference between the average radius of curvature and each of the 10 individual radius of curvature measurements in (C) above.

6. Calculate the greatest percentage deviation by dividing the greatest numerical difference determined in (E) by the average radius of curvature and multiply by 100.

7. Inspect the convex mirror on the lower edge of the mirror's reflective surface for the words, "**Objects in Mirror Are Closer Than They Appear**."

8. Measure the height of the words on the convex mirror with a finely graduated ruler.

9. Record results of both flat and convex mirror tests on Data Sheet 6.

LOCATION OF TEN CONVEX MIRROR TESTING POSITIONS

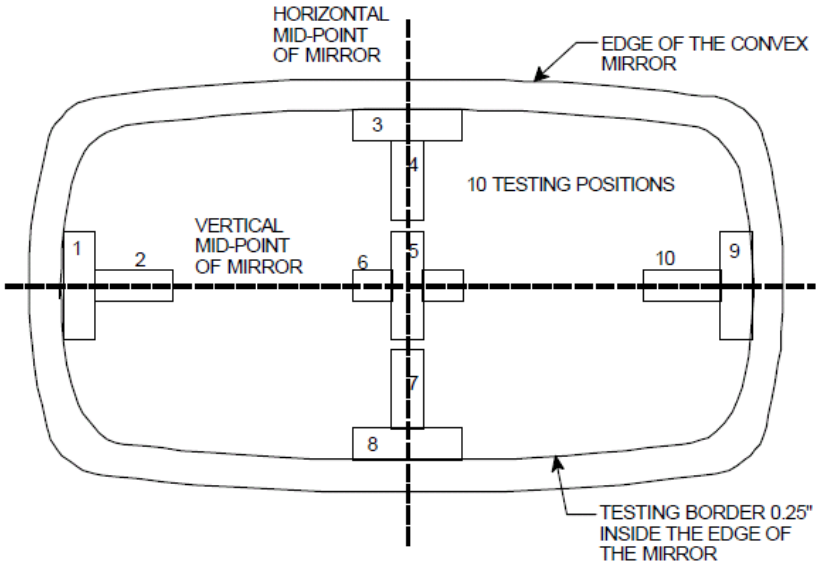


FIGURE 11

TABLE I
CONVERSION TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

Dial Reading (inches)	Radius of Curvature (inches)	Radius of curvature (mm)	Dial Reading (inches)	Radius of Curvature (inches)	Radius of curvature (mm)	Dial Reading (inches	Radius of Curvature (inches	Radius of curvature (mm
.00330	85.2	2164.1	.00822	34.2	868.7	.01700	16.6	421.6
.00350	80.4	2042.9	.00850	33.1	840.7	.01750	16.1	408.9
.00374	75.2	1910.1	.00878	32.0	812.8	.01800	15.6	396.2
.00402	70.0	1778.0	.00906	31.0	787.4	.01860	15.1	383.5
.00416	67.6	1717.0	.00922	30.5	774.7	.01910	14.7	373.4
.00432	65.1	1653.5	.00938	30.0	762.0	.01980	14.2	360.7
.00450	62.5	1587.5	.00960	29.3	744.2	.02040	13.8	350.5
.00468	60.1	1526.5	.00980	28.7	729.0	.02100	13.4	340.4
.00476	59.1	1501.1	.01004	28.0	711.2	.02160	13.0	330.2
.00484	58.1	1475.7	.01022	27.5	698.5	.02250	12.5	317.5
.00492	57.2	1452.9	.01042	27.0	685.8	.02340	12.0	304.8
.00502	56.0	1422.4	.01060	26.5	673.1	.02450	11.5	292.1
.00512	54.9	1394.5	.01080	26.0	660.4	.02560	11.0	279.4
.00522	53.9	1369.1	.01110	25.3	642.6	.02680	10.5	266.7
.00536	52.5	1333.5	.01130	24.9	632.5	.02810	10.0	254.0
.00544	51.7	1313.2	.01170	24.0	609.6	.02960	9.5	241.3
.00554	50.8	1290.3	.01200	23.4	594.4	.03130	9.0	228.6
.00566	49.7	1262.4	.01240	22.7	576.6	.03310	8.5	215.9
.00580	48.5	1231.9	.01280	22.0	558.8			
.00592	47.5	1206.5	.01310	21.5	546.1			
.00606	46.4	1178.6	.01360	20.7	525.8			
.00622	45.2	1148.1	.01400	20.1	510.5			
.00636	44.2	1122.7	.01430	19.7	500.4			
.00654	43.0	1092.2	.01480	19.0	482.6			
.00668	42.1	1069.3	.01540	18.3	464.8			
.00686	41.0	1041.4	.01570	17.9	454.7			
.00694	40.5	1028.7	.01610	17.5	444.5			
.00720	39.1	993.1	.01650	17.1	434.3			
.00740	38.0	965.2						
.00760	37.0	939.8						
.00780	36.1	916.9						
.00802	35.1	891.5						

H. MULTIPURPOSE PASSENGER VEHICLES, TRUCKS AND BUSES (OTHER THAN A SCHOOL BUS) Applicable Data Sheets 1-7:

REQUIREMENTS

Each multipurpose passenger vehicle, truck and bus, other than a school bus, with a GVWR of 4,536 kg or less shall have either (S6.1):

(1) Mirrors conforming to the passenger car requirements, or

(2) Outside mirrors of unit magnification, each with not less than 126 cm^2 (19.5 in^2) of reflective surface, installed with stable supports on both sides of the vehicle, located so as to provide the driver a view to the rear along both sides of the vehicle, and adjustable in both the horizontal and vertical directions to view the rearward scene.

Each MPV, truck and bus, other than a school bus, with a GVWR of more than 4,536 kg shall have (S7.1 and S8.1):

an outside mirrors of unit magnification, each with not less than 323 cm^2 (50 in^2) of reflective surface, installed with stable supports on both sides of the vehicle. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the vehicle and shall be adjustable both in the horizontal and vertical directions to view the rearward scene.

PROCEDURE

Repeat applicable passenger car mirror tests A - G and if required, measure the surface area of each outside rearview mirror on both sides of the vehicle, and verify driver view to the rear along both sides of the vehicle.

I. MOTORCYCLES (Applicable Data Sheets 1 – 7)

REQUIREMENTS

Each motorcycle shall have either a mirror of unit magnification with not less than 8065 mm^2 of reflective surface, or a convex mirror with not less than 6450 mm^2 of reflective surface and an average radius of curvature not less than 508 mm and not greater than 1524 mm installed with a stable support mounted so that the horizontal center of the reflective surface is at least 279 mm outward of the longitudinal centerline of the motorcycle. The mirror shall be adjustable by tilting in both the horizontal and vertical directions.

PROCEDURE

Repeat applicable passenger car mirror tests A - G and measure the surface area and where necessary, the radius of curvature of each rearview mirror. Verify horizontal center of reflective surface is a least 279 mm outward of the longitudinal centerline of the motorcycle.

13.2 REARVIEW IMAGE TESTING

Passenger cars, multipurpose passenger vehicles, trucks, and buses with a GVWR of 4536 kg or less and low speed vehicles shall be subjected to testing in the order below:

Note:
Parenthesis e.g. (S5.5.1) refer to Sections in Standard PART 49 CFR 571, FMVSS 111

A. Inspection

B. Field-of-View Test

C. Test Object Image Size

D. Response Time

E. Linger time

F. Deactivation

G. Default View

H. Durability

1. Corrosion Conditioning followed by:
    A. Field –Of-View Test
    B. Test Object Image Size Test

2. Humidity Conditioning followed by:
    A. Field –Of-View Test
    B. Test Object Image Size Test

3. Temperature Conditioning followed by
    A. Field –Of-View Test
    B. Test Object Image Size Test

A. INSPECTION (Data Sheet 8)

1. Reinstall driver seat to manufacturer specifications if removed for the rearview mirror testing in Section 13.1 above. Remove vehicle support jacks if previously used to stabilize vehicle.

2. Inspect the rearview image display, camera, and the installation and mounting of the outside rearview camera. Note any evidence of defects or imperfections.

3. Verify that the rear visual image is detected by a single source e.g one camera, and that the image is displayed at one location.

4. Identify the location of the inside visual display (located within the interior rearview mirror, center console, etc.) If the visual surface is not directly accessible e.g. visual display is behind a curved, clear sheet of plastic, this should be noted. This protective surface may need to be removed so that the ruler for image size testing can be placed as close to the visual display surface as possible to promote measurement accuracy.

5. Record, if identifiable, the display manufacturer and model.

6. Document the rearview display dimensions for height, width, and diagonal. Measure the tilt angle of the display with reference to ground.

7. Record if display is part of a multifunction display.

8. Verify that the interior display meets the manufacturer's specification as described in the Vehicle Owner's Manual.

9. Determine if any adjustments can be made to the visual display for contrast, brightness, or resolution prior to or after initiation of a backing event. Modification made by the operator to the display output prior to or after initiation of a backing event such as brightness lowered to non-visible condition, must not inhibit the display with complying with the standard. During the backing event the image can be modified provided the initial default image is compliant.

10. Determine if the rearview image camera system can be disabled.

11. Document if the interior display mounting is adjustable i.e. rotation, telescoping, etc.

12. Document if display is recessed and if so, record how raised, and time required.

13. Indicate if transmission gear selector is lever type, rotational, or pushbutton.

14. Is the transmission gear selector recessed and not functional until fully raised? If so, indicate method to raise and time required.

15. Start and stop the engine and place into reverse and other gear positions multiple times and record whether the rearview image appears in any gear position other than reverse.

16. Document if default rearview image can be set to standard, or wide angle etc.

17. Determine and record if the system automatically generates an overlay on the visual display of the Rearview image such as path projection, wire grid, messages, etc. Identify if the overlay varies based on steering wheel input.

18. Determine and record if the default rearview image can be modified by the driver once displayed by the addition of overlays, wide angle view, bird's eye view, turn off, path projection, messages, split screen (allowed if required image is also present) etc. and how is it accomplished.

19. Measure the height from the ground surface to the center point of the camera lens.

20. Measure the lateral position of the center point of the rearview camera lens with respect to the vehicle centerline.

21. Measure the angle in degrees of the plane of the rearview camera lens with reference to the ground.

22. Determine if any part of the vehicle body extends rearward of the camera lens plane.

23. Is the vehicle equipped with a rear bumper?

24. Is a navigation system part of the rear image display?

25. Determine if there are options for the driver to select various default rearview images prior to the backing event and it that image selected remains for subsequent backing events e.g normal and wide angle. If so, and remains the default view, image must meet the rearview image requirements e.g. field-of-view and test object size.

B. FIELD-OF-VIEW (S5.5.1, S6.2.1, S14**.**1**)** - (Data Sheet 9)

REQUIREMENT:

When tested in accordance with the procedures in S14.1, the Rearview image shall display:

A. a minimum of a 150-mm wide portion along the circumference of each test object located at positions F and G as shown in figures 13 and 14.

   Note: A visible 150-mm wide portion means that the full width of any horizontal segment of the 150-mm vertical stripe must be visible. The entire vertical stripe need not be visible.

B. the full width and height of each test object located at positions A through E as shown in figures 13 and 14.

Notes:
Overlays generated automatically in the default Rearview image at the beginning of the backing event cannot cover any of the required portions of the test objects. This coverage prohibition does not apply to manually activated overlays by the driver after a complying default view.

Complete a separate data sheet 9 for any view such as wide angle, which system can default to at initiation of backing event.

PROCEDURE:

1. Park the vehicle in the test area centered on grid as described in section 12 (Pre-test requirements). Parking brake should be set and wheels chocked as appropriate for the test being conducted.

2. Lighting (S14.1.1)

   Place a photo receptor at the center of the vehicle roof and on the top surface of Cylinder B. Verify that the ambient illumination is evenly distributed from above and is at an intensity of between 7000 lux and 10,000 lux for the roof mounted sensor. Cylinder B measurement is for information purposes. Record the intensity level measured at the two locations. Vehicles without a roof must also comply with this lighting specification and may require that the monitor be equipped with a shading device.

3. Vehicle conditions (S14.1.2):

   Set the tires to the vehicle manufacturers recommended cold inflation pressure.

   Verify that the fuel tank is full.

   Load the vehicle to simulate the weight of the driver and four passengers or the designated occupant capacity, if less. The weight of each occupant (68 kg) is represented by 45 kg resting on the seat pan and 23 kg resting on the vehicle floorboard placed in the driver's designated seating position and any other available designated seating positions. If more than 5 designated seating positions are available (van, large SUV etc.) the 4 passenger weights may be placed in any passenger seat.

   Note:
   If J826 Manikin device is used in this procedure as a driver surrogate to determine eye-point positions and to act as a camera platform, it may have a weight greater than the 68 kg specified (approximately 77 kg). If possible, remove manikin weighted disks to reduce weight to 68 kg. If unable to do so, contact the COTR for further guidance.

Verify rear hatches or trunk lids are closed and latched in their normal vehicle operating condition.

Notes:
Pick-up truck lift gates are closed in normal operating condition.
Bike racks or similar add-ons by a dealer and not supplied as original equipment by the manufacturer are to be removed if obscuring the rear camera view.

If a manufacturer, dealer, distributor, or motor vehicle repair business installs a cap on a pickup truck or similar vehicle that obscures the rear mounted camera, or removes the tailgate that houses the rear camera that was originally provided, the camera must be reinstalled or substituted with a camera that meets the original requirements.

If the vehicle head restraints obstruct a camera or video camera view of the display, especially if placed rearward of the driver to document test, the head restraints may be adjusted or removed prior to testing. (not cited in FMVSS 111)

Regardless of any visual display contrast, brightness, or resolution adjustments made prior to the backing event, once the backing event is initiated, a compliant rearview image is required, e.g. brightness adjustment cannot be made which makes the rearview image not visible. Testing should be conducted with these settings at levels resulting in the most difficult to visualize the test objects.

4. Driver's seat positioning (S14.1.2.5)

Adjust the driver's seat to the midpoint of the longitudinal adjustment range. If the seat cannot be adjusted to the midpoint of the longitudinal adjustment range, the closest adjustment position to the rear of the midpoint shall be used.

Adjust the driver's seat to the lowest point of all vertical adjustment ranges present.

Note:
If the seat cushion has tilt option, set the seat front and rear tilt to the midpoint of the tilt angle.

Using the three-dimensional SAE Standard J826- JUL95 (incorporated by reference, see 571.5) manikin, adjust the driver's seat back angle at the vertical portion of the H-point machine's torso weight hanger to 25 degrees as shown in **Figure 12**. If this adjustment setting is not available, adjust the seat-back angle to the positional detent setting closest to 25 degrees in the direction of the manufacturer's nominal design riding position.

Notes:
If available, the COR will provide to the testing laboratory a manufacturer supplied nominal seat back angle for a 50^{th} percentile male driver and measurement method

which will result in a 25 degree torso weight hanger value for a seated manikin. The Laboratory shall adjust the seat back angle to this provided value, and install the manikin according to the steps described within J286. The FMVSS 208 manikin positioning procedure, which is also based on J286, is provided in APPENDIX 1 for reference purposes. Once manikin is set, if necessary, slowly adjust seat back until the hanger angle is at 25 degrees from vertical. With the manikin in this fixed position, determination of the test reference point can then proceed as described below. If manufacturer initial seat back angle is not provided, the laboratory must adjust seat back to obtain the required 25 degree specification.

The manikin per J826 for this procedure utilizes 95th percentile legs. If unable to position these legs due to length interference, the length of the lower leg and thigh segments of the H-point machine can be adjusted to match FMVSS 216a specifications at 414 and 401 millimeters respectively, instead of the values specified in SAE J826 Table one – 459 mm and 456mm. If leg/knee bolster interference occurs, leg removal with placement of the legs on the seat pan for correct weight may be required for proper manikin positioning. Contact the COR for guidance.

Figure 12 - Measurement of the H-point manikin machine torso weight hanger angle at 22.8 degrees. Adjust to 25 degrees from vertical.

5. Test Object (S14.1.3)

Each test object is a right circular cylinder that is 0.8 m high and 0.3 m in external diameter as shown **i**n **Figure 13**. There are seven test objects, designated A-G which are to be marked as follows:

a. Test objects A, B, C, D, and E are marked with a horizontal band encompassing the uppermost 150 mm of the side of the cylinder.

b. Test objects F and G are marked on the side with a solid vertical stripe of 150 mm width extending from the top to the bottom of each cylinder.

c. Both the horizontal band and vertical stripe shall be of a color that contrasts with both the rest of the cylinder and the test surface.

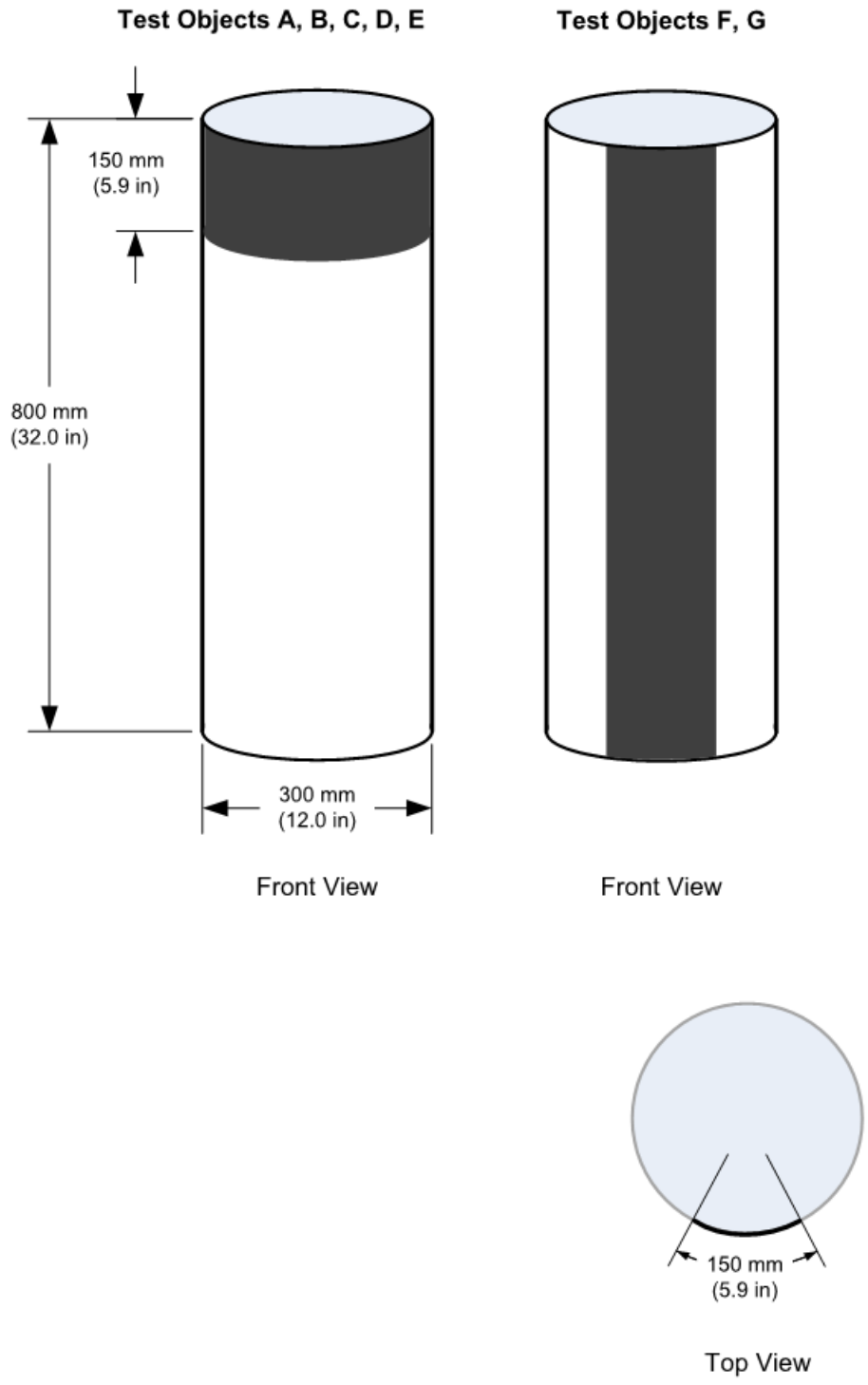
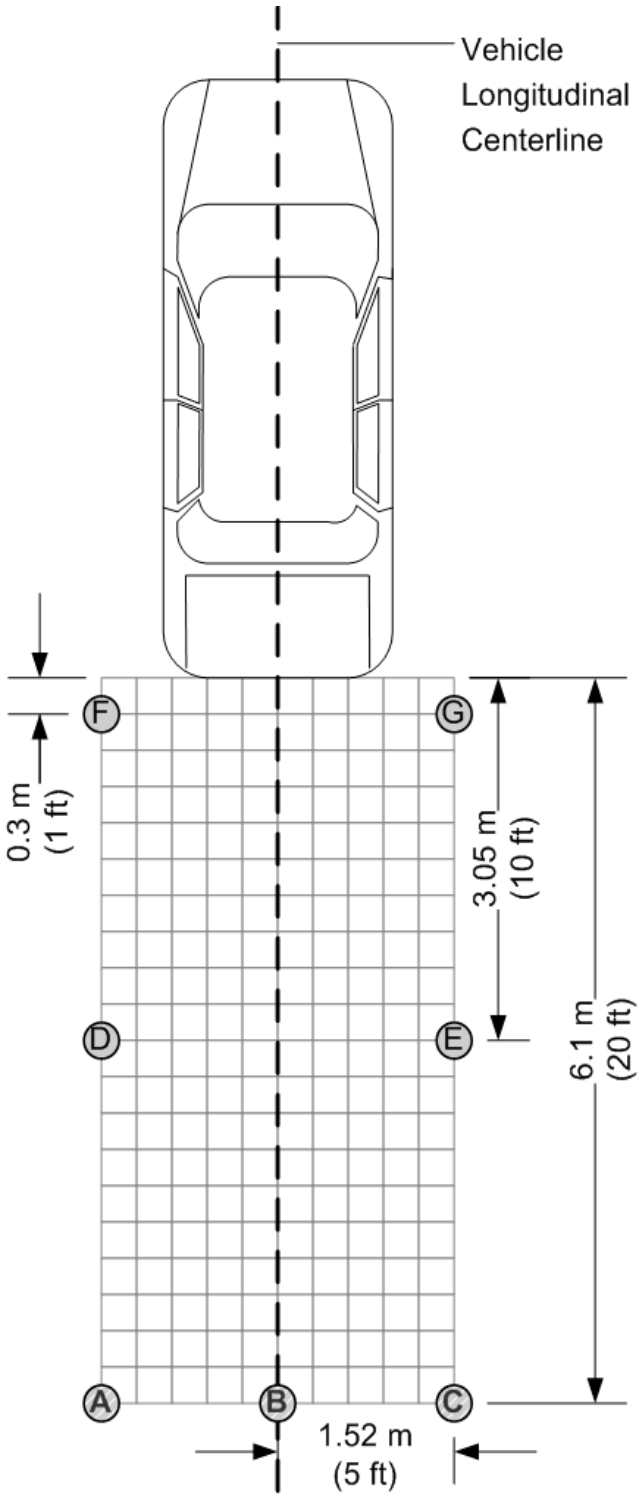


FIGURE 13 - Test Object Dimensions and Markings

FIGURE 14 – CYLINDER TEST OBJECT LOCATIONS



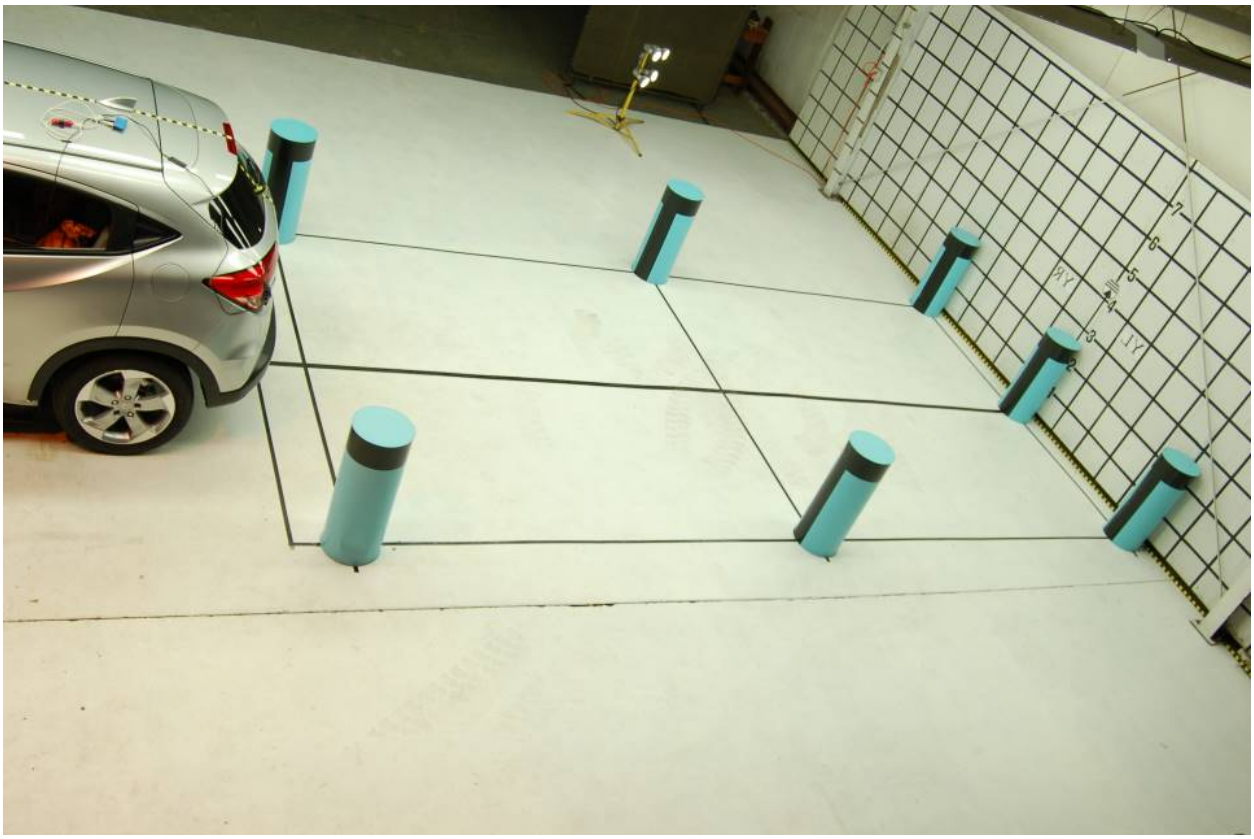


Figure 15 - Overhead view of vehicle and test objects.

6. Test object locations and orientation(S14.1.4)

   a. Place the test objects at locations specified below and illustrated in **Figures 14 and 15**. Measure the distances shown in the figure from a test object to another test object or another object from the cylindrical center (axis) of the test object as viewed from above. Each test object is oriented so that its axis is vertical.

   b. Place test objects F and G so that their centers are in a transverse vertical plane that is 0.3 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

      Notes:
      Vehicles with spare tires or other equipment mounted on the rear of the vehicle still require objects F and G to be positioned 0.3 m to the rear of the bumper.

      For vehicles without a bumper, test objects F and G are positioned 0.3 m to the rearmost surface of the vehicle.

   c. Place test objects D and E so that their centers are in a transverse vertical

plane that is 3.05 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

d. Place test objects A, B and C so that their centers are in a transverse vertical plane that is 6.1 m to the rear of a transverse vertical plane tangent to the rearmost surface of the rear bumper.

e. Place test object B so that its center is in a longitudinal vertical plane passing through the vehicle's longitudinal centerline.

f. Place test objects C, E, and G so that their centers are in a longitudinal vertical plane located 1.52 m, measured laterally and horizontally, to the right of the vehicle longitudinal center line.

g. Place test objects A, D, and F so that their centers are in a longitudinal vertical plane located 1.52 m, measured laterally and horizontally, to the left of the vehicle longitudinal center line.

Note:
Test objects F and G can be rotated so that the vertical 150 mm marking is visible in the Rearview image display.

7. Test Reference Point (S14.1.5)

The test reference point is intended to simulate the location of a 50^{th} percentile male driver's eyes when looking at the Rearview image visual display. This procedure is performed having already established the fixed position of the H-point manikin as described above. To establish this reference point, a fixture to hold the camera is required. The fixture can be fabricated and mounted in place of the manikin neck and should have multiple points of adjustment such that it can be adjusted to lock and hold the camera in a specific position that corresponds to the required eye points. **Figure 16** is an example of a camera mounting system which identifies three views and coordinates (M_f, I, J H). Where applicable, after use of the H-point device, the camera can be positioned and held at the required location using an interior scaffolding or a robotic type arm extending from outside the vehicle.

Obtain the test reference point as follows:

1. Locate the center of the forward-looking eye midpoint (M_f) illustrated in **Figures 17 and 18** so that it is 635 mm vertically above the H point and 96 mm aft of the H point (H).

2. Locate the head/neck joint center (J) so that it is located 100 mm

rearward of M_f and 588 mm vertically above the H point.

3. Draw an imaginary horizontal line between M_f and a point vertically above J, defined as J_2.

4. Rotate the imaginary line about J_2 in the direction of the Rearview image until the straight-line distance between M_f and the center of the visual display used to present the Rearview image reaches the shortest possible value.

5. Define this new, rotated location of M_f to be M_r (eye midpoint rotated).

6. Rotate the camera upward/downward about a horizontal axis through point M_r to simulate eye movement up or down to cause the line of sight to intersect with the center of the Rearview image display.

Note:
The manufacturer may at the request of NHTSA, provide coordinates for M_r (eye midpoint rotated) measured from a vehicle reference body point. For convenience, these coordinates may be used to position camera if COR approval is provided. They also can be used for reference purposes to compare test laboratory installed Manikin derived M_r versus manufacturer data.

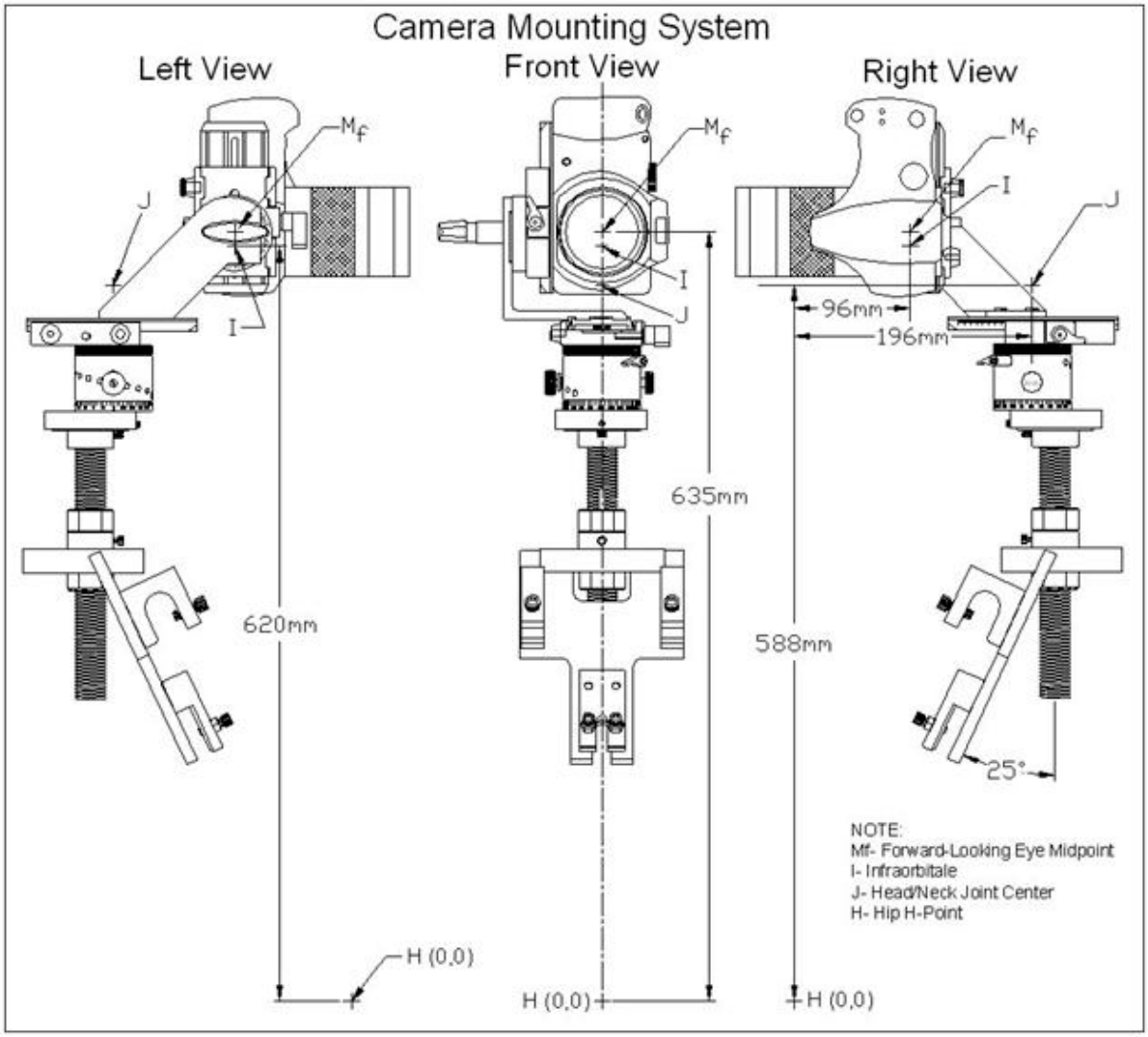


Figure 16 - Camera Mounting System. Three Views, with Coordinates (Mf, I, J, H)

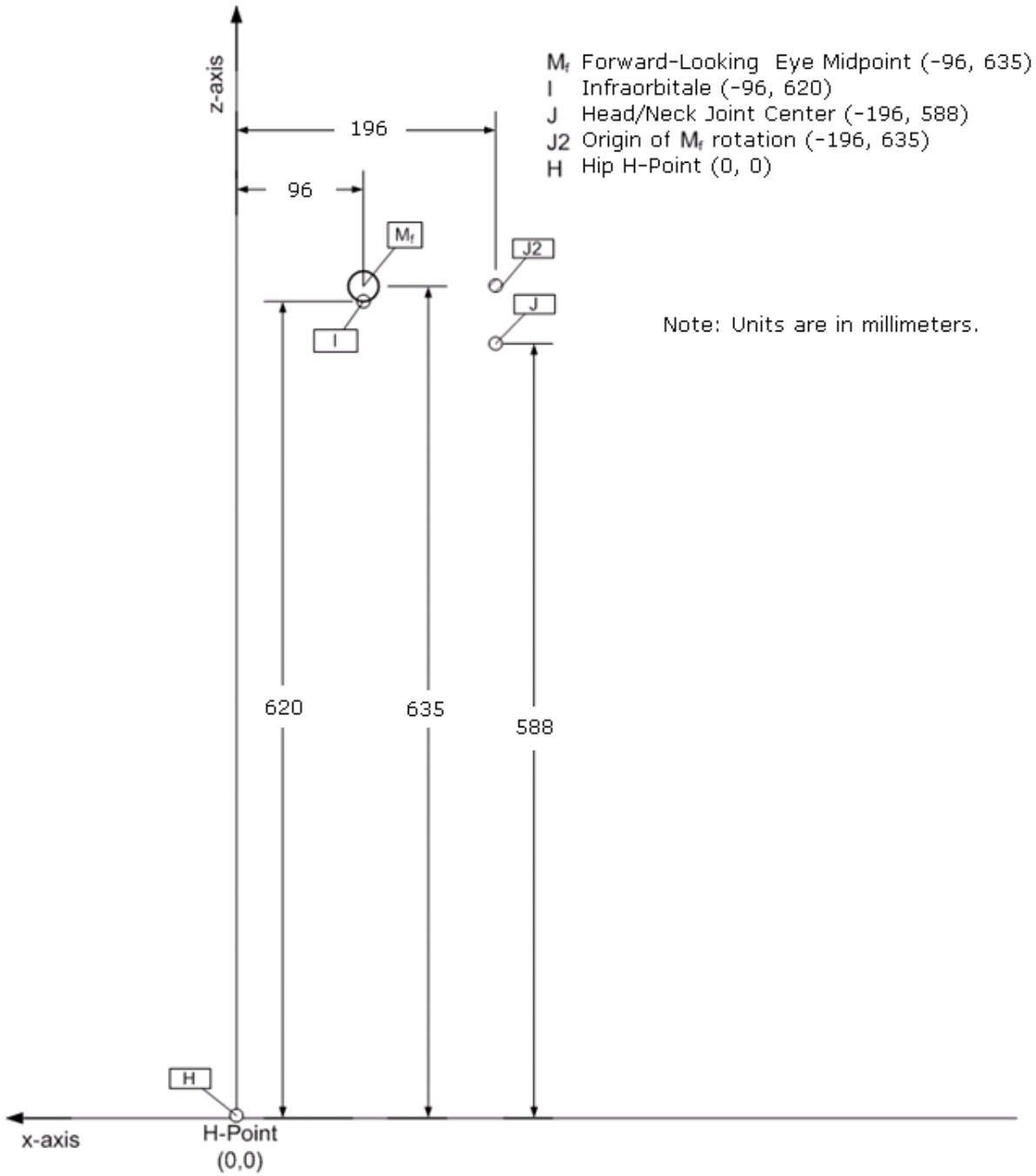


Figure 17 - Eye midpoint location (m_f) in the mid-sagittal plane with respect to h point for forward-looking 50th percentile male driver seated with 25 degree seat back angle.

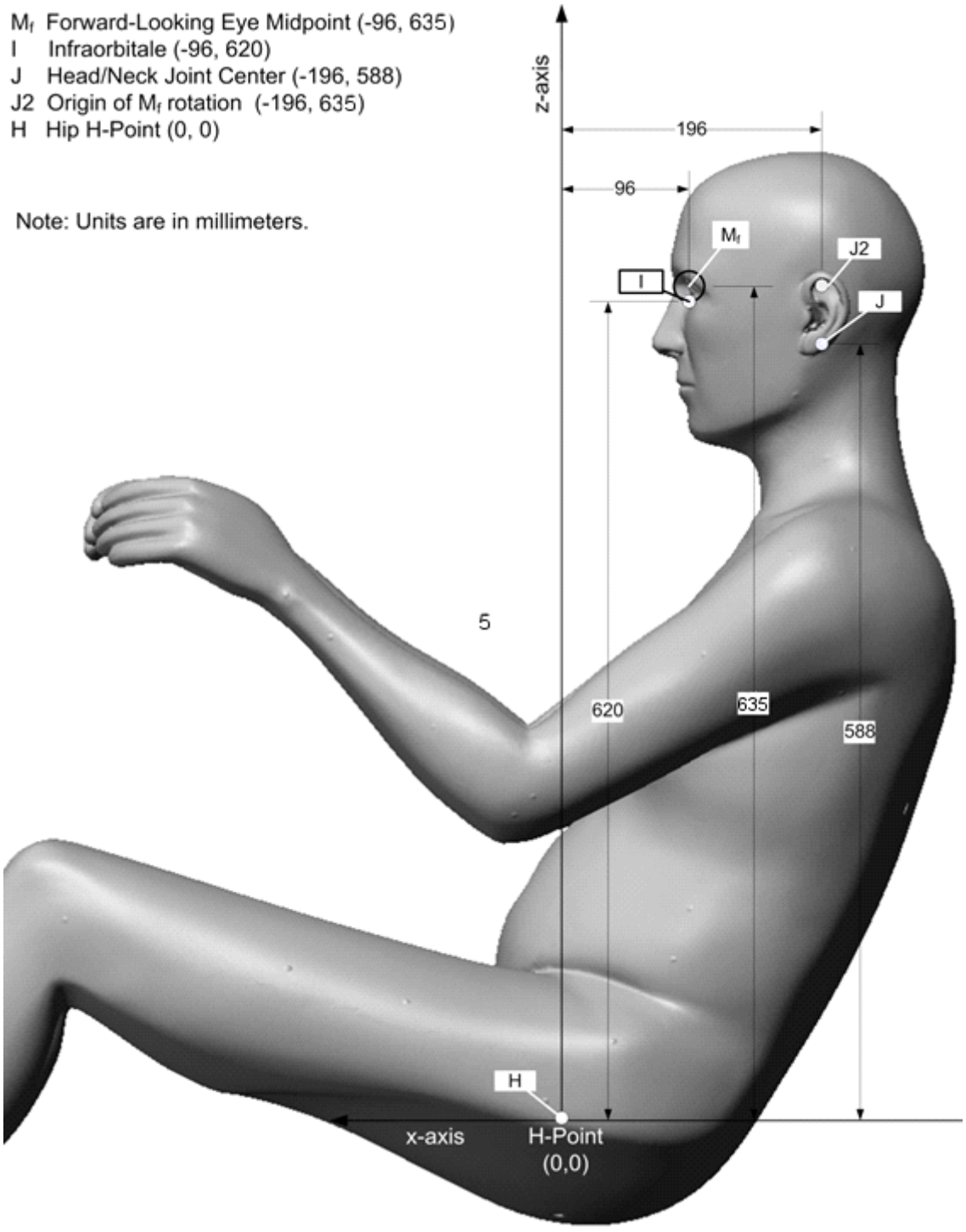


Figure 18 - Coordinates of the forward-Looking Eye Midpoint (MF) and Joint Center (J) of Head/Neck rotation of a 50th percentile male driver with respect to the H-Point in the Sagittal body plane.

Figure 19 – Camera & Mounting fixture on Neck of H-Point Machine

H. Display adjustment (S14.1.6)

If the display is mounted with a rotational adjustment mechanism, adjust the display such that the surface of the display is normal to the imaginary line traveling through M_r and J_2 or as near to normal as the display adjustment will allow. Indicate on data sheet 9 any adjustments made.

I. Steering Wheel Adjustment (S14.1.7)

Adjust the steering wheel to the position where the longitudinal centerline of all vehicle tires are parallel to the longitudinal centerline of the vehicle. If no such position exists, adjust the steering wheel to the position where the longitudinal centerline of all vehicle tires are closest to parallel to the longitudinal centerline of the vehicle.

J. Measurement procedure (S14.1.8)

1. Position a 35 mm or larger format still camera, video camera, or digital equivalent such that the center of the camera's image plane is located at M_r and the camera lens is directed at the center of the display's rearview image **(Figure 19).**

   Note: To make and accurate precise measurement for the test object size in the following section, it is recommended that a very high resolution camera be utilized which is capable of capturing the image screen pixels.

2. Affix a precision quality ruler at the base of the rearview image in an orientation perpendicular with a test object cylinder centerline. Ruler should have a matte finish so as not to cause reflections when taking the data photograph. If the vehicle head restraints obstruct the camera's view of the display, they may be adjusted or removed. (Ruler in frame to be used for test object size below – not necessary for field-of-view compliance determination.)

3. Photograph the image of the visual display with the ruler included in the frame and the rearview image displayed (Include in final report similar to **Figure 20)**.

4. Utilizing the photograph of the Rearview image, verify and record on Data Sheet 9 that:

   - a minimum of a 150-mm wide portion along the circumference of each test object located at positions F and G in **Figure 14** is visible, and

   - the full width and height of each test object located at positions A through E in **Figure 14** is visible.

     Note: A visible 150-mm wide portion means that the full width of any horizontal segment of the 150-mm vertical stripe must be visible. The entire vertical stripe need not be visible.

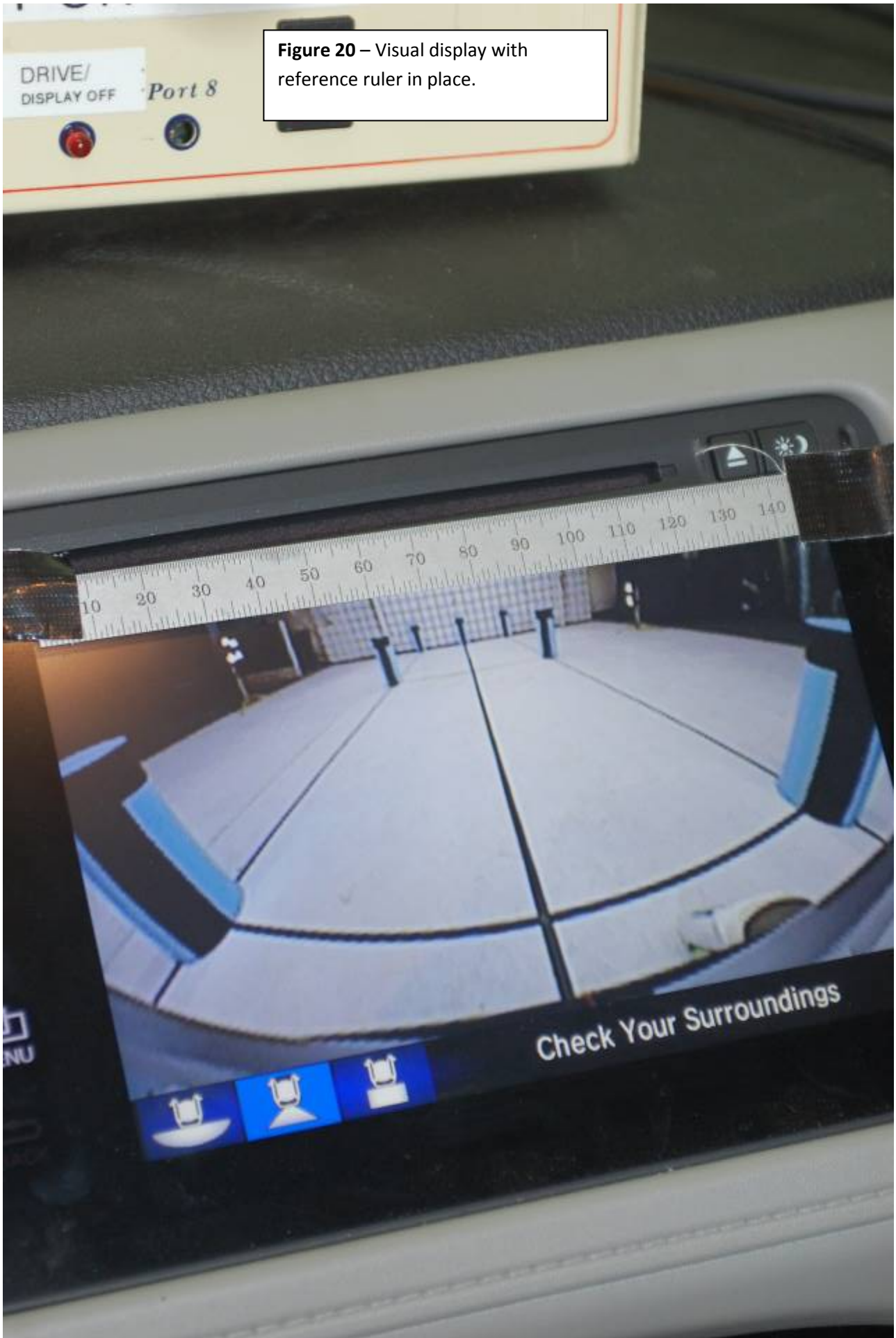


Figure 20 – Visual display with reference ruler in place.

C. TEST OBJECT IMAGE SIZE (S5.5.2, S6.2.2) (Data Sheet 10)

REQUIREMENT:

When the Rearview image is measured in accordance with the procedures in S14.1, the calculated visual angle subtended by the horizontal width of:

- all three test objects located at positions A, B, and C in Figure 14 shall average not less than 5 minutes of arc; and

- each individual test object (A, B, and C) shall not be less than 3 minutes of arc.

This test serves to ensure that a minimum image quality is present, and that the test objects appear large enough for an average driver to quickly determine their presence and nature.

Note:
Complete a separate data sheet 10 for any view such as wide angle, which system can default to at initiation of backing event.

PROCEDURE:

1. Extract photographic data *(*S14.1.8.1)

    a. Using the photograph for Field-of-View determination from above, measure the apparent length of a 50 mm delineated section of the in-photo ruler, along the ruler's edge, closest to the Rearview image and at a point near the horizontal center of the Rearview image.

    b. Using the photograph, measure the horizontal width of the colored band at the upper portion of each of the three test objects located at positions A, B, and C in **Figure 14**. An accurate test cylinder width measurement is critical for determination of compliance to this section of the standard. As such, it is recommended that a very high quality camera be used to take the photograph of the monitor screen, and zoom capabilities should be utilized to obtain the width of the test object by counting pixels. Calipers can also be used as shown in **Figure 21** for test object width measurement.

    c. Define the measured horizontal widths of the colored bands of the three test objects as d_a, d_b, and d_c.

2. Obtain scaling factor (S14.1.8.2)

    Using the apparent length of the 50 mm portion of the ruler as it appears in the photograph, divide this apparent length by 50 mm to obtain a scaling factor. Define this scaling factor as s_{scale}.

3. Determine viewing distance (S14.1.8.3)

   Determine the actual distance from the rotated eye midpoint location (M_r) to the center of the Rearview image. Define this viewing distance as a_{eye}

   Note:
   COR will provide to laboratory the a_{eye} value if available, from manufacturer for comparative purposes.

4. Calculate visual angle subtended by test objects (S14.1.8.4)

   Use the following equation to calculate the subtended visual angles:

$$\theta_i = 60 \sin^{-1}\left(\frac{d_i}{a_{eye} s_{scale}}\right)$$

   where *i* can take on the value of either *test object A, B,* or *C,* and arcsine is calculated in units of degrees.

5. Record results of photographic extraction on Data Sheet 10, verifying that:

   a. all three test objects located at positions A, B, and C average not less than 5 minutes of arc; and

   b. each individual test object (A, B, and C) are not be less than 3 minutes of arc.

   Note:
   If the vehicle has a compliant normal/traditional rear view image displayed which can be modified by the driver such as a wide-angle view, and it appears that all test objects are visible with this wide angle selected, then additional Field-of-View and Test Object Size testing must be conducted with this modified view displayed, to determine if it too, is compliant. This is important when conducting the Default View testing where if this additional view is selected after the backing event has begun, the backing event is then completed/cleared and another event is initiated, this view can be displayed in addition to the normal view as both are compliant. If the wide angle does not meet the field of view and size criteria, then at the start of the next backing event the traditional compliant normal view must appear. The manufacturer may opt to use software programing to allow multiple views (normal and wide angle) to be compliant. If the wide angle (additional view) is measured, then utilize the existing data sheets to record the resulting information.

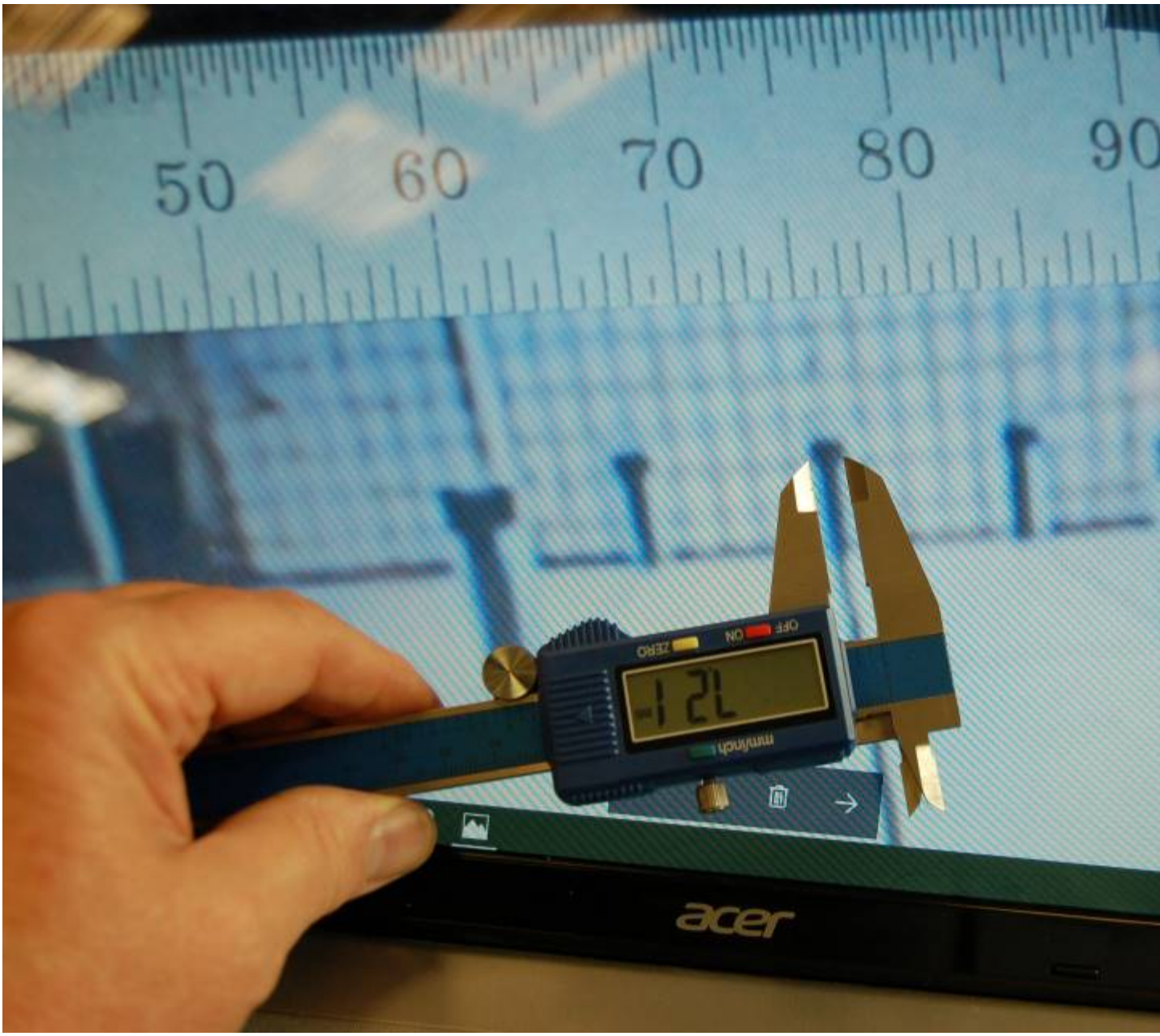


Figure 21 – Digital Caliper test object width measurement. Photographic Pixel calculation can also be used to determine test object width.

D. REARVIEW IMAGE RESPONSE TIME (S5.5.3, S6.2.3, S14.2) (Data Sheet 13)

REQUIREMENT:

The rearview image meeting the requirements of S5.5.1 and S5.5.2 (S6.2.1 and S6.2.2), when tested in accordance with S14.2, shall be displayed within 2.0 seconds of the start of a backing event (transmission gear selector placed into reverse). Note that image

response time testing requires the inside of the vehicle temperature to be between 15^0 C to 25^0 C (59^0 F to 77^0 F).

PROCEDURE:

Prior to positioning the gear selector into reverse and determining response time, a pre-sequence of events must be performed and the timing of those events recorded. The following is provided for determination of the timing for door opening, transmission gear selector placed in reverse, and rearview image displayed. The timing of these events (triggers), should be input into a continuous time recorder.

1. Install a time trigger such as a trip switch, contact switch, or break wire at the door edge/B-pillar intersection, to identify at what point the door is opened (T_0)..

2. Tap into the rear backup lamps signal wiring or affix a photoreceptor to the backup light lens for a time zero trigger source/ indicator, to identify at what point the vehicle transmission gear selector (lever, rotating knob, push button) is placed into reverse. Verify with video or an observer, the time delay, if any, between the gear selector in reverse and the rear backing lights activated. If there is limited to no time delay this light activation can be used to determine when the gear selector is placed in reverse. If there is a delay, mount a contact switch at the transmission shift selector which outputs a voltage signal when selector is placed in reverse(T_1). Identify method utilized and confirm that the signal is occurring simultaneous to the selector being placed into reverse (e.g. reverse light activates without lag time when gear selector placed into reverse).

3. To identify when the rearview image is displayed (T_2), place a photo-receptor with software image recognition on the display which can distinguish between the default splash screen display and the required rearview image. If automatic mode, the aperature at time of image display may respond from closed to full open then back to an intermediate steady-state position. This “focusing” time lag in automatic mode may reduce the accuracy for event timing. Identify method used to determine rearview display activation.

   Another option for the laboratory to obtain the required data, is to incorporate a video recording system as described below:

4. Mount a digital video camera rearward of the driver such that the timing of the driver door opening, door closing, activation of the starting system, transmission shifting into reverse, and the rearview image display activation are visible. Video should have timing marks to allow for frame-by-frame analysis. A known video frame rate can be used to establish timing of events. Placement of a timing device in the video image field e.g. digital meter mounted on vehicle dash, can also be considered for timing determination. Video with sound is another option allowing test observers to announce when the critical events occur. Analysis of the video can then be used to determine event timing. More than one video camera can be used to obtain required

data. For instance, video of driver door, rear image display screen, shifter, and reverse lights can be simultaneously viewed and synchronized for event timing.

5. Position vehicle on test area as described in Section 12 (pre-test requirements) which allows for unobstructed forward and rearward vehicle travel.

6. Verify that the temperature inside the vehicle during this test is at any temperature between 15 and 25 degrees C (59 to 77 F). Record the value.

7. Verify that the vehicle's battery power level is within the nominal operating range for the type of vehicle being tested

8. All components of the rear visibility system must be in the lowest power resting state. Contact COR for manufacturer recommendations for determination of this state. Record what constitutes lowest power resting state.

   For steps 9, 11 and 12 below, record timing of door opening (T_0), gear selector into reverse (T_1), and rearview image display time (T_2).

9. The driver's door is opened to any width and closed. T_0 is the time when the driver's door is first opened. The driver's door is open when the edge of the driver's door opposite the door's hinges is no longer flush with the exterior body panel.

   Note:
   For a vehicle without a driver door such as many LSV'S, the time of door opening is established based on an imaginary door plane which would exist between the vehicle A and B pillars.

10. Immediately activate the starting system.

    For automatic transmission equipped vehicles, the engine is to be started with the shift lever in PARK. For manual transmission equipped vehicles, the engine is to be started with the shift lever in any position other than reverse.

    For an Electric or Hybrid Vehicle (which uses electric motor for initial propulsion), activation of the starting system is equivalent to when the vehicle is energized and is capable or movement as soon as the vehicle is placed in gear and the throttle is depressed. This vehicle condition may be indicated to the driver by illumination of a "Ready" instrument cluster light.

11. Place the vehicle's transmission selector into reverse (the start of the backing event - T_1) in not less than 4 seconds and not more than 6 seconds after the driver's door is opened. Brake application may be required for gear selector movement.

Notes:
To meet the 4 to 6 second time frame specification, an already seated driver with an assistant performing the door opening and closing operation may be necessary.

If vehicle cannot be placed in the reverse gear position within the 6 second time frame due to design constraints, (e.g shift lever/mechanism is recessed with vehicle off, and raises when the vehicle is started - can only function when fully up requiring additional time) contact COR and perform testing as close to the 6 seconds as possible.

During the 4 to 6 second time interval after door opening, there are no specifications for when the sequence of events for door closure, engine activated and reverse gear selected must occur (e.g. time between engine activation and gear selector to reverse).

12. Record the time at which the rearview image is displayed. Repeat 3 times.

    Vehicle must comply with the 2 second response time requirement for image activation with the gear selector having been placed in reverse anytime within the 4 to 6 second post door opening range e.g. must comply at 4.01 seconds and at 5.99 seconds.

E. LINGER TIME **(**S5.5.4, S6.2.4) (Data Sheet 12)

REQUIREMENT:

The Rearview image meeting the requirements of S5.5.1 and S5.5.2 (S6.2.1 and S6.2.2) shall not be displayed after the backing event has ended.

PROCEDURE:

For information purposes, obtain from the COR, if available, which of the following was selected by the manufacturer as to what constitutes the end of the vehicle backing event:

- A forward speed of 10 mph
- A forward distance of 10 meters traveled, or
- A forward motion of continuous duration of 10 seconds.

Notes:
The manufacturer may elect to extinguish the rearview image at any interim time between when the transmission gear selector is moved out of reverse but prior to the end of the backing event which occurs at any of the three events described above. Many systems will extinguish the rearview image immediately after the

gear selector is shifted out of reverse. The driver is permitted to deactivate the rearview image at any time after the start of the backing event provided the compliant view is initially displayed.

The Backing event only ends at one of the three conditions described above. Rearview image extinguished does NOT equate to end of backing event unless it occurs simultaneous to one of the three conditions described, e.g image off immediately at gear selector out of reverse is NOT the end of the backing event – backing event is still in effect.

After the backing event has been initiated, and the vehicle transmission selector is placed into drive, the image can remain visible. However, it must extinguish at the manufacturer option at a forward speed not greater than 10 mph, or travels a distance no greater than 10 meters, or travels continuously forward for a time not exceeding 10 seconds. If for example, the end of the backing event is continuous forward travel for a maximum of 10 seconds, there is no restriction for distance travelled and speed at this 10 second mark.

1. Instrument the vehicle to determine forward vehicle speed, forward distance travelled, and time of continuous forward motion. A time zero needs to be established for when and where the vehicle first begins forward motion.

2. Position the vehicle in an area of sufficient size to allow for vehicle travel in the forward and reverse directions. A floor grid with defined distances marked is recommended.

3. To verify that the rearview image display is not displayed after the end of the backing event proceed as follows:

   Place the vehicle transmission selector into reverse gear and travel in reverse for a short distance. Stop and hold vehicle in this position. Rearview image must be displayed. Place the vehicle transmission selector into a forward gear and travel forward continuously to a speed greater than 10 mph, a distance greater than 10 meters and for a time greater than 10 seconds. Record the speed, distance, and time after the start of forward travel at which the rearview image is extinguished. Verify that the image is extinguished at or prior to the speed, distance or time specified above (regardless of manufacturer selected option). Repeat 3 times.

   Rearview image must not be present after all of the following three conditions are met: vehicle speed reaches 10 mph, after traveling forward 10 meters, and after time elapsed for continuous forward motion of 10 seconds. Extinguishment of image does not equate to end of backing event.

Note:

If it is determined during preliminary review of the vehicle rear visibility system operation that the rearview image is extinguished immediately when the vehicle is removed from the reverse

gear, then the above testing may not be necessary as the image would not be present after all three of the possible backing event termination points had been reached i.e. 10 mph, 10 meters, and travel 10 seconds.

F. DEACTIVATION **(**S5.5.5**,** S6.2.5) (Data Sheet 13)

REQUIREMENT:

The rearview image meeting the requirements of S5.5.1 and S5.5.2 (S6.2.1 and S6.2.2) shall remain visible during the backing event until either:

- the driver modifies the view, or
- the vehicle direction selector is removed from the reverse position.

This test is conducted to verify that once the backing event is initiated (transmission selector into reverse gear), the rearview image cannot be extinguished by any means other than driver intervention which would include the vehicle direction selector being removed from the reverse position. Rearview image must extinguish by end of backing event.

PROCEDURE:

1. Place vehicle transmission selector into reverse gear. Rearview image must be displayed. With vehicle stationary and maintained in reverse, actuate any provided switch/button/touch screen (other than gear selector) control which allows the displayed rearview image to be extinguished or modified**.** Verify the controls functionality. Document and include applicable Owner's Manual pages which describe method for extinguishing or modification. Include if any, what view is displayed e.g. overlays, bird's eye, etc. Repeat 3 times.

2. Place vehicle transmission selector into reverse gear. Rearview image must be displayed. Then place transmission gear selector into a neutral or forward gear**.** If image remains activated, activate any provided switch/button/touch screen control which allows the displayed Rearview image to be extinguished or modified prior to termination of the backing event. Verify the controls functionality. Document and include applicable Owner's Manual pages which describe method for extinguishing or modification. Include what view is displayed e.g. overlays, bird's eye, etc. Repeat 3 times.

3. Place vehicle transmission selector into reverse gear. Rearview image must be displayed. With vehicle maintained in reverse, determine if there is any vehicle conditions absent driver action in which the required rearview image can be modified or extinguished (not permissible).

4. Verify that there is no means by driver or otherwise to deactivate the rearview image from activating prior to the start of the backing event i.e. driver cannot disable the rear visibility system except during the backing event.

C. DEFAULT VIEW (S5.5.6, S6.2.6) (Data Sheet 14)

REQUIREMENT:

The rear visibility system must default to the rearview image meeting the requirements of S5.5.1 and S5.5.2 (S6.2.1 and S6.2.2) at the beginning of each backing event regardless of any modification to the field of view the driver has previously selected.

Note:
If display has driver controlled features such as object detection overlays, path prediction, warning statements, birds eye view, and screen contrast, brightness, resolution etc, which has been initiated during a prior backing event, this test uses the initial view that appears at the start of the subsequent backing event. This default view must comply with the rearview image requirements.

PROCEDURE:

For the following testing, to assure completion/clearing of the backing event regardless of the manufacturers selected option, the vehicle should be driven to a forward speed of at least 10 mph, a forward distance of at least 10 meters, and continuously forward for at least 10 seconds. With all three of these conditions being met, the backing event should, if compliant with the standard, end/clear the backing event. The image cannot be present at the end of the backing event. It is noted that backing event termination and extinguishment of the rearview image are not the same i.e. image can be absent but backing event is still in effect. Upon initiation of another backing event, the required rearview image must appear.

1. Start the vehicle, initiate and complete a backing event (without modifying the image) as described above. Turn off the vehicle and remove the ignition key. Restart the vehicle and initiate a backing event. Verify that the required rearview image is displayed. Repeat 3 times.

2. Start the vehicle, initiate and complete a backing event as described above (without modifying the image) as described above. With engine still running initiate another backing event and verify that for each subsequent backing event, the required rearview image appears. Repeat 3 times.

3. Start the vehicle, and initiate a backing event. During but prior to the end of the backing event, extinguish or modify the rearview image by any means provided to the driver. Complete the backing event as described above. Indicate if modification is made prior to or after gear selection is out of reverse. Identify resulting image – warning message, distance markers, vehicle trajectory, wide angle view, bird's eye etc. Turn off the vehicle, restart, and initiate a backing event Verify that the required default rearview image is displayed and complies with all applicable requirements. Repeat 3 times.

4. Start the vehicle, and initiate a backing event. During but prior to the end of the backing

event, extinguish or modify the rearview image by any means provided to the driver. Complete the backing event as described above. Indicate if modification is made prior to or after gear selection is out of reverse. With engine still operating, initiate another backing event. Verify that the required default Rearview image is displayed and complies with all applicable requirements. Repeat 3 times.

5. Verify that there is no means to deactivate or modify the required rearview image prior to the start of the backing event and that altered condition remains once the backing event starts (not permissible – i.e. Rearview image must always appear at the start of backing event regardless of actions taken prior to backing event.)

Note:

If the vehicle has a compliant normal/traditional rear view image displayed which can be modified by the driver such as a wide-angle view, and it appears that all test objects are visible with this wide angle selected, then additional Field-of-View and Test Object Size testing must be conducted with this modified view displayed, to determine if it too is compliant. This is important when conducting the Default View testing above where if this additional view is selected after the backing event has begun, the backing event is then completed/cleared and another event is initiated, this view can be displayed in addition to the normal view as both are compliant. If the wide angle does not meet the field of view and size criteria, then at the start of the next backing event the traditional compliant normal view must appear. The manufacturer may opt to use software programing to allow multiple views (normal and wide angle) to be compliant.

H. DURABILITY (S5.5.7, S6.2.7) (Data Sheet 15)

REQUIREMENT:

The rearview system shall after environmental conditioning, meet:

A. The field of view requirements of S5.5.1 (S6.2.1) and

B. Test Object Image Size requirements of S5.5.2 (S6.2.2) after each durability test specified in S14.3.1, S14.3.2, and S14.3

This testing is a component level test to environmentally condition (corrosion, humidity, and temperature) the external portion of the rearview imaging system (usually the camera) which is exposed to the elements and then to determine that the system remains functional and continues to comply with the field-of-view and test object image size requirements without degradation in image quality.

PROCEDURE:

1. Note the model and manufacturer of camera, if available.

2. Prior to removal of camera and associated electrical attachments from the vehicle, measure the angle of the camera lens plane with reference to ground, the camera lens center position from the ground, and the lateral position on vehicle.

3. Photograph and examine the sealing method that the camera is affixed to the vehicle, and document on data sheet e.g. camera screwed to vertical portion of trunk with gasket material at interface.

4. Remove the camera and any other portion of the Rearview image system which is exposed to the elements. Carefully detach the camera and undo any electrical connections. (Typical as shown in **Figure 22**)

Figure 22 – Typical camera and associated connector and wiring removed from vehicle.

5. Position the camera in an environmental test fixture as defined in Section 11. Use of manufacturer supplied test fixture is recommended, if available.

6. The portions of the camera not exposed to the elements (usually rear) can be inserted into a cutout portion of a plastic enclosure utilizing the same gasket or sealing method as on the test vehicle. Connectors can be protected and sealed in air tight containers or bags, and if necessary, coated with removable silicon or plastic-dip in the terminal area temporarily. Document and photograph the procedures taken prior to the start of the durability testing to ensure that the cameras and associated wiring are mounted in weatherproof enclosures in a manner and orientation that simulates their original equipment (OE) installation against the vehicle body. (See **Figures 23, 24, and 25** for sample installation)

Figure 23 – Sample plastic environmental enclosure with camera installed.

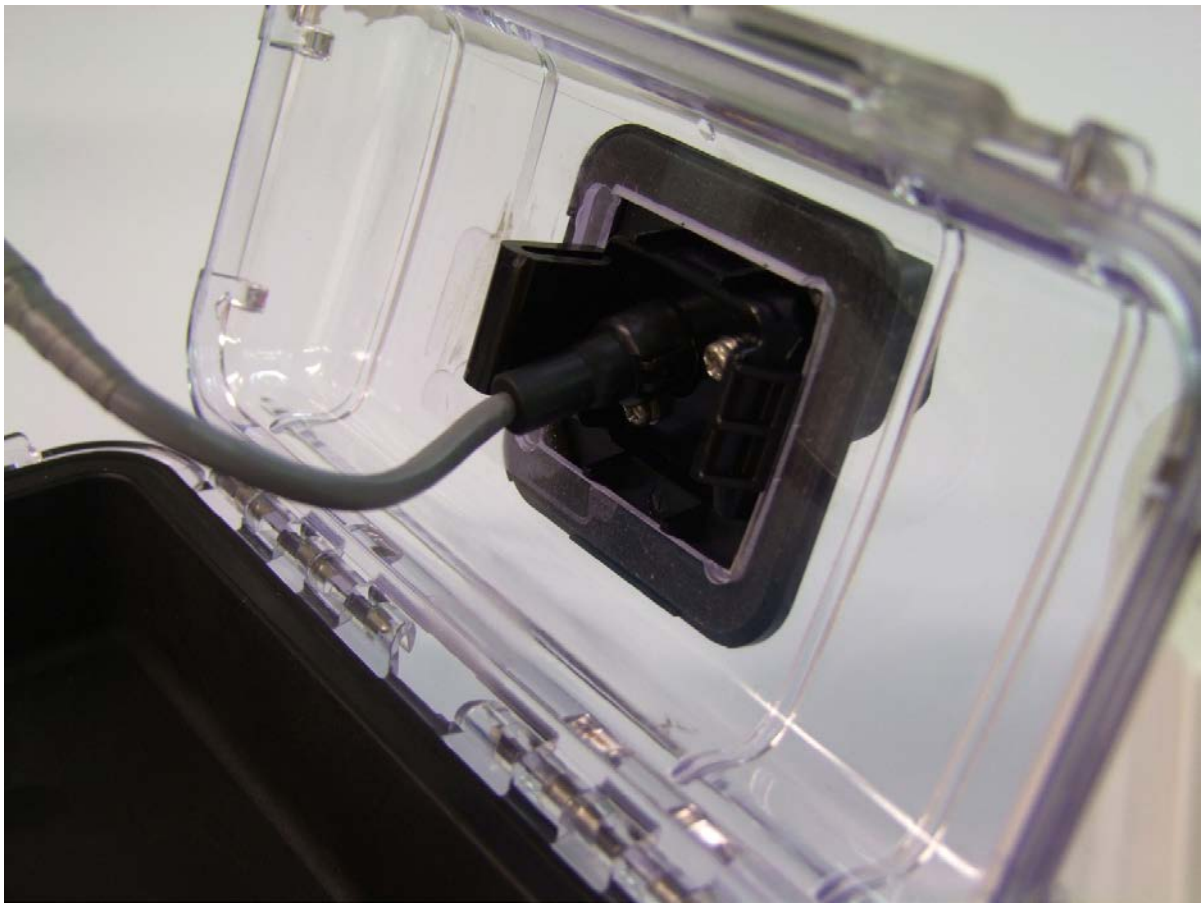


FIGURE 24 – Plastic enclosure from the interior showing camera mounting seal.

Figure 25 – Camera removed from vehicle showing OEM compressible water-tight foam seal on perimeter which would be against vehicle body.

7. Proceed with the Durability/environmental testing as described below with the applicable rear view system components installed in the environmental test fixture. There is no required order for the three environmental tests.

   Note:
   After exposure to each of the three environmental conditions, the rear visibility system component is to be removed from test fixture, reinstalled onto the vehicle and compliance tested for rear-view-image and test object image size. However, with approval of COR, to facilitate the testing, after each of the first two durability tests, the conditioned rear visibility components do not have to be re-installed on the vehicle and tested to field-of-view and image size if there is a means to power up the system to verify that it continues to be operational i.e. bench tested. After the final conditioning test, the camera is to be reinstalled on the vehicle and the rear visibility system field-of-view and test object image size tested. If the outcome of this abbreviated testing results in a failure, the conditioning procedures may need to be repeated to the specific requirement of the standard with a newly purchased camera system. The COR may authorize the test laboratory at the completion of all the environmental testing to reinstall the camera on the vehicle and make a subjective determination that the field-of-view and test object sizing appears to unchanged from the view and sizing from the original un-conditioned camera system test e.g. no fogging or distortion.
   An alternative to the Durability testing procedure above and with approval of the COR, would be to purchase three OE replacement cameras and subject one camera just to corrosion, another camera to corrosion and then humidity conditioning and the third to

corrosion, humidity, and then temperature conditioning. The field-of-view and test object size would then be verified for each of the three conditioned camera systems.

8. Corrosion Conditioning (S14.3.1)

   The external components are subjected to two 24-hour corrosion test cycles. In each corrosion test cycle, the external components are subjected to a salt spray (fog) test in accordance with ASTM B117-73, Method of Salt Spray (Fog) Testing (incorporated by reference, see § 571.5) for a period of 24 hours. Allow 1 hour to elapse without spray between the two test cycles.

   After completion of the corrosion conditioning, photograph the camera, associated wiring, and any other rear image system components environmentally exposed and record any visual anomalies such as corrosion, lens deterioration, water droplets in the camera lens, or wiring/connector deterioration.

   a. Disassemble camera from the environmental test fixture, and reinstall the camera and associated wiring back on the subject test vehicle. The installed rearview system should be positioned and affixed as close to the original configuration as possible. Consult COR if camera reinstallation alignment requires manufacturer specifications.

      Note: The camera exterior lens can be gently wiped clean with a soft cloth to remove surface moisture and particles (equivalent to that found on the vehicle during normal operational use) which may have been deposited during the environmental conditioning.

   b. Start vehicle engine and perform fore and aft vehicle travel to verify that the camera and Rearview image system is operational.

   c. Proceed with post durability verification field-of-view and test object image size testing as described in Compliance Test Execution Sections B and C.

   d. Remove the camera and associated wiring from the vehicle and install back into the environmental test fixture as described above. Proceed with the Humidity conditioning as shown below (allow the rear visibility camera system to stabilize at room temperature for a minimum of one hour after the end of corrosion conditioning and before the start of humidity conditioning).

   e. Document in final report before and after durability image as shown in **Figure 26**.

9. Humidity Conditioning (S14.3.2)

   The external components are subjected to 24 consecutive 3-hour humidity test cycles. In each humidity test cycle, external components are subjected to a temperature of 100°+7°-0° F (38°+4°-0° C) with a relative humidity of not less than 90% for a period of 2 hours. After a period not to exceed 5 minutes, the external components are subjected to a

temperature of 32° +5° -0° F (0° +3° -0° C) and a humidity of not more than 40% for 1 hour. Allow no more than 5 minutes to elapse between each test cycle.

a. After completion of the Humidity conditioning, photograph the camera, associated wiring, and any other rear image system components environmentally exposed and record any visual anomalies such as corrosion, lens deterioration, water droplets in the camera lens, or wiring/connector deterioration.

b. Remove camera from the environmental test fixture, and reinstall the camera and associated wiring back on the subject test vehicle. The installed rearview system should be positioned and affixed as close to the original configuration as possible. Consult COR if camera reinstallation alignment requires manufacturer specifications. The camera exterior lens can be gently wiped clean with a soft cloth to remove surface moisture and particles (equivalent to that found on the vehicle during normal operational use) which may have been deposited during the environmental conditioning.

c. Start vehicle engine and perform fore and aft vehicle travel to verify that the camera and Rearview image system is operational.

d. Proceed with post durability verification field-of-view and test object image size testing as described in Compliance Test Execution Sections B and C.

f. Remove the camera and associated wiring from the vehicle and install back into the environmental test fixture as described above. Proceed with the Temperature conditioning as shown below (allow the rear visibility camera system to stabilize at room temperature for a minimum of one hour after the end of humidity conditioning and before the start of temperature conditioning).

g. Document in final report before and after durability image as shown in **Figure 26**.

10, Temperature Conditioning (S14.3.3)

The external components are subjected to 4 consecutive 2-hour temperature test cycles. In each temperature test cycle, the external components are first subjected to a temperature of 176° ± 5° F (80° ± 3° C) for a period of one hour. After a period not to exceed 5 minutes, the external components are subjected to a temperature of 32° +5° -0° F (0° +3° -0° C) for 1 hour. Allow no more than 5 minutes to elapse between each test cycle.

a. After completion of the Temperature conditioning, photograph the camera, associated wiring, and any other rear image system components environmentally exposed and record any visual anomalies such as corrosion, lens deterioration, water droplets in the camera lens, or wiring/connector deterioration.

b. Disassemble camera from the environmental test fixture, and reinstall the camera and

associated wiring back on the subject test vehicle. The installed rearview system should be positioned and affixed as close to the original configuration as possible. Consult COR if camera reinstallation alignment requires manufacturer specifications.
The camera exterior lens can be gently wiped clean with a soft cloth to remove surface moisture and particles (equivalent to that found on the vehicle during normal operational use) which may have been deposited during the environmental conditioning.

c. Start vehicle engine and perform fore and aft vehicle travel to verify that the camera and Rearview image system is operational.

d. Proceed with post durability verification field-of-view and test object image size testing as described in Compliance Test Execution Sections B and C.

e. Document in final report before and after durability image as shown in **Figure 26.**

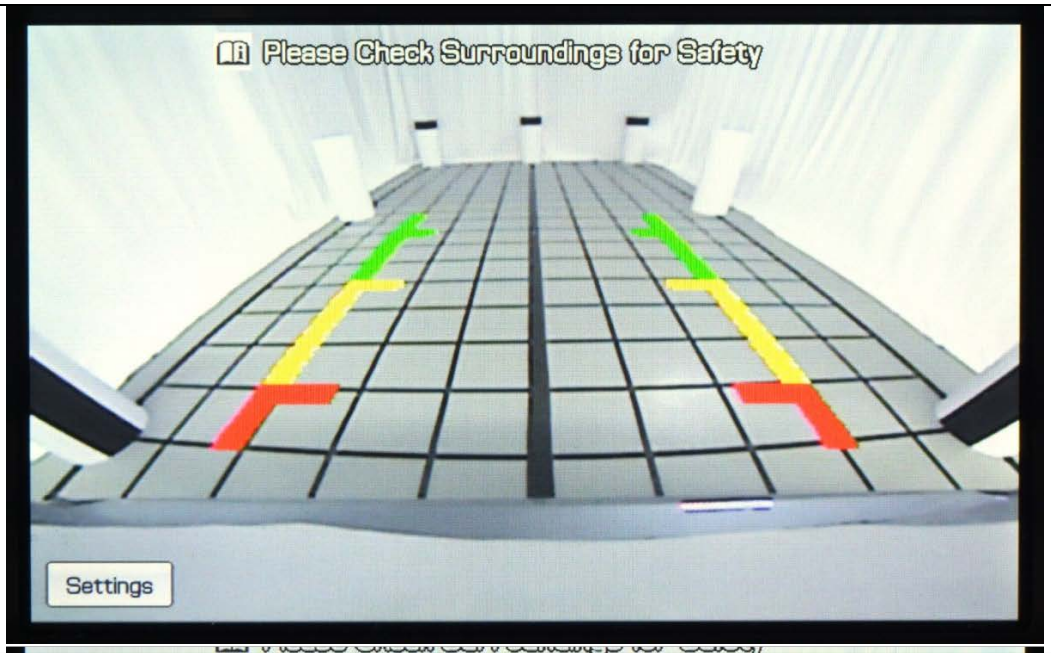
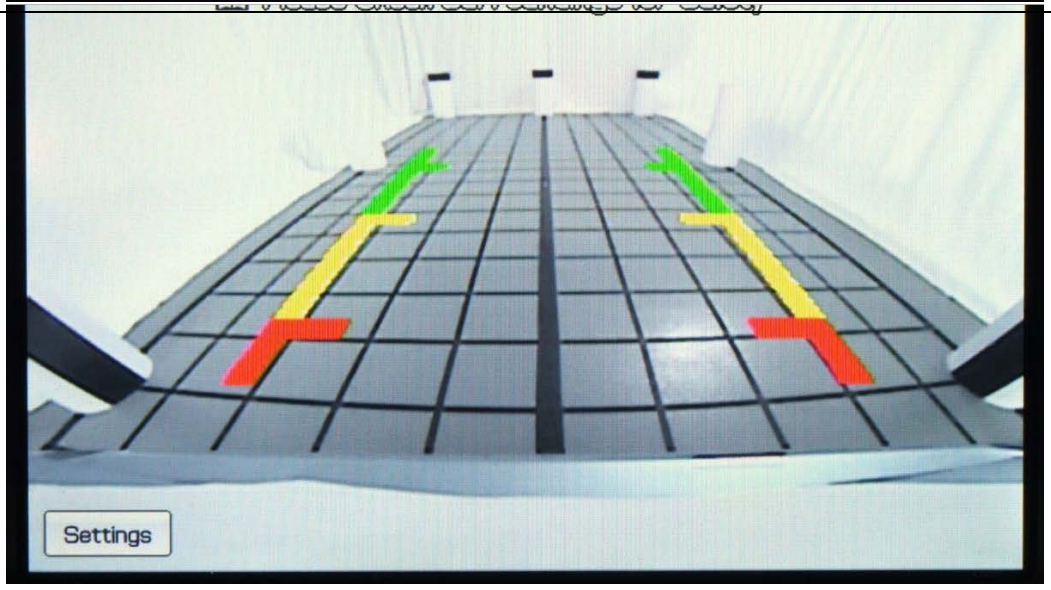
Comparison Image	
Rearview Image After Durability Exposure	

Figure 26 - Sample report documentation photographs of visual image before and after durability testing. Note that the wire overlay/projection lines do not obscure the cylinders and are thus permissible.

14. POST TEST REQUIREMENTS

After the required tests are completed, the contractor shall:

A. Verify all instrumentation, data sheets and photographs

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

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

D. Move the test vehicle to a secure area

E. 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 or items of equipment are disposed of. Samples of the required Monthly Status Reports are contained 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 is required for verification of accuracy. The calibration shall be performed without additional costs to the OVSC.

15.3 FINAL TEST REPORTS

15.3.1 COPIES

In the case of a test failure, copies of the Final Test Report shall be submitted to the COTR for acceptance within three weeks of test completion according to the terms of the contract. The Final Test Report format to be used by all contractors can be found in the "Report Section".

Where there has been no indication of a test failure, copies of each Final Test Report shall be submitted to the COTR within three weeks of test completion according to the terms of the contract. Payment of contractor's invoices for completed compliance tests may be withheld until the Final Test Report is accepted by the COTR. Do NOT submit invoices before the COTR is provided copies of the Final Test Report.

Contractors are required to submit the first Final Test Report in draft form within two weeks 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, 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 below for the purpose of 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 111ABCXX001 where –

111	is the FMVSS tested
ABC	are the initials for the laboratory
XX	is the last two numbers of the Fiscal Year of the test program
001	is the Group Number (001 for the 1st test)

(2) Final Report Title and Subtitle such as

COMPLIANCE TESTING FOR FMVSS 111
Rear Visibility
* *
World Motors Corporation
20XX XYZ Motor Cars
NHTSA No. CX0901

(3) Contractor's Name and Address such as

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

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

(4) Date of Final Report completion

(5) The words "FINAL REPORT"

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

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NEF-210
1200 New Jersey Ave., SE
Washington, DC 20590

B. FIRST PAGE AFTER COVER PAGE

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:
_____

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
111ABCXX001 (format as shown in 15.3.3A above)

Block 2 — GOVERNMENT ACCESSION NUMBER
Leave blank

Block 3 — RECIPIENT'S CATALOG NUMBER
Leave blank

Block 4 — TITLE AND SUBTITLE
Final Report of FMVSS 111 Compliance Testing of 20XX World XYZ Motor Cars, NHTSA No. CX0901

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
ABCDOTXXX001

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS
ABC Laboratories
405 Main Street
Detroit, MI 48070

Block 10 — WORK UNIT NUMBER
Leave blank

Block 11 — CONTRACT OR GRANT NUMBER
DTNH22XXD12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS
U.S. Department of Transportation
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NVS-210
1200 New Jersey Ave., 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

Block 16 — ABSTRACT

Compliance tests were conducted on the subject 20XX World XYZ Motor Car in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP111XX for the determination of FMVSS 111 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 111

Block 18 — DISTRIBUTION STATEMENT

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

Block 22 — PRICE

Leave blank

15.3.4 TABLE OF CONTENTS

Final test report Table of Contents shall include the following:

Disclaimer Notice

Technical Report Documentation Page

Table of contents

Introduction

Test Vehicle Information

Purpose of Compliance Test

Compliance Test Data Summary

Compliance Test Data Sheets

Notice of Possible Noncompliance (if applicable)

Photographs

Test Equipment List and Calibration Information

Copy of Manufacturer’s Sticker

Applicable pages from vehicle owner’s manual

Discussion of Data/ Contractor Comments (if applicable)

Procedure Modifications and Test Facility Description (if applicable)

16. DATA SHEETS

DATA SUMMARY SHEET
FMVSS 111 - REARVIEW MIRRORS: VEHICLES TESTED TO PASSENGER CAR REQUIREMENTS (1 of 2)

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

OUTSIDE DRIVER SIDE MIRROR

	PASS	FAIL	COMMENTS
STABLE SUPPORT			
DOES NOT PROTRUDE BEYOND VEHICLE BODY			
NOT OBSCURED BY UNWIPED PORTION OF WINDSHIELD			
ADJUSTABLE BY TILTING			
ADJUSTABLE FROM DRIVER SEAT			
FREE OF SHARP EDGES			
FIELD-OF-VIEW			
REFLECTANCE			
UNIT MAGNIFICATION			

16. DATA SHEETS CONTINUED…..

FMVSS 111 - REARVIEW MIRRORS: VEHICLES TESTED TO PASSENGER CAR REQUIREMENTS (2 of 2)

INSIDE REARVIEW MIRROR

	PASS	FAIL	COMMENTS
STABLE SUPPORT			
ADJUSTABLE BY TILTING			
FIELD-OF-VIEW			
REFLECTANCE			
BREAK AWAY			
UNIT MAGNIFICATION			

OUTSIDE PASSENGER SIDE MIRROR (if required)

	PASS	FAIL	COMMENTS
STABLE SUPPORT			
ADJUSTABLE BY TILTING			
REFLECTANCE			
FREE OF SHARP EDGES			
UNIT MAGNIFICATION or			
CONVEX			

REMARKS:

16. DATA SHEETS CONTINUED…..

FMVSS 111 TEST SUMMARY –
MPV'S, BUSES (NOT SCHOOL BUSES), AND TRUCKS
NOT TESTED TO PASSENGER CAR MIRROR REQUIREMENTS

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

OUTSIDE DRIVER SIDE MIRROR

	PASS	FAIL	COMMENTS
STABLE SUPPORT			
ADJUSTABLE BY TILTING			
VIEW TO REAR			
SURFACE AREA			
REFLECTANCE			
UNIT MAGNIFICATION			

OUTSIDE PASSENGER SIDE MIRROR

	PASS	FAIL	COMMENTS
STABLE SUPPORT			
ADJUSTABLE BY TILTING			
VIEW TO REAR			
SURFACE AREA			
REFLECTANCE			
UNIT MAGNIFICATION			

16. DATA SHEETS CONTINUED…..

FMVSS 111 TEST SUMMARY –
MOTORCYCLE MIRRORS

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

LEFT SIDE MIRROR

	PASS	FAIL	COMMENTS
STABLE SUPPORT			
ADJUSTABLE BY TILTING			
REFLECTIVE SURFACE AREA			
LONGITUDINAL (279mm) CENTERLINE OUTWARD			
REFLECTANCE			
UNIT or CONVEX MAGNIFICATION			

RIGHT SIDE MIRROR

	PASS	FAIL	COMMENTS
STABLE SUPPORT			
ADJUSTABLE BY TILTING			
REFLECTIVE SURFACE AREA			
LONGITUDINAL (279mm) CENTERLINE OUTWARD			
REFLECTANCE			
UNIT or CONVEX MAGNIFICATION			

16. DATA SHEETS CONTINUED…..

DATA SHEET 1 (1 of 2)
VEHICLE INSPECTION AND IDENTIFICATION

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

TYPES OF REARVIEW MIRRORS (flat, spherical, etc.):

INSIDE REARVIEW: _____

DRIVER'S SIDE OUTSIDE: _____

PASSENGER'S SIDE OUTSIDE: _____

OTHER:

DESIGNATED SEATING CAPACITY: _____

PASSENGER CARS AND MPVs, TRUCKS, AND BUSES, OTHER THAN SCHOOL BUSES, WITH GVWR 4,536 KG (10,000 LB) OR LESS, USING OPTIONAL PASSENGER CAR REQUIREMENTS:

LOCATION AND DESCRIPTION OF MANUFACTURER PROVIDED REFERENCE POINT FOR EYE POINT MEASUREMENT:

LOCATION OF DRIVER SEATING REFERENCE POINT (SRP): _____

REMARKS:

COORDINATES (FROM MANUFACTURER REFERENCE POINT) OF DRIVER EYE POINTS:

	X	Y	Z
LEFT EYE			
RIGHT EYE			

RESULTS OF RECEIVING INSPECTION:
PASS _____
FAIL _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 1 (2 of 2)
VEHICLE INSPECTION AND IDENTIFICATION

CONDITIONS:
GENERAL VEHICLE INFORMATION:

GVWR: _____ kg

FRONT GAWR: _____ kg

REAR GAWR: _____ kg

UNLOADED WEIGHT: _____ kg

CARGO WEIGHT: _____ kg

TOTAL RATED LOAD: _____ kg

BODY STYLE:_____

TRANSMISSSION:_____

ENGINE: _____

FRONT TIRE SIZE AND RECOMMENDED COLD INFLATION PRESSURE:

_____

REAR TIRE SIZE AND RECOMMENDED COLD INFLATION PRESSURE:

_____

DISPOSITION/ACTION/REMARKS:

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 2 (1 OF 2)
FMVSS 111 MOUNTING ADEQUACY TEST

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

MIRROR MOUNTING PROVIDES A STABLE SUPPORT:

	PASS	FAIL	CONDITIONAL
INSIDE REARVIEW MIRROR			
DRIVER'S SIDE OUTSIDE MIRROR			
PASS. SIDE OUTSIDE MIRROR			

CONDITIONS:
Driver outside mirror does not protrude farther that the widest part of the vehicle body except to the extent necessary to produce the required field-of-view (Pass/Fail)___

The driver side outside mirror is not obscured by the unwiped portion of the windshield (Pass/fail)___

OUTSIDE MIRRORS FREE OF SHARP POINTS OR EDGES (PASS/FAIL):_____

MIRROR IS ADJUSTABLE IN BOTH THE VERTICAL AND HORIZONTAL DIRECTIONS:

	PASS	FAIL	CONDITIONAL
INSIDE REARVIEW MIRROR			
DRIVER'S SIDE OUTSIDE MIRROR			
PASSENGER SIDE OUTSIDE MIRROR			

CONDITIONS:

DRIVER’S SIDE OUTSIDE MIRROR ADJUSTABLE FROM THE DRIVER’S SEATED POSITION (PASS/FAIL):_____

16. DATA SHEETS CONTINUED…..

DATA SHEET 2 (2 of 2)
FMVSS 111 MOUNTING ADEQUACY TEST

ADJUSTMENT ANGLE	V+	V—	H+	H—
INSIDE REARVIEW MIRROR				
DRIVER'S SIDE OUTSIDE MIRROR				
PASS. SIDE OUTSIDE MIRROR				

CONDITIONS:

MPVs, TRUCKS AND BUSES, OTHER THAN SCHOOL BUSES, **NOT** CONFORMING TO PASSENGER CAR REQUIREMENTS

MIRROR PROVIDES A VIEW TO THE REAR ALONG BOTH SIDES OF THE VEHICLE:

	PASS	FAIL	CONDITIONAL
DRIVER'S SIDE OUTSIDE MIRROR			
PASS. SIDE OUTSIDE MIRROR			

CONDITIONS:

TEST RESULTS: PASS _____ FAIL _____

REMARKS:

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 3 (1 of 2)
FMVSS 111 FIELD-OF-VIEW TEST

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

INSIDE REARVIEW MIRROR (S5.1.1)

E Distance from center of mirror to projected eye point _____

A = Distance from rear of vehicle to projected eye point location _____

X1 = Distance from rear of vehicle to field of view grid _____

Z1 = Vertical distance to lowest point of field of view at distance X1_____

Z2 = Height of center of mirror _____

X2 = Distance from rear of vehicle where the road surface is first visible:

X2 = [(Z2 x X1) + (Z1 x A)]/(Z2 - Z1) = _____(61 m maximum)

YL, YR = Distance to driver's left or right of vehicle's centerline at the location of the field of view grid or markers

MONOCULAR DATA (ALR & ARL Are Angles)				
EYE LOCATION	YL	YR	ALR	ARL
LEFT EYE POINT	(YLL)	(YLR)		
RIGHT EYE POINT	(YRL)	(YRR)		

REMARKS:

16. DATA SHEETS CONTINUED…..

DATA SHEET 3 (2 of 2)
FMVSS 111 FIELD-OF-VIEW TEST

CALCULATED HORIZONTAL AMBINOCULAR VIEW ANGLE (AB) _____

ALR = TAN [1YLR/(X1 + A)] _____ARL = TAN [1YRL/(X1 + A)] _____

ANGLE AB = ANGLE ALR + ANGLE ARL _____ (20 degrees minimum)

TEST RESULTS: PASS _____ ; FAIL _____;

DRIVER SIDE MIRROR (S5.2)

MIRROR OBSCURED BY UNWIPED PORTION OF WINDSHIELD? (Y/N): _____

HEIGHT OF TARGET DISC ON MIRROR: _____

DISTANCE OF TARGET DISC ON MIRROR FROM VEH. TANGENT PLANE: _____

TARGET DISC LOCATION RELATIVE TO VEH. TANGENT PLANE: _____ Outboard
_____ Inboard

ENTIRE TRIANGULAR TEST TARGET AREA ON SCREEN VISIBLE? (Y/N): _____

MIRROR PROTRUDES BEYOND VEH. TANGENT PLANE? (Y/N): _____

PROTRUSION REQUIRED TO MEET FIELD OF VIEW REQUIREMENTS? (Y/N): _____

TEST RESULTS: PASS _____ ; FAIL _____:

PASSENGER SIDE MIRROR (S5.3 or MFG. OPTION)

PASSENGER SIDE MIRROR TYPE (convex or unit magnification): _____

REMARKS:

RECORDED BY: _____ APPROVED BY: _____ DATE:_____

16. DATA SHEETS CONTINUED…..

DATA SHEET 4 (1of 4)
FMVSS 111 REFLECTANCE TEST – ALL MIRRORS

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

INSIDE MIRROR:

TYPE OF MIRROR:

2 POSITION PRISMATIC _____ ; ELECTROCHROMATIC_____

ELECTRO/MECHANICAL _____ ; LIQUID CRYSTAL _____

OTHER: (Specify) _____

DESCRIPTION OF TEST APPARATUS: _____

MIRROR DESCRIPTION: _____

VOLTAGE READING FROM CALIBRATION (Average Value): _____

VOLTAGE READING FROM LIGHT REFLECTED BY DAY MIRROR (Average Value):

_____

REFLECTANCE (Day) = Voltage (Refl)/Voltage (Cal) = 0.___ x 100 = ___ percent
(Minimum Requirement = 35 percent)

VOLTAGE READING FROM CALIBRATION (Average Value) = _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 4 (2of 4)
FMVSS 111 REFLECTANCE TEST – ALL MIRRORS

VOLTAGE READING FROM LIGHT REFLECTED BY NIGHT MIRROR (average Value): _____

REFLECTANCE (Night) = Voltage (Refl)/Voltage (Cal) = 0.___ x 100 = ___ percent
(Minimum Requirement = 4 percent)

NOTE: If meter reading directly in percent is used, record only percent

INSIDE MIRROR WITH MULTIPLE REFLECTANCE LEVELS:

Does the mirror have a manual adjustment to achieve day mode operation?

YES _____ NO_____

If "NO" above, test for reflectance in the event of electrical failure:

VOLTAGE READING FROM CALIBRATION (Average Value) = _____

VOLTAGE READING FROM LIGHT REFLECTED BY ELECTRICALLY FAILED MIRROR (Average Value): _____

REFLECTANCE (Failed electrical, manually adjusted)
= Voltage (Refl)/Voltage (Cal) = 0.___ x 100 = ___ percent
(Minimum Requirement = 35 percent)

NOTE: If meter reading directly in percent is used, record only percent

OBSERVATIONS: _____

TEST RESULTS FOR INSIDE MIRROR
PASS _____ FAIL _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 4 (3 of 4)
FMVSS 111 REFLECTANCE TEST – ALL MIRRORS

DRIVER'S SIDE MIRROR:_____

DATE OF TEST:_____

TYPE OF MIRROR: UNIT MAGNIFICATION

OTHER (Specify): _____

MIRROR DESCRIPTION: _____

VOLTAGE READING FROM CALIBRATION (Average Value): _____

VOLTAGE READING FROM LIGHT REFLECTED BY MIRROR (Average Value): _____

REFLECTANCE = Voltage (Refl)/Voltage (Cal) = 0.___ x 100 = ___ percent
(Minimum Requirement = 35 percent)

NOTE: If meter reading directly in percent is used, record only percent

OBSERVATIONS: _____

TEST RESULTS FOR DRIVER SIDE MIRROR:

PASS _____ FAIL _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 4 (4 of 4)
FMVSS 111 REFLECTANCE TEST – ALL MIRRORS

PASSENGER'S SIDE MIRROR (if required):

DATE OF TEST:_____

TYPE OF MIRROR: UNIT MAGNIFICATION _____ CONVEX _____

OTHER (Specify): _____

DESCRIPTION OF TEST APPARATUS: _____

MIRROR DESCRIPTION: _____

VOLTAGE READING FROM CALIBRATION (Average Value): _____

VOLTAGE READING FROM LIGHT REFLECTED BY DAY MIRROR (Average Value): _____

REFLECTANCE (Day) = Voltage (Refl)/Voltage (Cal) = 0.___ x 100 = _____ percent
(Minimum Requirement = 35 percent)

NOTE: If meter reading directly in percent is used, record only percent

OBSERVATIONS: _____

TEST RESULTS FOR PASSENGER SIDE MIRROR

PASS _____ FAIL_____

RECORDED BY: _____ APPROVED BY: _____ DATE:_____

16. DATA SHEETS CONTINUED…..

DATA SHEET 5
FMVSS 111 BREAKAWAY TEST - INSIDE REARVIEW MIRROR

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

MOUNTING OF MIRROR (INSIDE) DESCRIPTION: _____

(Requirement: the mirror shall deflect, collapse or break away when it is subjected to a force of 400 N or less)

TEST NO.	LOAD DIRECTION (Vertical/Horizontal)	MAXIMUM FORCE (N)	PASS	FAIL
1				
2				
3				
4				
5				
6				
7				

REMARKS:

FAILURE TYPE DESCRIPTION:

XY PLOTTER DATA I.D. NUMBER:

TEST RESULTS: PASS _____ FAIL _____

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 6 (1 of 3)
FMVSS 111 UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

DESCRIPTION OF TEST APPARATUS: _____

DRIVER'S SIDE and INSIDE REARVIEW MIRRORS:

DRIVER SIDE MIRROR:

TEST POSITION	DIAL READINGS
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

INSIDE MIRROR:

TEST POSITION	DIAL READINGS
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

All dial indicator readings for unit magnification mirrors must be zero.

TEST RESULTS: PASS____ FAIL_____

16. DATA SHEETS CONTINUED…..

DATA SHEET 6 (2 of 3)
FMVSS 111 UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

PASSENGER'S SIDE REARVIEW MIRROR:

CONVERSION DATA TABLE FROM SPHEROMETER DIAL READING TO RADIUS OF CURVATURE

TEST POSITION	DIAL READINGS (inches)	RADIUS OF CURVATURE (mm)	DEVIATION BETWEEN THE AVERAGE RADIUS OF CURVATURE AND THE TEST POSITION RADIUS OF CURVATURE (mm)	PERCENT DEVIATION FROM THE AVERAGE RADIUS OF CURVATURE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Average Radius of Curvature - A summation of Column 3 divided by 10: _____(mm)			Greatest percent Deviation From the Average Radius of Curvature - From Column 5: _____%	

REMARKS:

16. DATA SHEETS CONTINUED…..

DATA SHEET 6 (3 of 3)
FMVSS 111 UNIT MAGNIFICATION AND CONVEX MIRROR TESTS

PASSENGER'S SIDE REARVIEW MIRROR

IF CONVEX, ARE THERE ANY DISCONTINUITIES IN THE SLOPE OF THE SURFACE OF THE MIRROR:

YES _____ NO _____

IF CONVEX, ARE THE WORDS, "**OBJECTS IN THE MIRROR ARE CLOSER THAN THEY APPEAR**" PRESENT?

YES _____ NO _____

IF CONVEX, MEASURE LETTER HEIGHT OF ABOVE WORDS: _____ mm

IF CONVEX, LETTERS ARE NOT LESS THAN 4.8 mm OR MORE THAN 6.4 mm HIGH
YES _____ NO _____ ____

IF CONVEX, THE AVERAGE RADIUS OF CURVATURE IS NOT LESS THAN 889 mm AND NOT MORE THAN 1651 mm:

YES _____ NO _____

IF CONVEX, THE GREATEST PERCENT DEVIATION FROM THE AVERAGE RADIUS OF CURVATURE IS ± 12.5 PERCENT:

YES _____ NO ____

IF UNIT MAGNIFICATION, ALL DIAL READINGS ARE ZERO +/_ 0.

YES_____ NO_____

TEST RESULTS:

PASS _____ FAIL _____

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 7
FMVSS 111 MIRROR REFLECTIVE SURFACE AREA, VIEW TO REAR TEST,
MOTORCYCLE MIRROR CENTERLINE POSITION

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

DATA TABLE FOR SURFACE AREA

MIRRORS	AREA	REQUIREMENT MPVs, TRUCKS, BUSES (OTHER THAN SCHOOL), GVWR 4536 kg	REQUIREMENT MPVs, TRUCKS, BUSES (OTHER THAN SCHOOL), GVWR 4536 kg	REQUIRMENT FOR MOTORCYCLE	PASS/ FAIL
Driver Outside		≥126 cm^2	≥323 cm^2	≥8065 mm^2 Unit magnification or 6450 mm^2 Convex	
Passenger Outside		≥126 cm^2	≥323 cm^2		

MIRRORS LOCATED SO AS TO PROVIDE DRIVER A VIEW TO THE REAR:
LEFT SIDE (Y/N): _____RIGHT SIDE (Y/N): _____

FOR MOTORCYCLES:

A. HORIZONTAL CENTER OF THE REFLECTIVE SURFACE OUTWARD TO THE LONGITUDINAL CENTERLINE OF THE MOTORCYCLE (Minimum of 279 mm) _____
B. RADIUS OF CURVATURE IF CONVEX MIRROR USED (508 mm to 1524 mm) ____

TEST RESULTS: PASS _____ FAIL ____

REMARKS:

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SUMMARY SHEET
FMVSS 111 - REARVIEW IMAGE TESTING

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

	PASS	FAIL	COMMENTS
INSPECTION			
FIELD-OF-VIEW (S5.5.1, S6.2.1)			
TEST OBJECT IMAGE SIZE (S5.5.2, S6.2.2)			
RESPONSE TIME (S5.5.3, S6.2.3)			
LINGER TIME (S5.5.4, S6.2.4)			
DEACTIVATION (S5.5.5, S6.2.5)			
DEFAULT VIEW (S5.5.6, S6.2.6			
POST CORROSION DURABILITY (S5.5.7, S6.2.7)			
FIELD-OF-VIEW (S5.5.1, S6.2.1)			
TEST OBJECT IMAGE SIZE (S5.5.2, S6.2.2)			
POST HUMIDITY DURABILITY (S5.5.7, S6.2.7)			
FIELD-OF-VIEW (S5.5.1, S6.2.1)			
TEST OBJECT IMAGE SIZE (S5.5.2, S6.2.2)			
POST TEMPERATURE DURABILITY (S5.5.7, S6.2.7)			
FIELD-OF-VIEW (S5.5.1, S6.2.1)			
TEST OBJECT IMAGE SIZE (S5.5.2, S6.2.2)			

16. DATA SHEETS CONTINUED…..

DATA SHEET 8 (1 of 2)
VEHICLE INSPECTION AND IDENTIFICATION

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

1. Reinstall Driver seat and remove vehicle stabilizing jack stands, if used previously for mirror testing _____ _

2. Identify any Defects or imperfections for visual display or camera_____

3. Visual image is detected by a single source (one camera) and image is displayed at a single location_____

4. Location of inside visual display (within the interior rearview mirror, center console, etc.)_____

   Describe any protective screen/plastic or curved surface over the visual display?_____

   Specify if cover is removed to improve test measurement with ruler accuracy_____

5. Display Manufacturer/Model _____

6. Rearview display height, width, diagonal and reference to ground angle?_____

7. Display part of multi-function display?_____

8. Interior display meets manufacturer specification per Owner's Manual?_____

9. Describe if any visual display adjustments for contrast, brightness, or resolution can be made prior to or after backing event initiation_____(testing should be conducted at lowest settings which can be set prior to backing event)

10. Can the rearview image be disabled by driver?_____ If yes, describe method _____

11. Interior display adjustable for rotation, angle, telescoping?_____

16. DATA SHEETS CONTINUED…..

DATA SHEET 8 (2 of 2)
VEHICLE INSPECTION AND IDENTIFICATION

12. Is Interior display recessed ? ___ If so, how raised and time to do so_____

13. Transmission gear selector is lever type, rotational, or pushbutton _____

14. Is transmission gear selector recessed and not functional until fully raised _____. If so, how raised and time to do so _____

15. Rearview image displayed in any gear position other than reverse_____

16. Can default rearview image be set to standard, or wide angle etc. _____

17. Default rearview image automatically includes overlay, bird's eye view, path projection, messages, etc. Does overlay vary based on steering input_____

18. Can driver modify default rearview image once displayed (overlays, wide angle view, bird's eye view, turn off, path projections messages, split screen, etc.)_____ If so how accomplished _____

19. Height from ground to center point of rearview camera lens_____

20. Lateral position center point of rear camera lens measured from vehicle centerline_____

21. Angle of camera lens plane with reference to ground_____

22. Any vehicle body point which extends rearward of camera lens plane_____

23. Is the vehicle equipped with a rear bumper _____

24. Is a navigation system part of the rear image display _____

25. Determine if there are options for the driver to select various default rearview images prior to the backing event and it that image selected remains for subsequent backing events e.g Normal and Wide angle. If so, and remains the default view, image must meet the rearview image requirements e.g. field-of-view and test object size. _____

REMARKS:_____

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 9 (1 of 2)
FIELD-OF-VIEW (S5.5.1/S6.2.1)

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____
GENERAL VEHICLE and SETUP INFORMATION (Field-of-view and Test Object Size):

GVWR: _____ kg
FRONT GAWR: _____ kg
REAR GAWR: _____ kg
UNLOADED WEIGHT (optional): _____kg
CARGO WEIGHT: _____ kg
VEHICLE CAPACITY WEIGHT: _____ kg
DESIGNATED SEATING POSITIONS_____

Measured Vehicle Interior Temperature_____
Measured Exterior Ambient Temperature_____

Measured Ambient Illumination LUX : Roof ____ (Required 7000 to 10000 LUX) Top surface of Cylinder B ____ (Information Purposes)
Measured tire inflation pressure_____

Verify Fuel Tank is full:_____
Ballast added to vehicle for occupant load (five occupants max.) DSP x 68 kg =_____kg

Rear hatches or trunk lids closed and latched:_____

Driver seat longitudinal adjustable position – placed at mid-point of travel or closest adjustment to the rear of midpoint?_____

Driver seat adjusted to lowest point of vertical travel?_____

Driver seat cushion have tilting feature and set to mid-tilt?_____
Lumbar setting? _____

Manufacturer supplied nominal seat back angle (if provided) and/or seat back angle resulting in H-point machine torso weight hanger angle of 25 degrees_____

Driver seat back adjusted so that vertical portion of the H-point machine torso weight hanger is at 25 degrees?_____
Interior Display adjustment if equipped with rotational mounting adjustment?_____
Steering wheel adjustments made_____
If so equipped, visual display settings for contrast, brightness, and resolution_____(test at lowest settings)

16. DATA SHEETS CONTINUED…..

DATA SHEET 9

FIELD-OF-VIEW (S5.5.1/S6.2.1) (2 of 2)

Coordinates measured from H-point_____, or fixed point on vehicle body_____ :

	X	Y	Z
H- Hip H-Point			
J - Head/Neck Joint Center			
J2 – Orgin of Mf rotation			
M_f Forward-Looking Eye Midpoint			
M_R – Eye Mid-point Rotated (X,Y,Z value or degrees rotated)			
M_R – Eye Mid-point Rotated (If manufacture supplied)			

Measured shortest straight-line distance between M_R and the Center of the display___ = (a_{eye}) Method used to make measurement_____

Manufacturer supplied a_{eye} value _____

PHOTOGRAPHIC REVIEW:

Field-of-View from photograph (S5.5.1): (Refer to photographs)

1. Is a 150 mm wide portion along circumference visible for:
   Test Object F_____
   Test Object G _____
   YES___ Pass, NO____ Fail

2. The full width and height of test objects visible:
   Test Object A____
   Test Object B____
   Test Object C____
   Test Object D____
   Test Object E____
   YES___ Pass, NO____ Fail

Indicate if any test objects are obscured by a default overlay/projection lines_____

Can visual display contrast, brightness, resolution adjustment be made prior to backing event which makes the test objects not-visible during the backing event (not permissible) _____

[Include photographic documentation in final report]

REMARKS:_____

TEST RESULTS: PASS_____ FAIL_____

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 10 (S5.5.2, S6.2.2)
TEST OBJECT IMAGE SIZE

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

PHOTOGRAPHIC DATA EXTRACTION:

Image Size from photograph (S5.5.2):

Apparent length of 50mm delineated section of the in-photo ruler_____

Horizontal width of the colored band on the upper portion of test objects as measured on the photograph of the rearview image monitor:

Test Object A_____ = d_a
Test Object B_____=d_b
Test Object C_____=dc

Method used to make measurement_____

Scaling Factor:
Apparent Length/ 50mm = _____ S scale

Actual distance from the rotated eye midpoint location (Mr) to the center of the rearview image (a_{eye}) = _____

Visual Angle subtended by test Objects:

For Test object:

Test Object A_____ arc minutes
Test Object B_____ arc minutes
Test Object C_____ arc minutes

Each individual test object horizontal width not less than 3 minutes of arc?

YES___ Pass, NO____ Fail

Average for A, B,C, =_____
Not less than 5 minutes of arc YES___ Pass, NO____ Fail

Include data reduction for arc minutes determination if pixel measurements used.

[Include photographic documentation in final report]

REMARKS:_____

TEST RESULTS: PASS_____ FAIL_____
RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 11

RESPONSE TIME (S5.5.3, S6.2.3)

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

Measured vehicle interior compartment Temperature_____ (Required 15 to 25 C)

Measured Exterior Ambient Temperature_____

Measured Ambient Illumination LUX at Roof Center_____ (Required 7000 to 10000LUX)
At Test Object B Surface_____

Method used to establish rear visibility system is at lowest power resting state_____ (manufacturer supplied information?)

Method used to establish time zero for door opening ____

Method used to establish time zero for gear selector in reverse (rear back-up lights, video etc)_____ Type of gear selector (lever, rotating knob, pushbutton) _____

If rear back-up lights utilized, indicate time lag from selector in reverse and rear backing lights activated _____

Method used to establish visual display activation (driver hand trigger, photo receptor, video, etc.)_____

Door opening, door closed, activation of starting system, transmission gear shift selector into reverse (From 4 to 6 seconds)

ATTEMPT	Time interval from door opening, door closed, activation of starting system, and vehicle selector into reverse position (t = 4 to 6 seconds)	Time interval from vehicle selector into reverse gear until rearview image is displayed.	Complies if image display less than 2 seconds after gear selector into reverse (pass/fail)
1			
2			
3			

REMARKS:_____
TEST RESULTS: PASS_____ FAIL_____
RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 12 (1 of 2)
LINGER TIME (S5.5.4, S6.2.4)

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

Measured Exterior Ambient Temp._____

Manufacturer selection for termination of backing event – COR Supplied Information:

Forward Speed 10 mph	
Forward Distance 10 feet	
Forward Continuous Time Travel 10 Seconds	

The manufacturer may elect to extinguish the rearview image at any interim time between when the transmission gear selector is moved out of reverse but prior to the end of the backing event. The driver is permitted to deactivate the rearview image at any time after the start of the backing event.

From testing below, is image extinguished at time of transmission selector moved out of reverse (yes/no)_____

Does driver have option to select when rearview image is extinguished e.g. original setting – extinguished when vehicle out of reverse, or select when vehicle has travelled forward 10 meters, reached 10 mph, forward travel 10 seconds, or during interval prior to backing event termination? If so describe operation and how change made and if permanent or defaults to original setting after completion of backing event._____

Indicate method used by laboratory to determine vehicle speed, distance and time, and how events were triggered:
(GPS, Video, etc.)_____

16. DATA SHEETS CONTINUED…..

DATA SHEET 12 (2 of 2)
LINGER TIME (S5.5.4, S6.2.4)

For the following, vehicle transmission selector into reverse gear, rearward travel, vehicle stopped, gear selector to a forward position, travel forward, and verify that image is extinguished prior to achieving a speed of 10 mph, a distance less than 10 meters from the point where the transmission was shifted to a forward gear, or for continuous forward travel time less than 10 seconds starting from the time the vehicle first begins forward movement.

Attempt	Rearview image is present with transmission in reverse gear (Yes/no)	Record Speed (mph), Time (seconds) and Distance (meters) when image is extinguished	Passes if rearview image is extinguished at a speed not greater than 10 mph, a distance not greater than 10 meters, **OR** a continuous time greater than 10 seconds. (PASS/FAIL)
1			
2			
3			

Rearview image extinguished at time gear selector moved from reverse (yes/no) _____

REMARKS:_____

TEST RESULTS: PASS_____ FAIL_____

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 13
DEACTIVATION (S5.5.5, S6.2.5)

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

With vehicle transmission selector placed and maintained in reverse gear, activate any provided driver actuated switch/button/touch screen to extinguish or modify the required rearview image.

Attempt	Switch/Button Location	Image Extinguished or modified?	If applicable, describe modified view
1			
2			
3			

With vehicle transmission selector placed into a neutral or forward gear after being placed in reverse, activate any provided driver actuated switch/button/touch screen to extinguish or modify the rearview image prior to end of backing event (assuming initial gear out-of-reverse does not deactivate image)

Attempt	Switch/Button Location	Image Extinguished or modified?	If applicable, describe modified view
1			
2			
3			

Is the required rearview image capable of being deactivated or modified during the backing event with the transmission selector in reverse and absent any driver action (excluding transmission selector into a position other than reverse?) Not permissible. If so describe._____

Is the required rearview image capable of being disabled by the driver or otherwise prior to the start of the backing event? Not Permissible. If so describe. _____

REMARKS:_____

TEST RESULTS: PASS_____ FAIL_____

RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 14 (1 of 2)
DEFAULT VIEW (S5.5.6, S6.2.6)

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

Is the required rearview image capable of being deactivated or modified after initiation of the backing event:_____
If so, describe_____

To determine that rear visibility system defaults to required image under standard operating conditions (no modifications to image), conduct testing below.
Note: Completion of backing event can be confirmed by performing all of the following: travelling forward at 10 mph, travelling forward a distance of 10 meters, and continuous forward travel for 10 seconds. These three conditions assure that the backing event has ended.

Attempt #	Engine off, ignition key out, vehicle then started and backing event initiated and completed. Motor turned off. Restart vehicle initiate another backing event.	Complies if defaults to required rearview image each time.
1		
2		
3		

To determine that rear visibility system defaults to required image under standard operating conditions (no modifications to image) but engine is still activated, conduct test as shown below:.

Attempt #	Engine on, backing event initiated and completed. Engine still activated/running – start another backing event.:	Complies if defaults to required rearview image each time.
1		
2		
3		

Note if the default display includes any automatic overlays and if so, does the overlay obscure any of the test object cylinders (not permissible)_____

Note if the driver can manually add overlays to the image and if so describe_____

16. DATA SHEETS CONTINUED…..

DATA SHEET 14 (2 of 2)
DEFAULT VIEW (S5.5.6, S6.2.6)

To determine that rear visibility system defaults to required image after a previous modification was made to the rearview image during the backing event, complete the following tests:

Attempt #	During backing event extinguish or modify the required rearview image. Complete the backing event. Turn off engine and remove ignition key. Start vehicle and initiate another backing event.	Identify when and how driver action taken: Prior to or after transmission removed from reverse. Touch screen, mechanical switch, etc.	Identify resulting image: Off, warning message, distance markers, vehicle trajectory, wide angle view, etc.	Complies if defaults to required rearview image at start of next backing event.
1				
2				
3				

Attempt #	During backing event extinguish or modify required rearview image. Complete the backing event. Engine still running, initiate another backing event.	Identify when and how driver action taken: Prior to or after transmission removed from reverse. Touch screen, mechanical switch etc.	Identify resulting image: Off, warning message, distance markers, vehicle trajectory, wide angle view, etc.	Complies if defaults to required rearview image at start of next backing event.
1				
2				
3				

Is the required rearview image capable of being deactivated or modified prior to initiation of the backing event and that altered condition remains once the backing event starts _____ (not permissible – at start of backing event rear image must be present regardless of actions taken prior to backing event.)

REMARKS:_____

TEST RESULTS: PASS_____ FAIL_____
RECORDED BY: _____ APPROVED BY: _____ DATE: _____

16. DATA SHEETS CONTINUED…..

DATA SHEET 15 (1 of 2)
DURABILITY (S5.5.7, S6.2.7)

VEH. MY/MAKE/MODEL/BODY STYLE: _____
NHTSA NO.: _____; VEH. TYPE: _____; VIN: _____
TEST LABORATORY: _____; CONTRACT NO.: _____
DATE OF TEST: _____

Model, Manufacturer of camera(s)_____

Plane of rear Camera Lens Angle with reference to ground	
Vertical height from ground to center of camera lens	
Lateral position of camera lens center	
Number of connecting camera cables	
Number of camera cable connector pins	
Method of Camera attachment to Vehicle (screw, rivet, etc.)	
OEM sealant or gaskets used on vehicle for sealing camera to rear of vehicle	

Indicate if manufacturer supplied environmental test fixture was utilized_____

Describe method utilized to condition exposed portion of rearview image (camera inserted into plexi-glass box, silicon sealant, etc. _____

Describe how associated wiring, connectors, and any other exposed portions of the rearview image system are prepared for conditioning _____

VISUAL OBSERVATION:

	Pre Durability Testing	POST Corrosion Exposure	POST Humidity Exposure	POST Temperature Exposure
Camera housing condition				
Camera Connector and wiring				
Camera lens Clarity				
Signs of lens Corrosion				
Signs of Lens Water intrusion				

Include Pre and post durability test photos of camera and associated rearview imaging system hardware after corrosion, after humidity and after temperature exposure.

16. DATA SHEETS CONTINUED…..

DATA SHEET 15 (2 of 2)
DURABILITY (S5.5.7, S6.2.7)

Include photographs of camera installed on vehicle prior to and after durability conditioning.

POST CORROSION CONDITIONING:

FIELD-OF-VIEW (S5.5.1/S6.2.1)

REPEAT USE OF DATA SHEET 9

POST CORROSION CONDITIONING:

TEST OBJECT IMAGE SIZE (S5.5.2/S6.2.2)

REPEAT USE OF DATA SHEET 10

POST HUMIDITY CONDITIONING:

FIELD-OF-VIEW (S5.5.1/S6.2.1)

REPEAT USE OF DATA SHEET 9

POST HUMIDITY CONDITIONING:

TEST OBJECT IMAGE SIZE (S5.5.2/S6.2.2)

REPEAT USE OF DATA SHEET 10

POST TEMPERATURE CONDITIONING:

FIELD-OF-VIEW (S5.5.1/S6.2.1)

REPEAT USE OF DATA SHEET 9

POST TEMPERATURE CONDITIONING:

TEST OBJECT IMAGE SIZE (S5.5.2/S6.2.2)

REPEAT USE OF DATA SHEET 10

17. FORMS

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.: 111 TEST DATE: _____

LABORATORY: _____

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

LABORATORY PROJECT ENGINEER'S NAME: _____

TEST VEHICLE DESCRIPTION: _____

VEH. NHTSA NO.: _____ VIN: _____

VEHICLE MANUFACTURER:_____

TEST FAILURE DESCRIPTION: _____

FMVSS 111 REQUIREMENT, PARAGRAPH ___ :

NOTIFICATION TO NHTSA (COTR):

DATE: _____ BY: _____

REMARKS:

MONTHLY TEST STATUS REPORT, FMVSS 111
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						

MONTHLY VEHICLE STATUS REPORT, FMVSS 111
DATE OF REPORT:

No.	VEHICLE NHTSA No., MAKE & MODEL	DATE OF DELIVERY	TEST COMPLETE DATE	VEHICLE SHIPMENT DATE	CONDITION OF VEHICLE
1					
2					
3					
4					
5					

Instrumentation and Calibration (12 Month Maximum Interval)

Test Equipment List and Calibration (example)

Rearview Mirror Testing

Equipment	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Computer					
Interior Camera Mount Fixture					
A/D Interface					
Signal Conditioner					
Load cell					
Inclinometer					
Linear Potentiometer					
Precision Steel Scale					
35 mm Still Camera					
Reflectometer					
Spherometer					

Rearview image Testing

Equipment	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Computer					
J826-1995 Manikin					
Camera to Manikin Bracket					
Light Intensity Meter					
Fifth wheel					
GPS					
A/D Interface					
Signal Conditioner					
Linear Potentiometer					
Precision Steel Scale					
35 mm Still Camera					
Video Camera (s)					
Corrosion Test Chamber					
Humidity Test Chamber					
Temperature Test Chamber					

18. APPENDICES

APPENDIX 1

H-Point Determination for 50th Percentile Male Dummy (Driver)

NHTSA No. _____ Test Date: _____

Laboratory: _____Test Technician(s): _____

__Driver Designated Seating Position

__1. Position the seat's adjustable lumbar supports so that the lumbar support is in its lowest, retracted or deflated adjustment position. (S8.1.3)

__N/A – No lumbar adjustment

__2. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position. (S16.2.10.2)

__ N/A – No additional support adjustment

__3. Use all the seat controls that have any affect on the fore-aft movement of the seat to move the seat cushion to the rearmost position. Mark this position. (8/31/95 legal interp to Hogan and Hartson)

__4. Use all the seat controls that have any affect on the fore-aft movement of the seat to move the seat cushion to the foremost position. Mark this position. (8/31/95 legal interp to Hogan and Hartson)

__5. **Mark** each fore-aft position so that there is a visual indication when the seat is at a particular position. For manual seats, mark each detent. For power seats, mark only the rearmost, middle, and foremost positions. Label three of the positions with the following: F for foremost, M for mid-position (if there is no mid-position, label the closest adjustment position to the rear of the mid-point), and R for rearmost. Determine the mid fore-aft seat position based on the foremost and rearmost positions determined in items 3 and 4. (8/31/95 legal interp to Hogan and Hartson)

__6. Move the seat to the mid position.

__7. While maintaining the mid position, move the seat to its lowest position. Mark the height position. For seats with adjustable seat cushions, use the manufacturer's recommended seat cushion angle for determining the lowest height position.

__8. Visually mark the seat back angle, if adjustable, at the manufacturer's nominal design riding position for a 50th percentile adult male in the manner specified by the manufacturer.

__ N/A – No seat back angle adjustment

__Previously marked during Data Sheet 14.1 go to 9

Manufacturer's design seat back angle _____

__9. Is the seat a bucket seat?

__Previously marked during data sheet 14.1. This form is complete.

__Yes, go to 10 and skip 11

__No, go to 11 and skip 10

__10. Bucket seats:

Locate and mark for future reference the longitudinal centerline of the seat cushion. The intersection of the vertical longitudinal plane that passes through the SgRP and the seat cushion upper surface determines the longitudinal centerline of a bucket seat cushion. (S10.4.1.2 and S16.3.1.10)

__11. Bench seats (complete ONLY the one that is applicable to the seat being marked):

11.1 Driver Seat

Locate and mark for future reference the longitudinal line on the seat cushion that marks the intersection of the vertical longitudinal plane through the centerline of the steering wheel and the seat cushion upper surface. (S10.4.1.1)

11.2 Passenger Seat (NA)

__12. Place a 910 mm^2 piece of muslin cotton cloth over the seat area. (The muslin cloth shall be comparable to 48 threads/in^2 and density of 2.85 lb/yd.) Tuck the muslin cloth in a sufficient amount to prevent hammocking of the material.

__13. Place the seat and back assembly of the H-Point machine at the centerline of the seat as determined in item 10 or 11.

__14. Install the lower leg, and foot segments.

__15. Set the length of the lower leg segment at 16.3 inches and the length of the thigh bar at 15.8 inches.

__16. Leg and foot placement

__16.1 Driver Designated Seating Position

__16.1.1 Insert the pin so that the foot angle is never less than 87 degrees.

__16.1.2 Place the right foot on the undepressed accelerator pedal with the sole of the foot on the pedal and the heel as far forward as allowable. Do not place the heel on the toe board.

__16.1.3 Adjust the left leg to be the same distance from H-point machine centerline as the right leg.

__16.1.4 With the T-bar level, place the left foot on the toe board with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toe board and the floor pan and not on the wheel well projection. If the foot cannot be positioned on the toe board, set it on the floor pan.

__Foot on toe board

__Foot on floor pan

__16.2 Passenger Designated Seating Position (NA)

__17. Apply the lower leg weights.

__18. Apply the thigh weights.

__19. Tilt the back pan forward against the forward stop and draw the H-point machine away from the seatback using the T-bar.

__20. Repositioning the back pan

__20.1 Allow the H-point machine to slide rearward until a forward horizontal restraining load on the T-bar is no longer required due to the seat pan contacting the seat back.

__The seat pan does not slide rearward. Go to 20.2

__20.2 Slide the H-point machine rearward by a horizontal rearward load applied at the T-bar until the seat pan contacts the seat back.

__21. Apply a 10 kg load at the intersection of the hip angle quadrant and the T-bar housing along a line from the above intersection to a point just above the thigh bar housing.

__22. Again apply a 10 kg load at the intersection of the hip angle quadrant and the T-bar housing along a line from the above intersection to a point just above the thigh bar housing.

__23. Carefully return the back pan to the seat back.

__24. Install the right and left buttock weights.

__25. Install the eight torso weights alternately the installation between right and left.

__26. Tilt the back pan forward until the stop is contacted.

__27. Rock the H-point from side to side over a 10degree arc (5 degrees to each side of the vertical centerline) for three complete cycles. Restrain the T-bar during rocking so that the seat pan does not change position. Minimize any inadvertent exterior loads applied in a vertical or fore-aft direction. The feet are free to move during this rocking motion.

__28. Without applying a forward or lateral load lift the right foot off the floor the minimum amount necessary until no additional forward foot movement is obtained.

__29. Lower the right foot until the heel is in contact with the floor pan and the ball of the foot is in contact with the floor, toe board, or undepressed accelerator pedal.

__30. Without applying a forward or lateral load lift the left foot off the floor the minimum amount necessary until no additional forward foot movement is obtained.

__31. Lower the left foot until the heel is in contact with the floor pan and the ball of the foot is in contact with the floor or toe board.

__32. Is the seat pan level?

__Yes. Go to 34

__No. Go to 33

__33. Apply a sufficient lateral load to the top of the seatback pan to level the H-point machine seat pan on the seat.

__34. Holding the T-bar to prevent the H-point from sliding forward on the seat cushion, return the seatback pan to the seatback.

__35. Holding the T-bar to prevent the H-point from sliding forward on the seat cushion, apply sufficient rearward force perpendicular to the back angle bar just above the torso weights to increase the hip angle 3 degrees. Minimize the exterior downward or side forces applied to the H-point machine. Release the force. Repeat this step until the hip angle readout is identical. Complete as many force applications as necessary and record the results in the following table:

Force Application	Hip Angle
1	
2	
3	
4	
5	

__36. Is the H-point machine level?

__Yes, go to 37.

__No, relevel. Go back to item 26 and repeat using a new data sheet.

__37. Record the H-point location.

Describe and mark the measuring reference point. _____

x direction measurement _____

z direction measurement _____