



Inside and Outside Rear View Mirrors, Certification Field of Vision, FMVSS 111 and CMVSS 111

1 Introduction

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

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

1.1 Purpose. The purpose of this analysis is to demonstrate that the vehicle meets the requirements of USA and Canada standards, FMVSS 111 and CMVSS 111, for ISRVMS and OSRVMS. The Mirror Certification function allows UniGraphics (UG) users to perform analyses on driver's side and passenger's side OSRVMS and ISRVMS. This function will generate vision rays and lines describing the geometric field of vision of rear view mirrors, along with reporting out the numerical results and summarizing the input data.

1.2 Applicability. This standard complies with USA and Canada standards, i.e., FMVSS 111 and CMVSS 111 respectively, for Inside and Outside Rear View Mirrors.

Note: ECE R46.01 is not met by this standard, but is instead covered by GMW15942.

Note: ECE R46.02 and UNECE R46.03 are not met by this standard, but is instead covered by GMW16224.

1.3 Remarks. This standard describes how to validate/certify the vision rays and lines describing the geometric field of vision of rear view mirrors. These vision rays and lines assist in demonstrating compliance with US and Canada standards, for Inside and Outside Rear View Mirrors (ISRVMS and OSRVMS).

While in the past a physical witness test was used to demonstrate that the vehicle's mirrors meet these requirements, this analysis procedure is the standard certification method currently conducted at GM. The certification analysis is done within UG through the Wizard Mirror Certification tool. A prerequisite for the mirror function when certifying the rear view mirrors according to the USA and Canada standards are eyellipses.

Note: Reference GMW16157 for additional requirements which support ISRVMS and OSRVMS certification.

2 References

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

2.1 External Standards/Specifications.

CMVSS 111	FMVSS 111	SAE J941	SAE J1100
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2.2 GM Standards/Specifications.

GMW16157

2.3 Additional References.

Note: The supplier shall work with the GM Design Responsible Engineer to comprehend these requirements.

- Eyellipse User Guide. Reference UG under the menu tool, select vehicle design automation, poke Occupant Packaging, select Eyellipse.
- GM Global Best Practice OSRVMS-9 Minimum Glass Size Requirements.
- GM Global Best Practice OSRVMS 103162.
- GM Global Best Practice ISRVMS-32 Inside Rearview Mirror Certification Requirements.
- GM Global Design infoBOOK: <http://gmna.gm.com/external/infobook/>
- Manual for the Field of Vision Function, (accessible within UG).

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- Mirror Certification User Guide. Reference UG under the menu tool, select Vehicle Design Automation, poke Vision Tools, Select Mirror Certification.
- Seating Arrangement Drawings available from Packaging Group. The seating arrangement excel sheet is found under Vehicle Packaging and Configuration web page under drawing index: <https://gmweb.gm.com/sites/AVDA/Pages/Vehicle-Packaging-and-Configuration.aspx>
- Suspension Heights and Wheel Travel document from Chassis department. In Teamcenter, under Total Vehicle, then Vehicle Integration Module, select Compartment Chassis.

3 Resources

3.1 Facilities.

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

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

3.2 Equipment. Access needed to a UG workstation with Vehicle Assembly Structure, (VAS).

3.3 Test Vehicle/Test Piece. See 4.3.1.1 for revision and variant rules.

3.4 Test Time. Not applicable.

3.5 Test Required Information. See Appendix A.

3.6 Personnel/Skills. Personnel capable of performing analysis for mirror certification function within UniGraphics.

4 Procedure

4.1 Preparation. The certification model is built up with parts from the VAS, 4.3.1.

4.1.1 Review the detailed information in the GM Global Design infoBOOK, at the following website:

<http://gmna.gm.com/external/infobook/>.

4.1.2 Review the Mirror Certification User Guide. This is part of the UG software package. Look under the menu tool, select vehicle design automation, poke Vision tools, Select Mirror Certification.

4.1.3 Review the GM Global OSRVM Best Practice OSRVM-9.

4.1.4 Review the GM Global ISRVM Best Practice ISRVM-32.

4.1.5 Review the Eyellipse User's Guide. This is part of the UG software package. Look under the menu tool, select vehicle design automation, poke Occupant packaging, select Eyellipse.

4.1.6 Review the Manual for the Field of Vision Function. This is part of the UG software package.

4.2 Conditions. Not applicable.

4.2.1 Environmental Conditions. Not applicable.

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

4.2.3. Coordinates. The Mirror Certification function is built on the assumption that the data is in vehicle position and follows GM data creation standards. In particular that X direction is established such that X increases from the front to the rear of the vehicle (length). The Z component increases from the ground upward (height), and that the Y component starts at the centerline of the vehicle and increases heading outboard to the right (cross-car). The standard GM coordinate system should be used, i.e., Cartesian right-oriented XYZ, system with axes according to Figure 1:

Where:

X: Rearwards in the vehicle, starting from in front of the front bumper

Y: Rightwards in the vehicle, starting from the center of the car

Z: Upwards, starting from below the body

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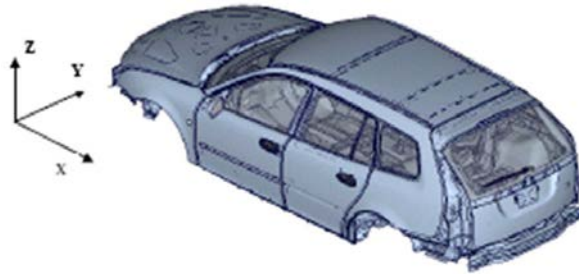


Figure 1: Standard GM Coordinate Directions

4.3 Instructions.

4.3.1 Certification Model.

4.3.1.1 The certification model is built up with parts from the VAS, or Teamcenter Engineering (TcAE). The parts, mirrors, backlight and other needed parts (e.g., side panel outer) shall have the revision rule equal to a status representing serial production before loading them into UG. Also make sure that the variant rule is set to the correct product line, body design, market specification and steering wheel position.

Note: The procedure can also be used during the development phase of a vehicle project. Then the revision rule shall be set to status which corresponds to the actual development phase.

4.3.1.1.1 The **hip point** and the values for the seat back angle and the seat travel have to be included. This is found in the Seating Arrangement Drawings from packaging group. Furthermore, the ground line has to be included. This originates from the vehicle loading. The points needed to create this line are found in the Suspension Heights and Wheel Travel Document from the Chassis Subsystem Management Team (SMT).

Note: For ISRVMs, use the ground line associated with Gross Vehicle Mass (GVM), and smallest tires.

Note: For OSRVM, use the ground line associated with Environmental Protection Agency (EPA) loading with two passengers, full fluids, full fuel, and largest tires. If the EPA ground line is not available, use the curb weight ground line. Gross Vehicle Mass is fully loaded, with as much as the vehicle can hold, versus Curb Weight, which is completely empty; the EPA loading is between these two extremes.

4.3.1.1.1.1 Driver Side Mirror. The FMVSS 111 and CMVSS 111 standard specifies that the target distance is 10.7 m behind the driver's ocular point for driver's side mirrors. For the mirror certification function the **ground wide point** must also be specified. (See glossary for definition of ground wide point). (Note that it may be different driver side **versus** passenger side). The target width for driver's side mirrors is 2.4 m outboard from the driver's side **ground wide point**. The field of view (FOV) generated by these targets for the driver's side OSRVM is shown in Figure 2.

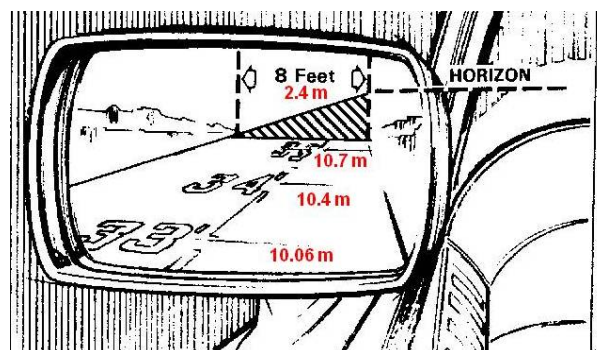


Figure 2: Driver's Side OSRVM FOV

4.3.1.1.1.2 Passenger Side Mirror. If the ISRVM cannot meet the vision requirements, an OSRVM, either flat or convex, must be added to the passenger's side of the vehicle. GMs internal practice for the passenger's side OSRVM is to meet the same requirements as the driver's side. As such, the target distance is 15.24m behind

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the driver's ocular point for passenger's side mirrors. For the Mirror Certification function the ground wide point must also be specified. (See glossary for definition of ground wide point). (Note that it may be different driver side versus passenger side). The target width for passenger's side mirrors is 3.66m outboard from the passenger's side ground wide point.

4.3.1.1.3 Inside Mirror. The FMVSS 111 and CMVSS 111 standard specifies that the target distance is 61.0 m behind the driver's ocular point for ISRV. In practice, this is calculated internally by the UG certification software based on the driver's eyellipse. The ISRV ground point is defined as a point at Y=0 (vehicle's centerline), 61 m behind the driver's ocular point along the ground line. Also, the mirror shall provide a field of view with an included horizontal angle measured from the projected eye point of at least 20 degrees. The FOV generated by these targets for the ISRV is shown in Figure 3.

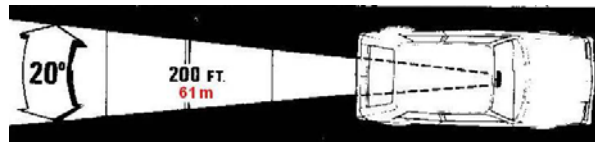


Figure 3: ISRV FOV

4.3.2 Certification Procedure.

4.3.2.1 The certification is done within UG through the function Mirror Certification in the general packaging menu. The Mirror Certification function provides numerical and visual performance of a given mirror design. Prior to this the eyellipse has to be created.

4.3.2.2 Eyellipse Creation. The Eyellipse functions allow UG users to create and manage SAE defined Eyellipse (SAE J941). These Eyellipses are developed by the statistical analysis of photogrammetric data of driver eye locations. The data used represents drivers in the 95th and 99th percentiles of the population mix. The drivers primarily represent the population of the US.

An Eyellipse output from this operator consists of three sets of ellipses. These include one for the left eye, one for the right eye, and one for the mid eye. Each set of ellipses consists of three ellipses, one in each of the three standard view planes. Each set also contains a three dimensional group of axis lines representing the center of each ellipse. A representation of the output is shown in Figure 4 and Figure 5. The center lines are bolded for clarity.

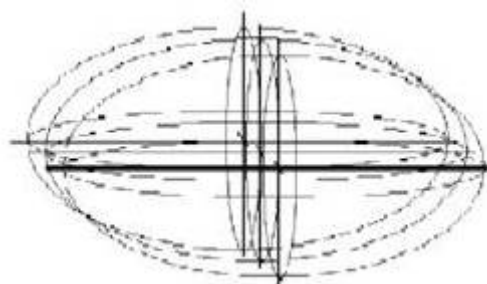


Figure 4: Overview of Eyellipses

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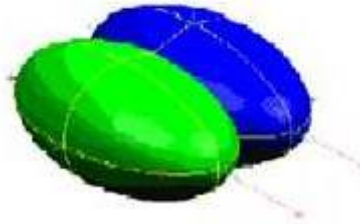


Figure 5: Eyellipses Created by Eyellipse Function

4.3.2.3 Eyellipses are defined by parameters that affect the coordinates (XYZ) of the center of the Eyellipse, the size of the Eyellipse, and the side of the vehicle in which the Eyellipse is located. Restrictions on the range of values for the parameters are derived from the latest SAE Recommended Practice, Motor Vehicle Drivers Eye Locations, and SAE J941.

4.3.2.4 For the certification of the rear view mirrors, the data shall represent the 95th percentile population mix and the restrictions on the range of values shall be derived from the SAE J941.

4.3.2.5 Eyellipse processing in UG will create a permanent data object that can be reviewed, selected, modified, or deleted. It allows the user to input data used to define an Eyellipse. The following parameters are required:

4.3.2.5.1 Hip Point (SgRP).

4.3.2.5.2 Back Angle (A40).

4.3.2.5.3 Percentile.

4.3.2.5.4 Seat Travel (L23).

4.3.3 Basic High Level Sequence.

4.3.3.1 Select the Standard for the eyellipse and then select OK to continue. This will lead to the next dialog: **Eyellipse Definition**.

4.3.3.2 Define the vehicle class and the eyellipse percentile. Choose **Class A** vehicle and the **95% Tangent Cutoff Eyellipse**, then select OK to continue. Next the **Hip Point**, **Back Angle** and **Seat Track Travel** selection dialog will be displayed.

4.3.3.3 Select the **hip point**, **SgRP (H-point)**, in the model. Set the **Back Angle** and the **Seat Track Travel** in the window dialog. Select OK to continue. This will lead to the next dialog: **Eyellipse Output Color Scheme**.

4.3.3.4 Specify the output color scheme, and select OK to continue. Next the Eyellipse function will calculate the eyellipse and put it into the model.

Note: For a detailed description of the mirror certification process, see Appendices A, B, and/or C in this procedure.

4.3.4 Mirror Certification.

4.3.4.1 It is the user that actually certifies the mirror when the results are compared to the established national rear view mirror standards. The Mirror Certification function for OSRVs is virtually identical for Driver Side and Passenger Side mirrors. Therefore, only the Driver Side Mirror Certification analysis is discussed.

4.3.4.2 Basic High Level Sequence Driver Side.

4.3.4.2.1 Select the **Location** and the **Standard** and select OK to continue. This will lead to the next dialog: **Mirror Definition**.

4.3.4.2.2 Follow the cue line messages and select all the required objects. Select OK to continue.

4.3.4.2.3 Select the eyellipse, and then select **next** to continue. This will lead to the next dialog: **Options**.

4.3.4.2.4 Change the Default Mirror Construction if desired, including adjusting the required Convex Radius. Do not select the **Deviate from Standard** option, unless specifically stated in the detailed steps of Appendices A, B or C. Select the restrictions to certify with mirror restrictions. Select OK from the Options dialog. This will lead to the next dialog: **Output Options**.

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4.3.4.2.5 Select the optional colors for output and then enter any user remarks. Select OK to continue the processing.

4.3.4.2.6 The mirror certification output will appear. Save this text to a file. This shall later be included in the simulation report.

Note: Per FMVSS 111 and CMVSS 111, vehicle level certification of the ISRVM is not required as long as the vehicle has **both** Driver side and Passenger side OSRVMs. Component level certification of the ISRVM (i.e., minimum reflective surface area, etc.) is the responsibility of the ISRVM supplier, since ISRVM are a Level III Supplier Integrated Commodity.

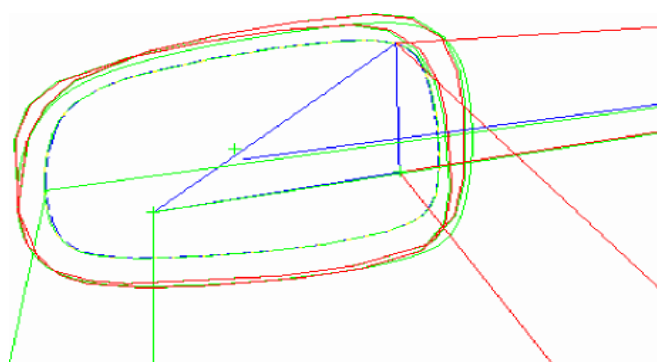
Note: For a detailed description of the mirror certification process, see Appendix A in this procedure for Eyellipse Creation, Appendix B for ISRVM, and/or Appendix C for OSRVMs.

4.4 Result Evaluation.

4.4.1 The results shall be presented as per the following examples in Table 1 and Table 2 and Figure 6 and Figure 7. Figure 8 shows the ISRVM output in the larger context of the analysis model.

Table 1: Table of Analyzed Models

	Outside Rear View Mirror: Driver's side (LH)
	Outside Rear View Mirror: Passenger's side (RH)
	Inside Rear View Mirror



Note: Picture of vision triangle displayed on the mirror glass for each mirror, as shown on the driver's side mirror.

Figure 6: OSRVM Output, Vision Triangle

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