



External Camera Lens Abrasion Test

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 test standard is to validate that the lenses of externally mounted cameras resist abrasion due to common mechanical and chemical elements that those lenses will be exposed to over the life of a vehicle.

1.2 Applicability. This test shall be applied to every camera mounted to the exterior of the vehicle. This includes but is not limited to rear, front and side mounted cameras.

1.3 Remarks.

1.3.1 The test shall be executed on cameras at the component level. It needs to be executed whenever a new camera is sourced.

1.3.2 After completing this test, if there is an engineering change to the shape of the outer lens surface, or of a change in lens material, this test shall be repeated.

1.3.3 Process changes to the camera lens shall be reviewed with the GM Component Validation Engineer (CVE) to determine if this test needs to be executed again.

2 References

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

2.1 External Standards/Specifications.

ISO 12103-1 ISO 12233 SAE J2527

2.2 GM Standards/Specifications.

GMW3172 GMW8738 (ID)

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

2.3 Additional References.

- CG3043.
- Component Technical Specification (CTS).
- General Motors Component EMC and Environmental Test (CEMENT) database.

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.

3.2.1 An ISO 12233 Test Chart (NT56-074).

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3.2.2 Macbeth ColorChecker color calibration chart.

(http://xritephoto.com/documents/literature/en/ColorData-1p_EN.pdf).

3.2.3 Spatial Frequency Response (SFR) - SFRplus chart.

3.2.4 Lens abrasion test fixture.

3.3 Test Vehicle/Test Piece. Not applicable.

3.4 Test Time. The following estimated test times are based upon a worst case of running abrasion cycles on one sample at a time.

Calendar time: 78 days

Test hours: 1872 h

Coordination hours: 8 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. The same general skill set used to set up and execute GMW3172 tests would be used to set up and execute the Ultraviolet (UV) and Abrasion Exposures defined in this standard. The same skill set used to validate the Image Evaluation requirements which are part of the normal Component Technical Speciation (CTS) would be used to execute the Image Evaluation Tests defined in this standard.

4 Procedure

4.1 Preparation. Not applicable.

4.2 Conditions.

4.2.1 Environmental Conditions. This test can be run at ambient room temperature (20 ± 5) °C.

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

4.3 Instructions.

4.3.1 Abrasion Tests.

4.3.1.1 Image Evaluation Tests. Twenty-four (24) samples of the camera shall be tested according to the tests in Appendices A and B and C. Photographs of each lens shall be taken (at 5x magnification). The purpose of these tests and pictures is to establish conforming material entering the abrasion test and to establish a performance base line against which to compare the post abrasion results. All 24 samples have to pass these tests. Non-conforming material shall enter the closed loop problem resolution process. Non-conforming material shall be replaced until there are 24 samples which pass these Image Evaluation Tests.

4.3.1.2 Dry Abrasion Exposure - First Half. After passing the Image Evaluation Tests, all 24 samples of the camera shall then be exposed to the UV exposure schedule per Appendix D. All 24 samples will then be exposed to abrasive compounds, by executing the First Half of the Dry Abrasion Test Cycle in Appendix E. All 24 samples of the camera shall then be visually inspected and photographed.

4.3.1.3 Wet Abrasion Exposure. All 24 samples of the camera shall then be exposed (again) to the UV exposure schedule per Appendix D. All 24 samples will then be exposed to abrasive compounds, according to the Wet Abrasion test plan in Appendix E. All 24 samples of the camera shall then be visually inspected and photographed.

4.3.1.4 Dry Abrasion Exposure – Second Half. The cameras under test shall be rotated 90° from their orientation in the First Half of the Dry Abrasion test. All 24 samples will then be exposed to abrasive compounds, by executing the Second Half of the Dry Abrasion Test Cycle in Appendix E. All 24 samples of the camera shall then pass the Image Evaluation Tests and be photographed.

4.3.1.5 Test Flow – Abrasion Tests. See Figure 1.

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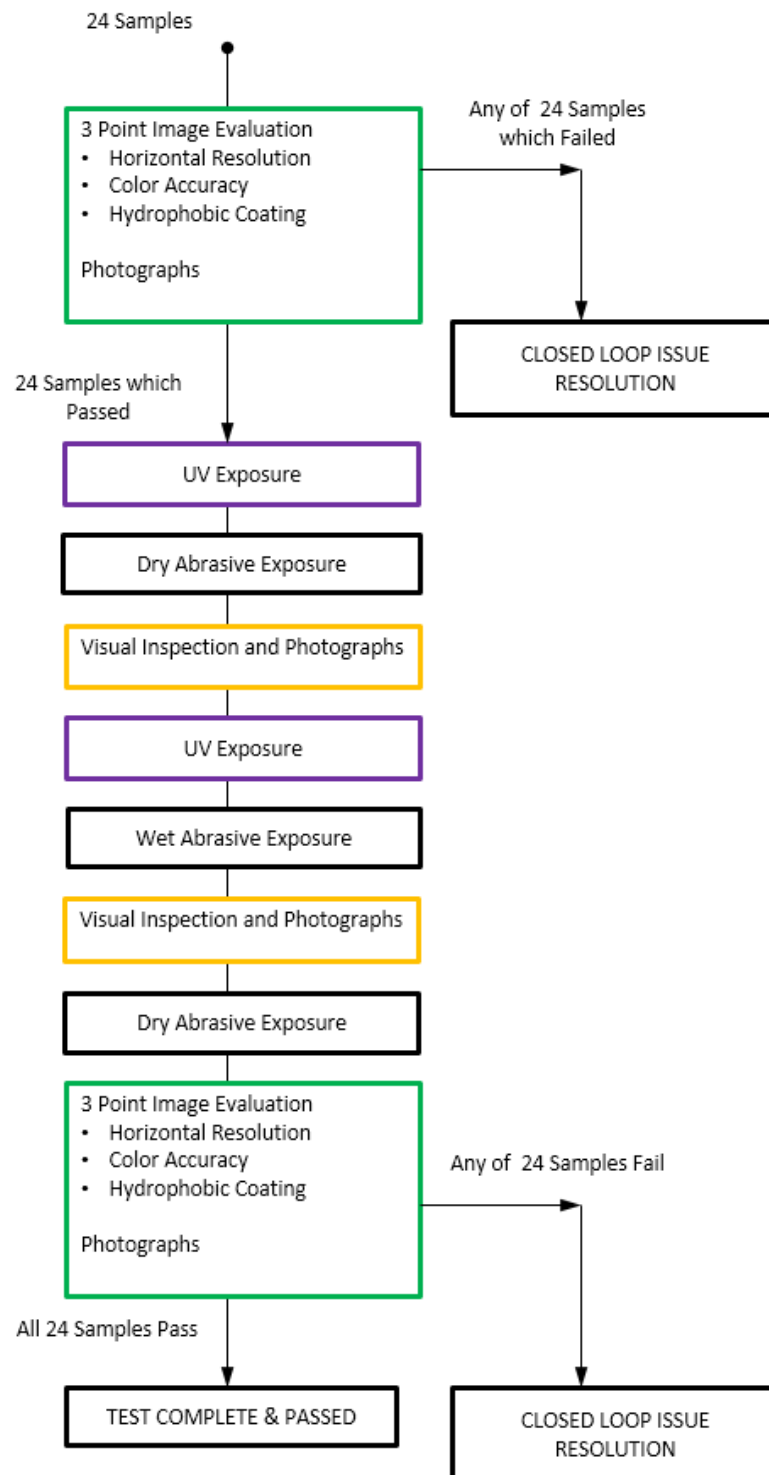


Figure 1: Test Flow

4.3.2 Accumulation Tests.

4.3.2.1 Image Evaluation Tests. Six (6) samples of the camera shall be tested according to the tests in Appendices A and B and C. Photographs of each lens shall be taken (at 5x magnification). The purpose of these tests and pictures is to establish conforming material entering the accumulation test and to establish a

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performance base line against which to compare the post accumulation results. All six (6) samples have to pass these tests. Non-conforming material shall enter the closed loop problem resolution process. Non-conforming material shall be replaced until there are six (6) samples which pass these Image Evaluation Tests.

4.3.2.2 Accumulation Test. After passing the Image Evaluation Tests, all six (6) samples of the camera shall then be exposed to the Accumulation Schedule per Appendix F. All six (6) samples will then be exposed to saline, dust, methanol and ethylene glycol by executing the Accumulation Cycle in Appendix F. All six (6) samples of the camera shall then be visually inspected and photographed. All six (6) samples of the camera shall then pass the Image Evaluation Tests and be photographed.

4.3.3 Test Plan.

GMW17555 External Lens Abrasion Test shall be included in the GMW3172 Component Environmental Development Validation/Product Validation (DV/PV) Test Plan (also known as CG3043 Test Plan) and shall be approved in Component Electro-Magnetic Compatibility (EMC) and Environmental Test (CEMENT) database with the rest of the CG3043. The following sections of the CG3043 Test Plan will need to be updated:

- Section 1.5 - The Test Requirements Table shall be updated to include External Lens Abrasion Test in the "Additional Activities" area. The number of samples to be tested shall be documented in the correct column(s).
- Section 1.6 - the Development Validation (DV) and/or Product Validation (PV) Test Flow shall include the Test Flow shown in 4.3.1.5 of this document (GMW17555).
- Section 7.1 - the External Lens Abrasion Test Procedure shall be documented in this section.

The GM Component Validation Engineer shall be responsible to review/approve the External Lens Abrasion Test documentation in the CG3043.

Note: In CEMENT, for the procedure association, choose "Others" to document the inclusion of the External Lens Abrasion Test.

5 Data

5.1 Calculations. Appendix A (Horizontal Resolution Tests), Appendix B (Color Accuracy) and Appendix C (Hydrophobic Lens Coating) all have quantified Compliance Data clearly listed. There are no calculations involved, but rather pure measurements.

5.2 Interpretation of Results. Appendix A (Horizontal Resolution Tests), Appendix B (Color Accuracy) and Appendix C (Hydrophobic Lens Coating) all have quantified Compliance Data clearly listed. Interpretation of results is a PASS/FAIL when the Compliance Data is compared against the thresholds.

5.3 Test Documentation. Test data templates for all image evaluation tests are included in Appendices A (Horizontal Resolution Tests), Appendix B (Color Accuracy) and Appendix C (Hydrophobic Lens Coating).

Supplier shall include External Lens Abrasion Test results in their DV and/or PV Test Report for the testing documented in the CG3043 Test Plan.

These templates shall be completed with measurements and PASS/FAIL evaluation and stored in CEMENT. In CEMENT, the External Lens Abrasion Test results shall be uploaded to the "Others" procedure section.

The GM Component Validation Engineer shall be responsible to review/approve the External Lens Abrasion Test results in CEMENT.

6 Safety

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

6.1 Safety Precautions.

- Follow all manufacturer's safety recommendations for whatever articulating machine is used to apply the grit, washer fluid and salt solution.
- Wear eye goggles when setting up and running this test.

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7 Notes

7.1 Glossary.

CIE76: A 1976 formula for color-difference.

CIELAB (L*a*b* color space): Commission Internationale de l'Eclairage (International Commission on Illumination) representation of colors using the coordinates in a uniform color space consisting of lightness variable L* and chromaticity indices a* and b*.

HSV: Hue, Saturation, Value. It is a nonlinear transformation of the Red Green Blue (RGB) color space.

SFRplus: Spatial Frequency Response test chart.

sRGB: Color space lies near the center of the (Red Green Blue) RGB circle

YUV: Color space typically used as part of a color image pipeline.

7.2 Acronyms, Abbreviations, and Symbols.

A_{CL-LS}	Angle from Centerline to Light Source
C	Camera
CC	Color Checker
CEMENT	Component EMC and Environmental Test (database)
CL	Centerline
CTS	Component Technical Specification
CVE	Component Validation Engineer
cy/pxl	Cycle/pixel
D_{CC-C}	Distance between the Color Checker and the Camera
D_{CC-LS}	Distance between the Color Checker and the Light Source
DMFC	Dry Mesh Fire Clay
DSLR	Digital Single-Lens Reflex
DV	Development Validation
DV/PV	Development Validation/Product Validation
EMC	Electro-Magnetic Compatibility
FDM	Full Display Mirror
FOV	Field of View
H_{C-CC}	Height of Camera to the Color Checker
H_{LS-CC}	Height of Light Source to Color Checker
LM	Light Measurement
LS	Left Side
LS	Light Source
LW/PH	Line Widths per Picture Height
No.	Number
PV	Product Validation
RGB	Red Green Blue
RS	Right Side
RVC	Rear View Camera
SFR	Spatial Frequency Response
UV	Ultraviolet

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8 Coding System

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

Test to GMW17555

9 Release and Revisions

This standard was originated in January 2016. It was first approved by Electrical - Electrical Components and Subsystems in March 2016. It was first published in March 2016.

Issue	Publication Date	Description (Organization)
1	MAR 2016	Initial publication.

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