REPORT NUMBER 111-GTL-21-001

SAFETY COMPLIANCE TESTING FOR FMVSS NO. 111 REAR VISIBILITY (REARVIEW IMAGE ONLY)

BAYERISCHE MOTOREN WERKE AG
2021 BMW X4 MPV
NHTSA NO. C20214100

GENERAL TESTING LABORATORIES, INC.
1623 LEEDSTOWN ROAD
COLONIAL BEACH, VIRGINIA 22443

December 10, 2020

FINAL REPORT

PREPARED FOR

U. S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
MAIL CODE: NEF-220
1200 NEW JERSEY AVE., SE
WASHINGTON, D.C. 20590

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The 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. The United States Government does not endorse products or manufacturers.

Prepared By: Debbie Messick

Approved By: Grant Farrand

Approval Date: 12/10/20

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By:

Acceptance Date: 12/10/2020

Technical Report Documentation Page

1. Report No. 111-GTL-21-001	2. Government Accession No. N/A	3. Recipient's Catalog No. N/A
4. Title and Subtitle Final Report of FMVSS 111 Compliance Testing (Rearview Image) of a 2021 BMW X4 MPV NHTSA No. C20214100		5. Report Date December 10, 2020 6. Performing Organ. Code GTL
7. Author(s) Grant Farrand, Project Engineer Debbie Messick, Project Manager		8. Performing Organ. Rep# GTL-DOT-21-111-001
9. Performing Organization Name and Address General Testing Laboratories, Inc. 1623 Leedstown Road Colonial Beach, Va 22443		10. Work Unit No. (TRAIS) N/A 11. Contract or Grant No. DTNH22-16-D-00031
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Admin. Enforcement Office of Vehicle Safety Compliance (NVS-210) 1200 New Jersey Ave., S.E. Washington, DC 20590		13. Type of Report and Period Covered Test Date October 15- November 5, 2020 14. Sponsoring Agency Code NVS-210

15. Supplementary Notes

16. Abstract

Compliance testing was conducted on the subject, 2021 BMW X4 MPV in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-111V-01 for the determination of FMVSS 111 Compliance. Note that only Section 13B, Rearview Image, was performed.

Test failures identified were as follows: None

17. Key Words Compliance Testing Safety Engineering FMVSS 111	18. Distribution Statement Copies of this report are available from NHTSA Technical Information Services (TIS) (NIO-120) 1200 New Jersey Ave., S.E.(Room E12-100) Washington, DC 20590 Telephone No. (202) 366-4946	
19. Security Classif. (of this report) UNCLASSIFIED	21. No. of Pages 55	22. Price
20. Security Classif. (of this page) UNCLASSIFIED		

Form DOT F 1700.7 (8-72)

TABLE OF CONTENTS

SECTION		PAGE
1	Purpose of Compliance Test	1
2	Compliance Test Procedure and Results Summary	2
3	Compliance Test Data	4
4	Test Equipment List	19
5	Photographs	20

5.1 ¾ Left Front View of Vehicle
5.2 ¾ Right Front View of Vehicle
5.3 Vehicle Certification Label
5.4 Vehicle Tire Information Label
5.5 Left Side View of Vehicle, Test Setup
5.6 Right Side View of Vehicle, Test Setup
5.7 View of Cone Placement
5.8 Rear Camera Mounting
5.9 Camera Mount Placed in Driver Seat
5.10 Camera Mount
5.11 Rearview Image Display
5.12 Photograph of Image used for Measurements
5.13 Photograph used to Evaluate Field-Of-View and to Measure Test Object A
5.14 Photograph used to Evaluate Field-Of-View and to Measure Test Object B
5.15 Photograph used to Evaluate Field-Of-View and to Measure Test Object C
5.16 Photograph of Scale Measurement
5.17 Measurement Data
5.18 Event Timer Set-up
5.19 Backup Light Sensor Setup
5.20 Driver Door Sensor Set-up
5.21 Response and Linger Time Test #1
5.22 Response and Linger Time Test #2
5.23 Response and Linger Time Test #3
5.24 Humidity and Salt Spray Chamber
5.25 High Temperature Test Chamber
5.26 Low Temperature Test Chamber
5.27 Front View of Rearview Camera Removed from Vehicle
5.28 Rear View of Rearview Camera Removed from Vehicle
5.29 Side View of Rearview Camera Removed from Vehicle
5.30 Rear View Camera Mounted in Plexiglass Box -Pre-Test
5.31 Camera Image Post Test Durability Testing

SECTION 1

PURPOSE OF COMPLIANCE TEST

1.0 PURPOSE OF COMPLIANCE TEST

A 2021 BMW X4 MPV was subjected to Federal Motor Vehicle Safety Standard (FMVSS) No. 111 testing to determine if the vehicle was in compliance with the requirements of the standard. All tests were conducted in accordance with NHTSA, Office of Vehicle Safety Compliance (OVSC) Laboratory Procedure, TP-111V-01 and General Testing Laboratories, Inc. (GTL) Test Procedure, "Rear Visibility". Note that only Rearview Image testing was performed.

1.1 TEST VEHICLE

The test vehicle was a 2021 BMW X4 MPV. Nomenclature applicable to the test vehicle are:

A. Vehicle Identification Number: 5UX2V1C07M9E28033

B. NHTSA No.: C20214100

C. Manufacturer: BAYERISCHE MOTOREN WERKE AG

D. Manufacture Date: 09/20

1.2 TEST DATE

The test vehicle was subjected to FMVSS No. 111 testing on October 15-November 5, 2020. (Rearview image testing only)

SECTION 2

COMPLIANCE TEST PROCEDURE AND SUMMARY OF RESULTS

2.0 COMPLIANCE TEST PROCEDURE

The BMW X4 was subjected to FMVSS 111 Rear Visibility compliance testing on October 15-November 5, 2020 using Test Procedure TP-111V-01. Only Rearview Image testing was performed.

2.1 INSPECTION

Inspected the vehicle per the test procedure and recorded information on Data Sheet 8.

2.2 FIELD OF VIEW TEST (S5.5.1, S6.2.1 and S14)

Rearview image must display a minimum of a 150 mm wide portion along the circumference of each test object located at positions F and G as shown at Figure 14 in the test procedure. Rearview image must display the full width and height of each test object located at positions A through E as shown in Figure 14 in the test procedure. The requirements were complied with.

2.3 TEST OBJECT SIZE (S5.5.2 and S6.2.2)

Rearview image measured in accordance with 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 13 of the test procedure must average not less than 5 minutes of arc and each individual test object (A,B and C) must not be less than 3 minutes of arc. The requirements were complied with.

2.4 RESPONSE TIME (S5.5.3 and S6.2.3)

Rearview image meeting the requirements of S6.2.1 and S6.2.2 when tested in accordance with S14.2 must be displayed within 2.0 seconds of the start of a backing event (transmission gear selector placed in reverse). The requirements were complied with.

2.5 LINGER TIME (S5.5.4 and S6.2.4)

Determined that the Rearview image meeting the requirements of S5.5.1 and S5.5.2 (S6.2.1 and S6.2.2) was not displayed after the backing event had ended. The requirements were complied with.

SECTION 2 CONTINUED

2.6 DEACTIVATION (S5.5.5 and S6.2.5)

Rearview image must meet the requirements of S6.2.1 and S6.2.2 remain visible during the backing event until either the driver modifies the view or the vehicle direction selector is removed from the reverse position. The requirements were complied with.

2.7 DEFAULT VIEW (S5.5.6 and S6.2.6)

Rear visibility system defaults to the Rearview image meeting the requirements of 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 had previously selected. The requirements were complied with.

2.8 DURABILITY (S5.5.7 and S6.2.7)

Rearview system must meet the Field of View Requirements and the Test Object Image Size Requirements after each durability test; i.e. Corrosion S14.3.1, Humidity S14.3.2 and Temperature S14.3. The requirements were complied with. This testing was abbreviated as described on Data Sheet 15.

2.9 SUMMARY OF RESULTS

Based on the tests performed, the test vehicle appears to be in compliance with the requirements of FMVSS 111, Rear Visibility for Rearview Image testing.

SECTION 3

COMPLIANCE TEST DATA

3.0 TEST RESULTS

The following data sheets document the results of FMVSS 111, Rear Visibility testing on the 2021 BMW X4 MPV utilizing TP-111V-01. Note that only Rearview Image testing, Section 13B was performed.

REARVIEW IMAGE TESTING:

DATA SUMMARY SHEET
FMVSS 111 - REARVIEW IMAGE TESTING

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
VEH. BUILD DATE 09/20 TEST DATE: OCTOBER 15 – NOVEMBER 5, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

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

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

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 15, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

1. Reinstall Driver seat and remove vehicle stabilizing jack stands, if used previously for mirror testing N/A

2. Identify any Defects or imperfections for visual display or camera None Observed

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

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

   Describe any protective screen/plastic or curved surface over the visual display? None

   Specify if cover is removed to improve test measurement with ruler accuracy N/A

5. Display Manufacturer/Model Not Found

6. Rearview display height, width, diagonal and reference to ground angle? 95 mm high, 245 mm wide, 260 mm deep, Angle = +17º FWD.

7. Display part of multi-function display? Yes

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

9. Describe if any visual display adjustments for contrast, brightness, or resolution can be made prior to or after backing event Brightness and Contrast are available for adjustment prior to and during the backing event.

10. Can the rearview image be disabled by driver? Yes If yes, describe method It can be disabled by the driver after the backing event has started.

11. Interior display adjustable for rotation, angle, telescoping? No

12. Is Interior display recessed? No If so, how raised and time to do so

13. Transmission gear selector is lever type, rotational, or pushbutton Electronic Lever on center console.

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

14. Is transmission gear selector recessed and not functional until fully raised No . If so, how raised and time to do so _____

15. Rearview image displayed in any gear position other than reverse? Yes

16. Can default rearview image be set to standard, wide angle, etc. No

17. Default rearview image automatically includes overlay, bird's eye view, path projection, messages, etc. Does overlay vary based on steering input Path projection guidelines and obstacle location overlays can be turned on or off

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.) Yes If so how accomplished Overlays can be turned on or off and brightness and contrast can be adjusted by on screen touch.

19. Height from ground to center point of rearview image lens 665 mm

20. Lateral position of center point of rear camera measured from vehicle centerline 0 mm Camera is on vehicle centerline.

21. Angle in degrees of camera lens plane with reference to ground 20º Down

22. Any vehicle body point which extends rearward of camera lens plane Rear bumper

23. Is the vehicle equipped with a rear bumper Yes

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

25. Determine if there are options for the driver to select various default rearview images prior to the backing event and if 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. No optional views are available.

26. Can Brightness/Contrast be set to a level at which subsequent backing event required image is not visible? No

REMARKS:

RECORDED BY: G. Farrand APPROVED BY: D. Messick DATE: 10/15/20

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

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 15, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

GENERAL VEHICLE and SETUP INFORMATION (Field-of-view and Test Object Size):

GVWR:	2400	kg
FRONT GAWR:	1135	kg
REAR GAWR:	1380	kg
UNLOADED WEIGHT (optional):	1859	kg
CARGO WEIGHT:	85	kg
TOTAL RATED LOAD:	425	kg

DESIGNATED SEATING POSITIONS 5
Measured Vehicle Interior Temperature 23 ºC
Measured Exterior Ambient Temperature 23 ºC

Measured Ambient Illumination LUX : Roof 8600 (Required 7000 to 10000 LUX)
Top surface of Cylinder B 4130 (Information Purposes)
Measured tire inflation pressure 220 Kpa Front, 260 Kpa Rear
Verify Fuel Tank is full: Yes

Ballast added to vehicle for occupant load (five occupants max.) DSP x 68 kg = 340 kg

Rear hatches or trunk lids closed and latched: Yes

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

Driver seat adjusted to lowest point of vertical travel? Yes

Driver seat cushion have tilting feature and set to mid-tilt? Yes
Lumbar setting? Fully Deflated

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 25.0

Driver seat back adjusted so that vertical portion of the H-point machine torso weight hanger is at 25 degrees? Yes

Interior Display adjustment if equipped with rotational mounting adjustment? No

Steering wheel adjustments made Straight Forward
If so equipped, visual display settings for contrast, brightness, and resolution Mid Setting

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

Coordinates measured from H-point X, or fixed point on vehicle body _____:

	X	Y	Z
H- Hip H-Point	+125	C/L of Seat	-225
J - Head/Neck Joint Center	-196	0	588
J2 – Orgin of Mf rotation	-196	0	635
M_f Forward-Looking Eye Midpoint	-96	0	635
M_R – Eye Mid-point Rotated (X,Y,Z value or degrees rotated)	27ºR		16º DOWN
M_R – Eye Mid-point Rotated (If manufacture supplied)	N/A	N/A	N/A

(All of the above values except H-Point and M_R, should be identical to those indicated in the standard.)

Measured shortest straight-line distance between M_R and the Center of the display 775 = (a_{eye})
Method used to make measurement Steel Tape Measure
Manufacturer supplied a_{eye} value 650 mm

PHOTOGRAPHIC DATA EXTRACTION:
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 YES
   Test Object G YES
   YES X Pass, NO _____ Fail

2. The full width and height of test objects visible:
   Test Object A YES
   Test Object B YES
   Test Object C YES
   Test Object D YES
   Test Object E YES
   YES X Pass, NO _____ Fail

Indicate if any test objects are obscured by a default overlay None Obscured

[Include photographic documentation in final report]

REMARKS: Measurement to Centerline of Door Striker

TEST RESULTS: PASS X FAIL _____

RECORDED BY: G. Farrand APPROVED BY: D. Messick DATE: 10/15/20

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

(Complete test for any view such as wide angle, which appears may comply with requirements)

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 21, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

Image Size from photograph (S5.5.2):

Apparent length of 50mm delineated section of the in-photo ruler 111.56

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 3.60 = d_a
Test Object B 3.60 = d_b
Test Object C 3.60 = dc

Scaling Factor:
Apparent Length/ 50mm = 111.56/50 = 2.2312 S scale

Actual distance from the rotated eye midpoint location (Mr) to the center of the rearview image (a_{eye}) = 775

Visual Angle subtended by test Objects:

For Test object:
Test Object A 0º 7’ 9” arc minutes
Test Object B 0º 7’ 9” arc minutes
Test Object C 0º 7’ 9” arc minutes
Method used to make measurement Digital Caliper

Each individual test object horizontal width not less than 3 minutes of arc?
YES X Pass, NO_____ Fail
Average for A, B,C, = 0º 7’ 9”
Not less than 5 minutes of arc YES X Pass, NO_____ Fail

Include data reduction for arc min determination if pixel measurements used.
[Include photographic documentation in final report]

REMARKS:

TEST RESULTS: PASS X FAIL _____

RECORDED BY: G. Farrand APPROVED BY: D. Messick DATE: 10/21/20

DATA SHEET 11
RESPONSE TIME (S5.5.3, S6.2.3)

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 21, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

Measured vehicle interior compartment Temperature 23.3 (Required 15 to 25 C)

Measured Exterior Ambient Temperature 23.3

Measured Ambient Illumination LUX @ Roof Center 8600 (Required 7000 to 10000LUX) at Test Object B Surface 4130

Method used to establish rear visibility system is at lowest power resting state Key off for 10 minutes and amp probe on battery cable (manufacturer supplied information?)

Method used to establish time zero for door opening Magnetic Door Edge Switch

Method used to establish time zero for gear selector in reverse (rear back-up lights, video etc) Photo Sensor on Back-up light and Video

Type of gear selector (lever, rotating knob, pushbutton) Lever

If rear back-up lights utilized, indicate time lag from selector in reverse and rear backing lights activated None Observed

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

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
1	5.238	0.567	YES
2	4.604	1.034	YES
3	4.637	0.700	YES

REMARKS:

TEST RESULTS: PASS X FAIL

RECORDED BY: G. Farrand APPROVED BY: D. Messick DATE: 10/21/20

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

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 21, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

Measured Exterior Ambient Temp. 23.3º C

Manufacturer Selection – COR Supplied Information:

Indicate Termination of backing event	
Forward Speed 10 mph	X
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) 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. NO

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

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 not greater than 10 seconds. (PASS/FAIL)
1	YES	8 mph	PASS
2	YES	8 mph	PASS
3	YES	8 mph	PASS

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

TEST RESULTS: PASS X FAIL _____

RECORDED BY: G. Farrand APPROVED BY: D. Messick DATE: 10/21/20

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

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 21, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

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	On Screen	Extinguished	Home Menu
2	On Screen	Extinguished	Setting Menu
3	Center Console	Extinguished	Map Menu

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	On Screen	Extinguished	Home Menu
2	On Screen	Extinguished	Settings Menu
3	Center Console	Extinguished	Map Menu

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. NO

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. NO

REMARKS:

TEST RESULTS: PASS X FAIL

RECORDED BY: G. Farrand APPROVED BY: D. Messick DATE: 10/21/20

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

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 21, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

Is the required rearview image capable of being deactivated or modified after initiation of the backing event: YES
If so, describe After backing event has begun, the image can be de-activated for other displays.

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	✓	YES
2	✓	YES
3	✓	YES

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	✓	YES
2	✓	YES
3	✓	YES

Note if the default display includes any automatic overlays and if so, does the overlay obscure any of the test object cylinders (not permissible) Yes. The image has a default overlay which does not obscure view of cylinder.

Note if the driver can manually add overlays to the image and if so describe Yes, Overlays for trajectory and close objects can be turned on or off.

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	✓	Prior	Menu	Yes
2	✓	Prior	Map	Yes
3	✓	After	Home	Yes

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	✓	Prior	Menu	Yes
2	✓	Prior	Map	Yes
3	✓	After	Home	Yes

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 __NO__ (not permissible – at start of backing event rear image must be present regardless of actions taken prior to backing event.)

REMARKS:

TEST RESULTS: PASS __X__ FAIL _____

RECORDED BY: __G. Farrand__ APPROVED BY: __D. Messick__ DATE: __10/21/20__

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

VEH. MOD YR/MAKE/MODEL/BODY: 2021 BMW X4 MPV
VEH. NHTSA NO: C20214100 ; VIN: 5UX2V1C07M9E28033
TEST DATE: OCTOBER 21 – NOVEMBER 5, 2020
TEST LABORATORY: GENERAL TESTING LABORATORIES

Model, Manufacturer of camera(s) ASA, 139605-14, 7216065

Plane of rear Camera Lens Angle with reference to ground	20º Down
Vertical height from ground to center of camera lens	665 mm
Lateral position of camera lens center	C/L of Vehicle
Number of connecting camera cables	1
Number of camera cable connector pins	8
Method of Camera attachment to Vehicle (screw, rivet, etc.)	Plastic Clips
OEM sealant or gaskets used on vehicle for sealing camera to rear of vehicle	None

Indicate if manufacturer supplied environmental test fixture was utilized NO

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

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

VISUAL OBSERVATION:

	Pre Durability Testing	POST Corrosion Exposure	POST Humidity Exposure	POST Temperature Exposure
Camera housing condition	OK	OK	OK	OK
Camera Connector and wiring	OK	OK	OK	OK
Camera lens Clarity	OK	OK	OK	OK
Signs of lens Corrosion	NONE	NONE	NONE	NONE
Signs of Lens Water intrusion	NONE	NONE	NONE	NONE

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

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

REMARKS: Post Durability field-of-view and test image size evaluation was based on reviewing photograph of image on monitor using camera hand-held (without H-point machine). Position of camera was in approximate location as original. In addition, vehicle had been moved from initial testing position, then repositioned for the follow-up tests. As such the photographs and test object positions may not appear exactly as shown in initial photographs. Test object size not specifically measured. Compliance based on visual observation that required image present and appears unchanged from original test. This was done for test brevity and was authorized by NHTSA COTR. As such, there are no repeat Data Sheets 9 or 10 shown below for this durability section. Note also test photographs of the camera lens and rearview image were not taken between temperature and humidity conditioning. For brevity, the conditioning was combined followed by camera and rearview image final post durability photographs.

After all conditioning, cameras were functional and appeared to provide required image.

TEST RESULTS: PASS__X__ FAIL_____
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

SECTION 4
INSTRUMENTATION AND EQUIPMENT LIST

TABLE 1 - INSTRUMENTATION & EQUIPMENT LIST

EQUIPMENT	DESCRIPTION	MODEL/ SERIAL NO.	CAL. DATE	NEXT CAL. DATE
COMPUTER	AT&T	U86D66	BEFORE USE	BEFORE USE
CAMERA MOUNT TEST FIXTURE	GTL	N/A	BEFORE USE	BEFORE USE
A/D INTERFACE	METRABYTE	CT91	BEFORE USE	BEFORE USE
SIGNAL CONDITIONER	METRYBYTE	EXP-RES	BEFORE USE	BEFORE USE
LOAD CELL	SENSOTEC	41/571-07 257818	03/20	03/21
INCLINOMETER	MITUTOYO	PRO360	BEFORE USE	BEFORE USE
LINEAR POTENTIOMETER	CELESCO	15/369	BEFORE USE	BEFORE USE
PRECISION STEEL SCALE	STARRETT	C416R	03/20	03/21
REFLECTOMETER	GTL	N/A	BEFORE USE	BEFORE USE
SPHEROMETER	GTL	N/A	BEFORE USE	BEFORE USE
DISPLAY TIMERS	GTL	EVENT TIMER 123	BEFORE USE	BEFORE USE
LIGHT METER	COOKE	CAL-LIGHT 400L	BEFORE USE	BEFORE USE
V-BOX	GPS BASED SPEED/ DISTANCE	RACELOGIC V-BOX 2	BEFORE USE	BEFORE USE
TEMPERATURE HUMIDITY DATA LOGGER	FLUKE HYDRA	HYDRAII	11/19	11/20
CAMERA	NIKON DIGITAL SLR CAMERA WITH INTERCHANGE-ABLE “F” MOUNT LENSES. EFFECTIVE PIXELS 24.2 MILLION. CCD; 23.7X15.6 MM.	D5600	N/A	N/A

SECTION 5

PHOTOGRAPHS



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.1
¾ LEFT FRONT VIEW OF VEHICLE



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.2
¾ RIGHT REAR VIEW OF VEHICLE



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.3
VEHICLE CERTIFICATION LABEL



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.4
VEHICLE TIRE INFORMATION LABEL



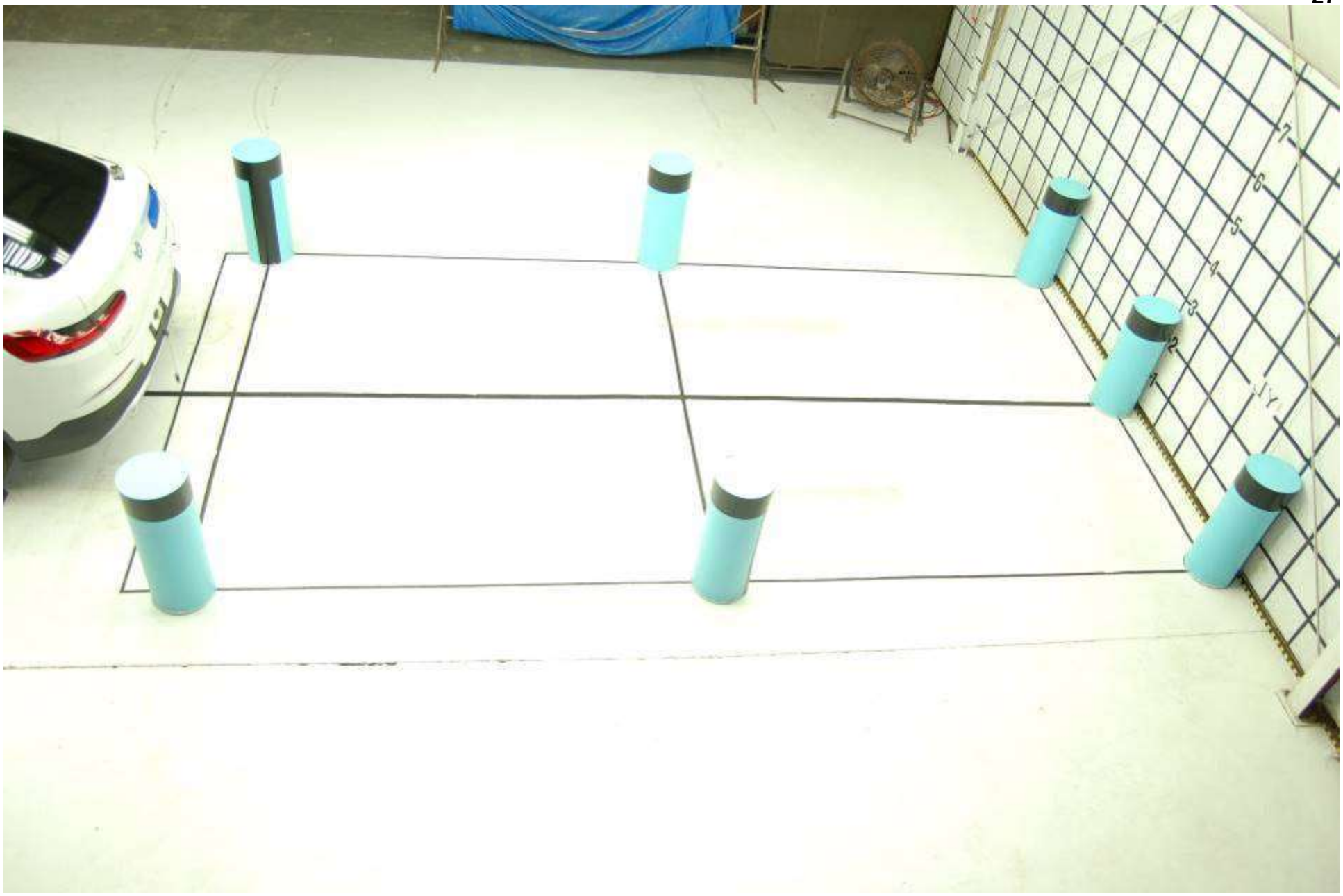
2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.5
LEFT SIDE VIEW OF VEHICLE, TEST SETUP



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.6
RIGHT SIDE VIEW OF VEHICLE, TEST SETUP



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.7
VIEW OF CONE PLACEMENT



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.8
REAR CAMERA MOUNTING, REAR VIEW



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.9
CAMERA MOUNT PLACED IN DRIVER'S SEAT



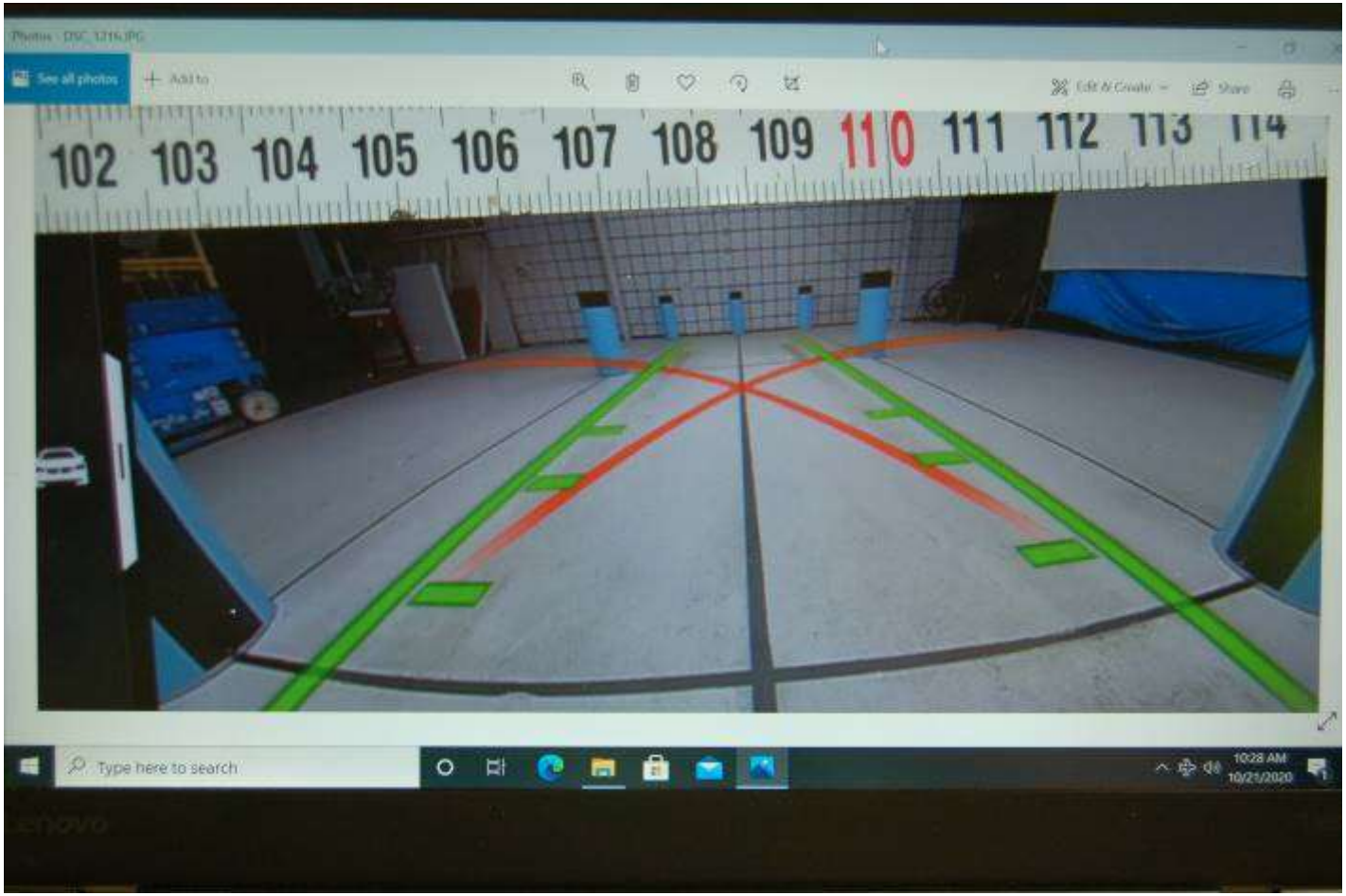
2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.10
CAMERA MOUNT



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.11
REARVIEW IMAGE



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.12
PHOTOGRAPH OF IMAGE USED FOR MEASUREMENTS



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.13
PHOTOGRAPH USED TO EVALUATE FIELD-OF-VIEW AND TO MEASURE TEST OBJECT A



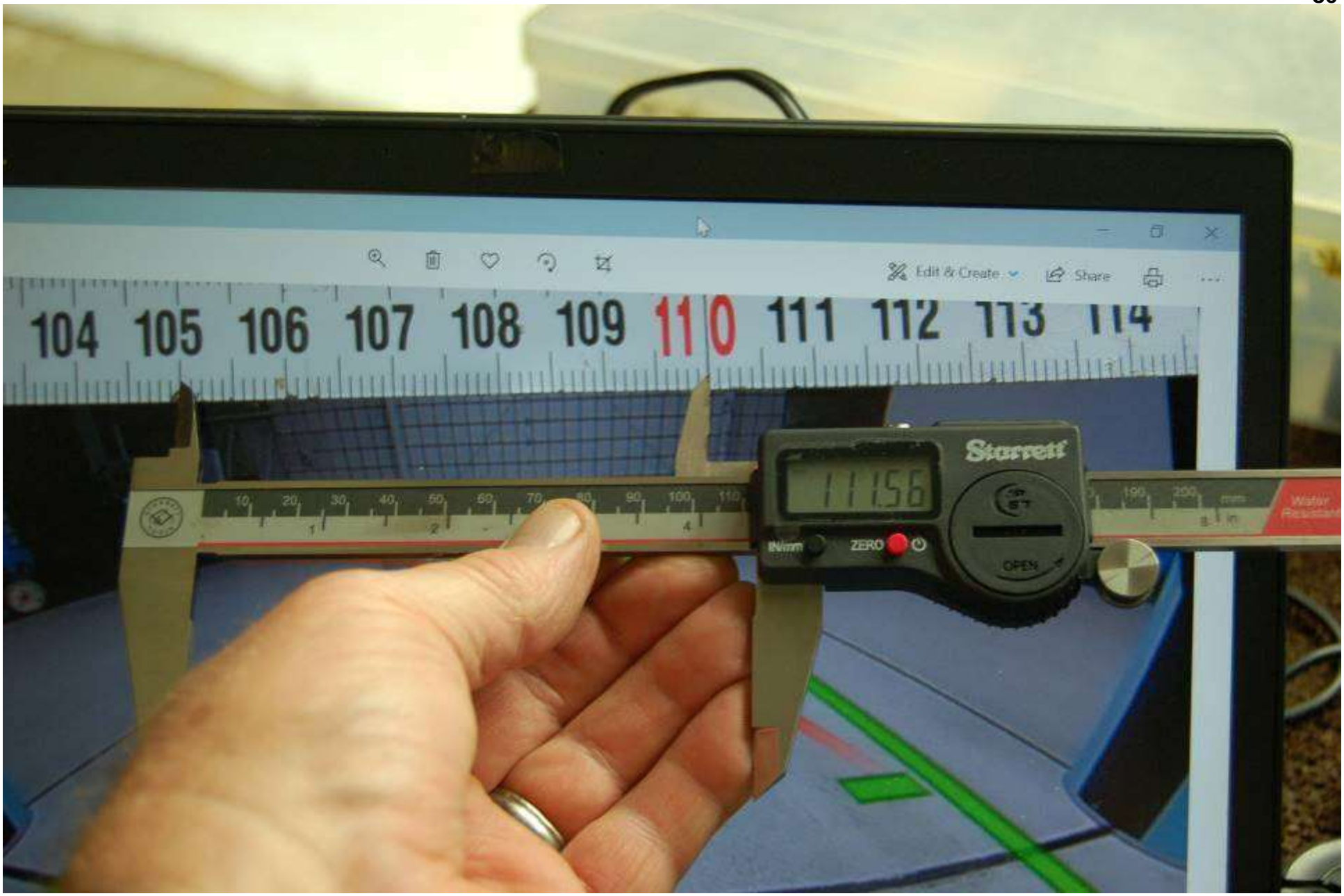
2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.14
PHOTOGRAPH USED TO EVALUATE FIELD-OF-VIEW AND TO MEASURE TEST OBJECT B



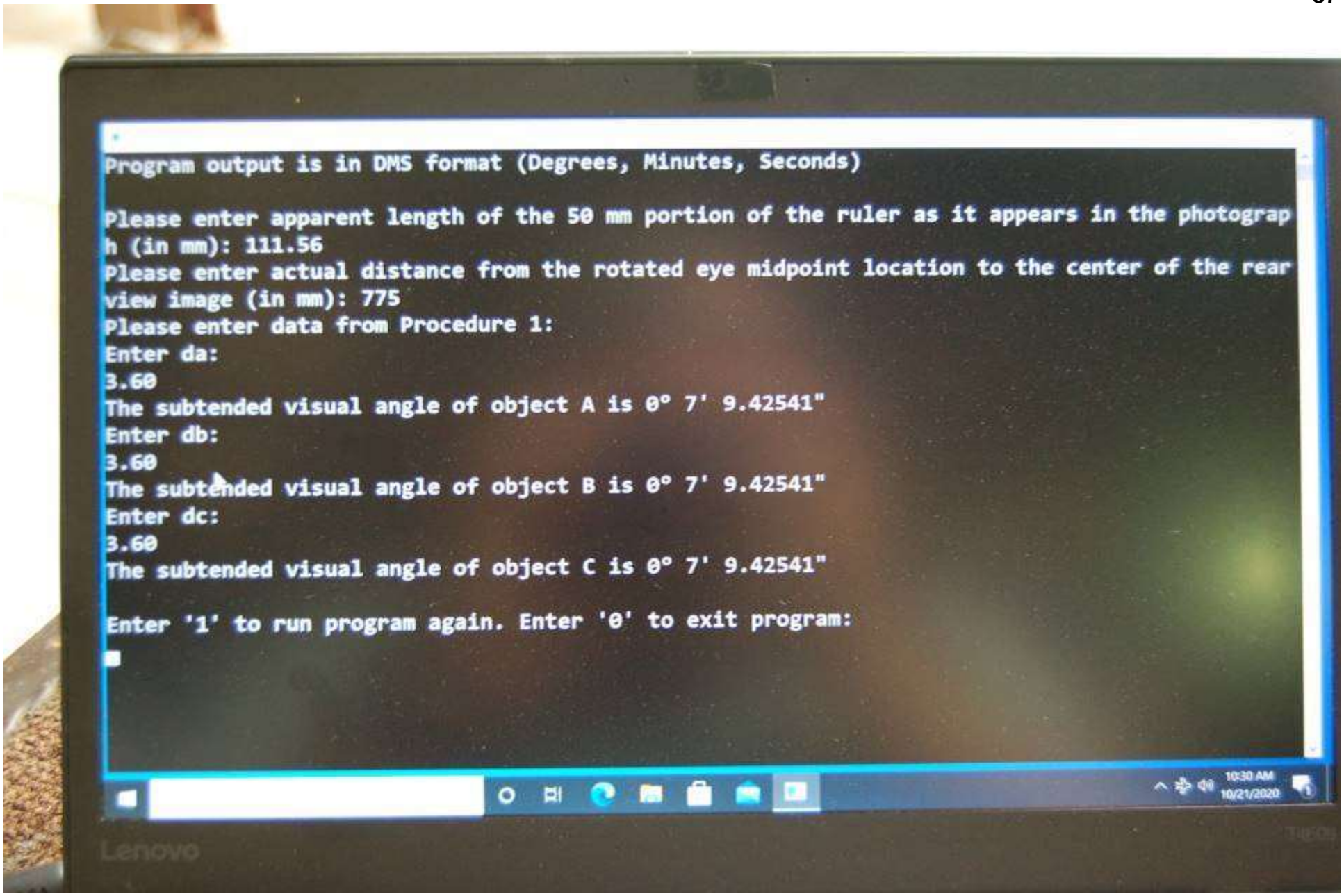
2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.15
PHOTOGRAPH USED TO EVALUATE FIELD-OF-VIEW AND TO MEASURE TEST OBJECT C



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.16
PHOTOGRAPH OF SCALE MEASUREMENT



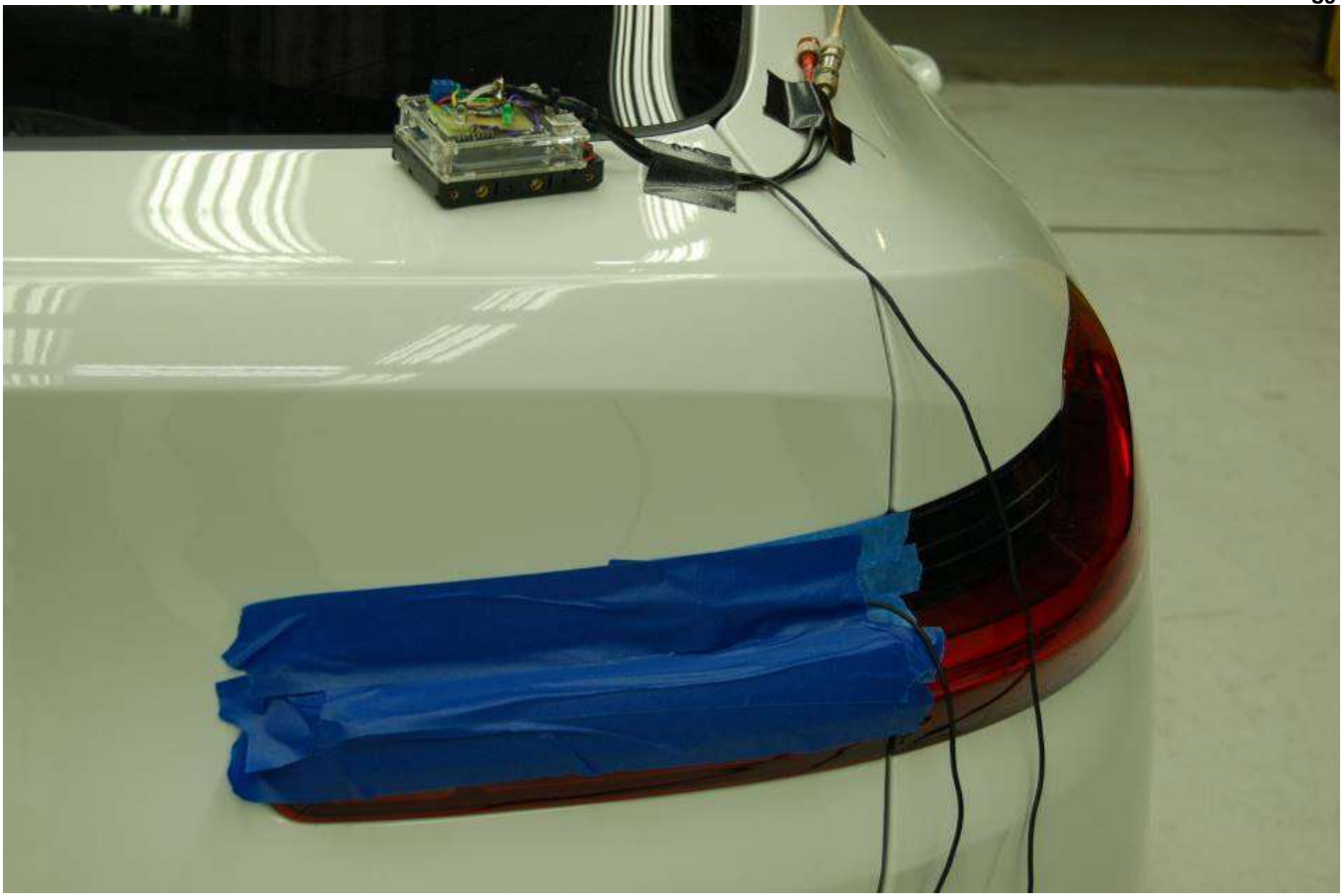
2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.17
MEASUREMENT DATA



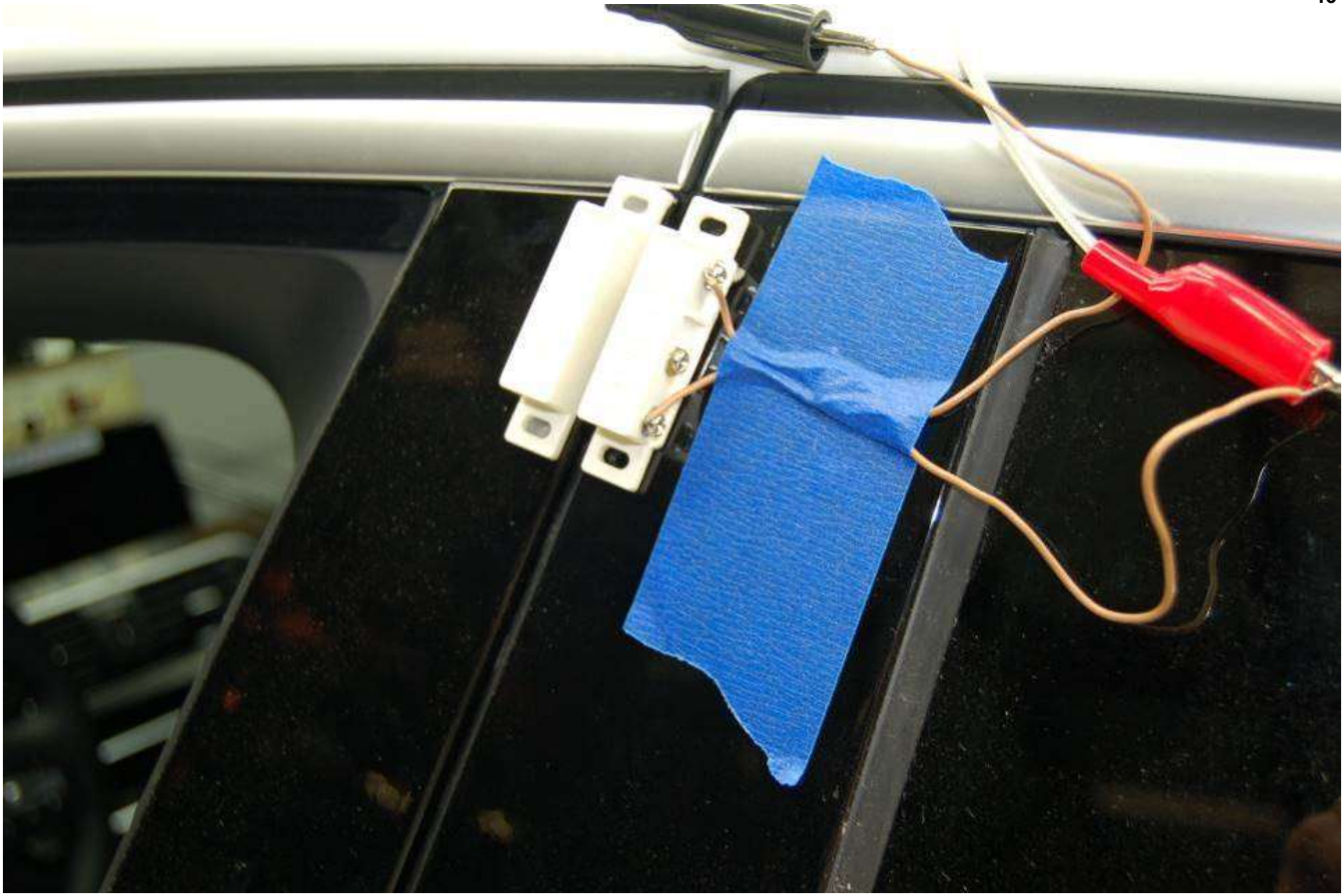
2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.18
EVENT TIMER SETUP



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.19
BACKUP LIGHT SENSOR SETUP



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.20
DOOR SENSOR TRIGGER SWITCH



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.21
RESPONSE AND LINGER TIME, TEST #1



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.22
RESPONSE AND LINGER TIME, TEST #2



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.23
RESPONSE AND LINGER TIME, TEST #3



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.24
SALT/FOG/HUMIDITY TEST CHAMBER



2021 BMW X4 MPV
NHTSA . C20214100
FMVSS NO. 111

FIGURE 5.25
HIGH TEMPERATURE TEST CHAMBER



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.26
LOW TEMPERATURE TEST CHAMBER



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.27
FRONT VIEW OF REARVIEW CAMERA REMOVED FROM VEHICLE



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.28
REAR VIEW OF REARVIEW CAMERA REMOVED FROM VEHICLE



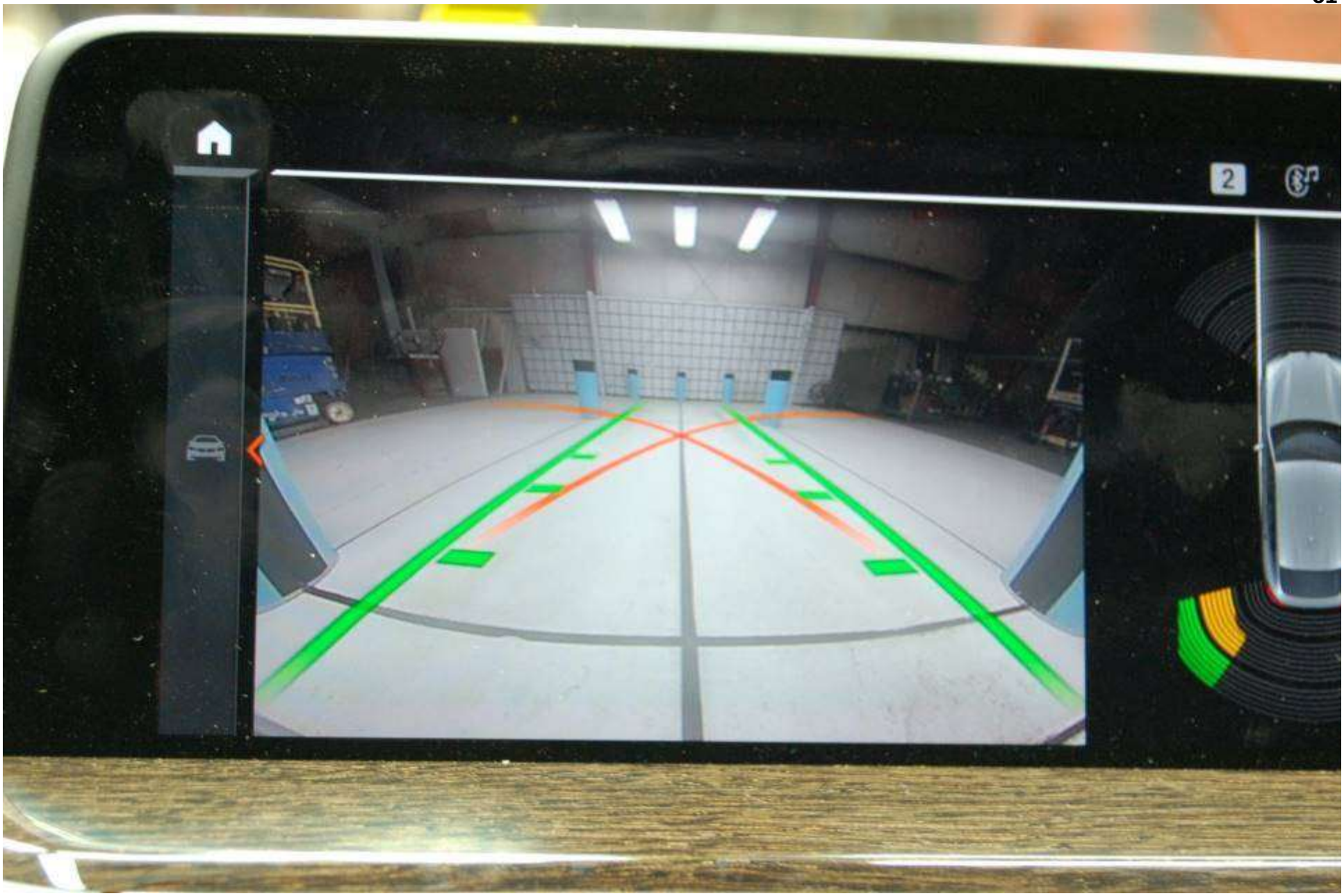
2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.29
SIDE VIEW OF REARVIEW CAMERA REMOVED FROM VEHICLE



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.30
VIEW OF CAMERA MOUNTED IN PLEXI-GLASS BOX – PRE-TEST



2021 BMW X4 MPV
NHTSA NO. C20214100
FMVSS NO. 111

FIGURE 5.31
CAMERA IMAGE POST TEST DURABILITY TESTING