U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA

DOT HS 813 213

December 2021

Adaptive Driving Beam Headlamps Test Repeatability Assessment

DISCLAIMER

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is 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.

NOTE: This report is published in the interest of advancing motor vehicle safety research. While the report may provide results from research or tests using specifically identified motor vehicle equipment, it is not intended to make conclusions about the safety performance or safety compliance of those motor vehicles, and no such conclusions should be drawn.

Suggested APA Format Citation:

Mazzae, E. N., Baldwin, G. H. S., Satterfield, K., & Browning, D.A. (2021, December). *Adaptive driving beam headlamps test repeatability assessment*. (Report No. DOT HS 813 213). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No. DOT HS 813 213	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Adaptive Driving Beam Headlamps Test Repeatability Assessment		5. Report Date December 2021
		6. Performing Organization Code NVS-120
7. Authors Elizabeth N. Mazzae, National Highway Traffic Safety Administration; G. H. Scott Baldwin, Kelly Satterfield, and D. Alex Browning, Transportation Research Center Inc.		8. Performing Organization Report No. DOT-VNTSC-NHTSA-xx- xx
9. Performing Organization Name and Address National Highway Traffic Safety Administration Vehicle Research and Test Center P.O. Box 37 East Liberty, OH 43319		10. Work Unit No. (TRAIS)
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590		13. Type of Report and Period Covered Final Report
		14. Sponsoring Agency Code

15. Supplementary Notes
Others suppporting this effort included Adam Andrella and Nathan Rea of Transportation Research Center Inc.

16. Abstract

This report describes an assessment of repeatability and limited assessment of reproducibility for an "adaptive driving beam" (ADB) headlighting system compliance test procedure. The 2018 NPRM proposed a compliance test procedure involving full-vehicle, dynamic test scenarios performed on a dry test track using stimulus vehicles to elicit ADB system performance. This effort used a modified test procedure involving stimulus test fixtures instead of stimulus vehicles. Testing was conducted with the test vehicle's headlighting system in lower beam mode to allow isolation of variance associated with the test procedure and measurement system and not the lighting system. SAE J3069 test procedure repeatability was examined for comparison.

The four main categories of analyses performed were: (1) assessment of repeatability associated with the measurement system (gauge repeatability); (2) assessment of repeatability associated with the test procedure; (3) assessment of repeatability of test outcomes; and (4) limited assessment of test reproducibility using tests performed at the same test facility but with different test technicians performing pre-test headlamp aiming (all other aspects of testing remained the same).

Results were generally favorable for the draft NHTSA ADB test procedure. The analysis of measurement system repeatability showed the measurement system used introduced very little variability. Test procedure repeatability for NHTSA test scenarios for straight and left curve paths resulted in most standard deviations less than 0.1 lux, while right curves had somewhat higher standard deviations between 0.5 to 1.0 lux. A reproducibility analysis that examined the effects of different individuals performing headlamp aiming found only small differences in illuminance values between aimers' datasets. Finally, an analysis of test outcome repeatability showed glare limits were consistently met for the six NHTSA test scenarios having straight or left curve paths, but the two right curve scenarios were less repeatable and had glare limit exceedances for some measurement distance sub-ranges at the car driver eye point location.

SAE J3069 test procedure and test outcomes were more repeatable for test drives in which the test fixture was to the left of the vehicle's path, but scenarios in which the test fixture was to the right of the vehicle's path produced results that were less repeatable.

17. Key Words Headlamp, headlighting system, adaptive driving beam		18. Distribution Statement	
19 Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21 No. of Pages	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report describes an assessment of test procedure repeatability for an "adaptive driving beam," or ADB, performance test procedure. This work is a portion of the efforts by the National Highway Traffic Safety Administration associated with a rulemaking effort initiated by a 2018 Notice of Proposed Rulemaking (NPRM) (FR 83, No. 198) that proposed to revise Federal Motor Vehicle Safety Standard FMVSS No. 108 (49 CFR Sec. 571.108) to allow optional adaptive driving beam (ADB) headlighting systems on light vehicles in the United States. The NPRM proposed a compliance test procedure involving full-vehicle, dynamic test scenarios performed on a test track in dry and dark ambient lighting conditions and corresponding compliance criteria. The proposed compliance test procedure used stimulus vehicles to evaluate the performance of an ADB system in preventing glare to other vehicles. The work described in this report involved modifying the test procedure proposed in the NPRM to use stimulus test fixtures instead of stimulus vehicles. A modified set of fewer test scenarios was also used. Testing per the modified test procedure was conducted to provide the data needed for this analysis and to support resolution of comments on NHTSA's proposal. Testing based on SAE's Surface Vehicle Recommended Practice J3069, Adaptive Driving Beam test procedure (2016) was also conducted for comparison.

To evaluate ADB performance, the NPRM proposed a set of maximum allowed illuminance values (glare limits). These are numeric illuminance values that would be the maximum illuminance the ADB system would be permitted to cast on the opposing or same-direction vehicle in the specified test scenarios. The following table summarizes glare limit illuminance values for each measurement range for both oncoming and same-direction test scenarios.

Proposed Maximum Illuminance Criteria

Range (m)	Maximum Illuminance Oncoming Direction (lux)	Maximum Illuminance Same Direction (lux)
15.0 to 29.9	3.1	18.9
30.0 to 59.9	1.8	18.9
60.0 to 119.9	0.6	4.0
120.0 to 220	0.3	N/A

The main objective of the assessment documented in this report was to characterize NHTSA ADB test procedure repeatability. Test repeatability for the SAE J3069 test procedure was examined for comparison. A limited examination of test reproducibility for the NHTSA ADB test procedure was also conducted.

Based upon the aspect of repeatability being addressed, the analyses performed can be summarized by four main categories:

- Repeatability associated with the measurement system used (i.e., gauge repeatability; variability introduced by components of the measurement system: illuminance meter, data acquisition equipment, cables, power source, fixture, and stimulus lamps)
- Repeatability associated with test procedures (i.e., "overall" repeatability; addresses variability introduced by measurement system as well as the test setup, text fixture, test maneuver performance, and environmental conditions) based on testing at the same test facility, using the same test equipment.

- Repeatability of test outcomes (i.e., consistency in test outcomes when comparing the results of measurement distance sub-ranges to the glare limits, using data from test scenarios performed multiple times)
- Reproducibility associated with test procedures: A limited examination of reproducibility was conducted using tests performed at the same test facility but with different test technicians performing pre-test headlamp aiming; all other aspects of testing remained the same.

A modified set of test scenarios from that proposed in the NPRM was used as shown in the table below. . All test scenarios for both test procedures involved a test vehicle with headlighting system in lower beam mode being driven toward a test fixture with light sensors mounted at specific locations. The conditions of the NHTSA ADB test matrix are shown in the following table.

Modified NHTSA ADB Test Matrix

Test Scenario No.	Test Vehicle Speed (mph)	Orientation	Radius of Curve (m)	Curve Direction	Superelevation (%)	Measurement Distance (m)
1	60-70	Oncoming	Straight	N/A	0-2	15-220
2	60-70	Same Direction	Straight	N/A	0-2	15-100
3	25-30	Oncoming	85-115	Left	0-2	15-59.9
4	40-45	Oncoming	210-250	Left	0-2	15-150
5	40-45	Same Direction	210-250	Left	0-2	15-100
6	40-45	Oncoming	210-250	Right	0-2	15-50
7	50-55	Oncoming	335-400	Left	0-2	15-220
8	50-55	Oncoming	335-400	Right	0-2	15-70

SAE J3069 test procedures were also performed for comparison. The SAE J3069 “test drive” conditions performed for the analyses reported in this document are shown in the following table. Rather than using three different test fixture positions and a single vehicle path as indicated in SAE J3069, to simplify and expedite testing, only one GPS-based fixture location was used and three vehicle paths (with respect to the fixture location) to produce the needed orientations between the vehicle and fixture. This test was conducted with the test vehicle’s headlighting system in only lower beam mode. As such, use of stimulus lamps was not necessary and only test drives 1 to 3 and 10 to 12 were needed. Further, data needed for SAE test drives 1 and 10, 2 and 11, and 3 and 12 could be obtained using data from different receptor heads collected during the same test trials.

SAE J3069 ADB Test Matrix

Test Drive No.	Direction	Fixture Position	Vehicle/Fixture Type	Lamp Presentation
1	Opposing	1	Car/Truck	Steady
2	Opposing	2	Car/Truck	Steady
3	Opposing	3	Car/Truck	Steady
4	Opposing	1	Motorcycle	Steady
5	Opposing	1	Motorcycle	Sudden
6	Opposing	2	Motorcycle	Steady
7	Opposing	2	Motorcycle	Sudden
8	Opposing	3	Motorcycle	Steady
9	Opposing	3	Motorcycle	Sudden
10	Preceding	1	Car/Truck	Steady
11	Preceding	2	Car/Truck	Steady
12	Preceding	3	Car/Truck	Steady
13	Preceding	1	Motorcycle	Steady
14	Preceding	1	Motorcycle	Sudden
15	Preceding	2	Motorcycle	Steady
16	Preceding	2	Motorcycle	Sudden
17	Preceding	3	Motorcycle	Steady
18	Preceding	3	Motorcycle	Sudden

A single test vehicle, a 2016 Volvo XC90 with LED headlamps, was used for all testing described in this report. The test vehicle was not equipped with an ADB headlighting system. All tests were conducted with the test vehicle's headlighting system in lower beam mode to eliminate any variability associated with the headlighting system and to isolate variability associated with the test procedure. As such, oncoming and same-direction data were collected during the same run, using receptor heads (i.e., light sensors) placed in the appropriate positions.

Testing to support assessment of repeatability associated with the measurement system (gauge) used involved each test scenario being performed 10 times in a row on a single night. Testing to support assessment of repeatability associated with the test procedure involved the vehicle being run through the full set of test scenarios in series once per night on 10 different days. Test outcome repeatability involved comparing the results from each repetition of full test procedure performance to the established glare limits to determine if the system consistently achieved the same outcome across all test sets. Lastly, to support a limited assessment of test reproducibility, the full test procedure was carried out with three different technicians performing the headlamp aiming procedure before test scenarios were executed. This reproducibility analysis was conducted to examine the effects of different operators performing headlamp aiming prior to running the test scenarios.

Data from these test trials were analyzed for each measurement distance sub-range, calculating the mean, standard deviation, 95 percent confidence interval, and 95 percent prediction interval. The standard deviation provided an indication of the variation within a data set. The table below presents measurement system standard deviation results showing that the measurement system resulted in standard deviations of 0.0570 lux or less for most test scenarios for both the NHTSA and SAE test procedures. Somewhat higher standard deviation values were seen for

NHTSA test scenarios 6 and 8, as well as SAE test drives 3 and 12, all of which are test scenarios in which the test fixture is positioned to the right of the vehicle's path. Overall, these data showed that the measurement system used in this testing contributed very little variability to the measurements.

Measurement System: Standard Deviation Results

NHTSA	**Oncoming NHTSA Test Scenarios 1, 3, 4, 7**	**Same-Direction NHTSA Test Scenarios 2, 5**	**Oncoming Right NHTSA Test Scenario 6**	**Oncoming Right NHTSA Test Scenario 8**
Measurement Distance Sub-Range	**All standard deviations were at or below:**			
220 m -120 m	0.0049 lux	-	-	-
150 m - 120 m	0.0101 lux	-	-	-
119.9 m - 60 m	0.0091 lux	-	-	-
100 m - 60 m	-	0.0144 lux	-	-
70 m - 60 m	-	-	-	0.2185 lux
59.9 m - 30 m	0.0156 lux	0.0221 lux	-	0.1805 lux
50 m - 30 m	-	-	0.5593 lux	-
29.9 m - 15 m	0.0338 lux	0.0570 lux	0.0270 lux	0.0346 lux
SAE	**Oncoming SAE Test Drives 1, 2**	**Preceding SAE Test Drives 10, 11, 12**	**Oncoming SAE Test Drive 3**	**Preceding SAE Test Drive 12**
Measurement Distance	**All standard deviations were at or below:**			
155 m	0.0142 lux	0.0209 lux	0.0851 lux	0.0887 lux
120 m	0.0146 lux	0.0259 lux	0.0878 lux	0.1186 lux
60 m	0.0171 lux	0.0254 lux	0.0787 lux	0.0973 lux
30 m	0.0216 lux	0.0218 lux	0.0180 lux	0.1230 lux

Test procedure repeatability analysis results based on the 10 test repetitions resulted in the standard deviation values shown in the table below. The table pools the standard deviation for each measurement distance sub-range for the oncoming straight and left curve scenarios (test scenarios 1, 3, 4, 7 – each of these tests provide similar means) and the same-direction straight and left curve scenarios (test scenarios 2, 5), and separately lists the standard deviation observed for the oncoming right medium curve (test scenario 6) and oncoming right large curve (test scenario 8).

Test Procedure: Standard Deviation Results

NHTSA	Oncoming NHTSA Test Scenarios 1, 3, 4, 7	Same-Direction NHTSA Test Scenarios 2, 5	Oncoming Right NHTSA Test Scenario 6	Oncoming Right NHTSA Test Scenario 8
Measurement Distance Sub-Range	**All standard deviations were at or below:**			
220 m - 120 m	0.0076 lux	-	-	-
150 m - 120 m	0.0068 lux	-	-	-
119.9 m - 60 m	0.0156 lux	-	-	-
100 m - 60 m	-	0.0153 lux	-	-
70 m - 60 m	-	-	-	0.5996 lux
59.9 m - 30 m	0.0599 lux	0.0494 lux	-	0.5921 lux
50 m - 30 m	-	-	0.9648 lux	-
29.9 m - 15 m	0.0713 lux	0.1324 lux	0.0651 lux	0.0602 lux
SAE	**Oncoming SAE Test Drives 1, 2**	**Preceding SAE Test Drives 10, 11, 12**	**Oncoming SAE Test Drive 3**	**Preceding SAE Test Drive 12**
Measurement Distance	**All standard deviations were at or below:**			
155	0.0141 lux	0.0228 lux	0.1234 lux	0.1436 lux
120	0.0132 lux	0.0231 lux	0.1489 lux	0.1909 lux
60	0.0219 lux	0.0226 lux	0.2464 lux	0.3020 lux
30	0.0380 lux	0.0341 lux	0.0413 lux	0.3503 lux

The 95th percentile confidence interval is the estimate of the upper and lower illuminance values in which there is a 95 percent probability that the true mean falls within this interval. The 95th percentile prediction interval is the estimate of the interval of which there is a 95 percent probability that future measurements will be within. The prediction interval indicates the range within which a similar vehicle's measured illuminance value is 95 percent likely to fall (5 percent chance of not falling within the range). If the upper end value of the prediction interval is less than the glare limit for a measurement distance sub-range, then a similar vehicle's measured value is 95 percent likely to be less than the glare limit when tested by NHTSA.

Having performed the test procedure for 10 repetitions which resulted in standard deviations of 0.091 lux or less for most scenarios and test drives, it is reasonable to assume that the calculated prediction intervals can be applied when assessing different manufacturer headlighting systems, as the test procedure should always result in comparable variability. Because the repeatability of the measurement system and test procedure produced small standard deviations, the variability of the illuminance values using the same measurement system and test procedure should not differ substantially with different manufacturer headlighting systems, even if the maximum illuminance value for other headlighting systems is higher. This assumption holds true provided the headlamp beam pattern under test demonstrates similar gradients in and around the measurement locations.

The maximum range of expected values for the measurement system over 8 NHTSA test scenarios, for each of the measurement sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Expected Range of Values of the Measurement System (NHTSA Test)

95th Percentile Prediction Interval Margin of Error								
Measurement Distance Sub-Range	**Test Scenario 1**	**Test Scenario 3**	**Test Scenario 4**	**Test Scenario 6**	**Test Scenario 7**	**Test Scenario 8**	**Test Scenario 2**	**Test Scenario 5**
	Car Eye Point (RH4) (lux)						**Passenger Side Mirror (RH7) (lux)**	
220 m - 120 m	+/- 0.0117	-	-	-	+/- 0.0094	-	-	-
150 m - 120 m	-	-	+/- 0.0202	-	-	-	-	-
119.9 m - 60 m	+/- 0.0144	-	+/- 0.0212	-	+/- 0.0141	-	-	-
100 m – 60 m	-	-	-	-	-	-	+/- 0.0199	+/- 0.0124
70 m - 60 m	-	-	-	-	-	+/- 0.5184	-	-
50 m - 30 m	-	-	-	+/- 1.3270	-	-	-	-
59.9 m - 30 m	+/- 0.0245	+/- 0.0179	+/- 0.0253	-	+/- 0.0208	+/- 0.4283	+/- 0.0382	+/- 0.0252
29.9 m - 15 m	+/- 0.0704	+/- 0.0286	+/- 0.0411	+/- 0.0641	+/- 0.0624	+/- 0.0770	+/- 0.1352	+/- 0.0712

The 95th percentile prediction intervals are calculated for the values measured in each of the measurement distance sub-ranges in the 8 NHTSA test scenarios. They are the maximum expected ranges of values that would be obtained using the test procedure described and are summarized in the following table.

Expected Range of Values of the Test Procedure (NHTSA Test)

95th Percentile Prediction Interval Margin of Error								
Measurement Distance Sub-Range	**Test Scenario 1**	**Test Scenario 3**	**Test Scenario 4**	**Test Scenario 6**	**Test Scenario 7**	**Test Scenario 8**	**Test Scenario 2**	**Test Scenario 5**
	Car Eye Point (RH4) (lux)						**Car PSM (RH7) (lux)**	
220 m -120 m	+/- 0.0113	-	-	-	+/- 0.0128	-	-	-
150 m - 120 m	-	-	+/- 0.0145	-	-	-	-	-
119.9 m - 60 m	+/- 0.0357	-	+/- 0.0238	-	+/- 0.0171	-	-	-
100 m - 60 m	-	-	-	-	-	-	+/- 0.0331	+/- 0.0189
70 m - 60 m	-	-	-	-	-	+/- 1.4225	-	-
50 m - 30 m	-	-	-	+/- 2.2890	-	-	-	-
59.9 m - 30 m	+/- 0.0741	+/- 0.0690	+/- 0.0933	-	+/- 0.0812	+/- 1.4047	+/- 0.0963	+/- 0.1121
29.9 m - 15 m	+/- 0.1436	+/- 0.1672	+/- 0.1693	+/- 0.1534	+/- 0.1637	+/- 0.1427	+/- 0.2348	+/- 0.3141

The prediction intervals shown in the above table are small compared to the limits that are finalized for each measurement distance sub-range.

The maximum range of expected values for the measurement system over 6 SAE test drives, for each of the measurement sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Expected Range of Values of the Measurement System (SAE Test)

95th Percentile Prediction Interval Margin of Error						
Measurement Distance	**Test Drive 1**	**Test Drive 2**	**Test Drive 3**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
	Car Eye Point (RH4) (lux)			**Car PSM (RH7) (lux)**		
155 m	+/- 0.0193	+/- 0.0238	+/- 0.2019	+/- 0.0169	+/- 0.0361	+/- 0.2038
120 m	+/- 0.0230	+/- 0.0346	+/- 0.2083	+/- 0.0159	+/- 0.0195	+/- 0.1755
60 m	+/- 0.0196	+/- 0.0301	+/- 0.1868	+/- 0.0167	+/- 0.0193	+/- 0.1370
30 m	+/- 0.0315	+/- 0.0513	+/- 0.0426	+/- 0.0156	+/- 0.0373	+/- 0.0592

The maximum range of expected values for the test procedure over 6 SAE test drives, for each of the measurement sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Expected Range of Values of the Test Procedure (SAE J3069 Test)

95th Percentile Prediction Interval Margin of Error						
Measurement Distance	**Test Drive 1**	**Test Drive 2**	**Test Drive 3**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
	Car Eye Point (RH4) (lux)			**Car PSM (RH7) (lux)**		
155 m	+/- 0.0167	+/- 0.0243	+/- 0.2928	+/- 0.0193	+/- 0.0211	+/- 0.3407
120 m	+/- 0.0241	+/- 0.0314	+/- 0.3532	+/- 0.0138	+/- 0.0108	+/- 0.2761
60 m	+/- 0.0349	+/- 0.0519	+/- 0.5845	+/- 0.0232	+/- 0.0324	+/- 0.5164
30 m	+/- 0.0461	+/- 0.0749	+/- 0.0981	+/- 0.0586	+/- 0.0803	+/- 0.1862

Both measurement system (gauge) repeatability results and full test repeatability results revealed NHTSA test scenarios involving right curves (test scenarios 6 and 8) to be less repeatable than the other test scenarios. These two scenarios showed a pattern of higher standard deviations with respect to the other NHTSA test scenarios. SAE test drive 3, in which the test fixture was located to the right of the test vehicle, also showed a pattern of higher standard deviations as compared to the other scenarios. U.S. vehicle headlighting systems' illumination patterns often have a higher right-side horizontal cutoff for each lamp. Variability was concluded to be attributable to the illumination cutoff at the right portion of the headlamp illumination pattern falling near the location of some of the light sensors. This can be reasonably remedied by minor modifications to the headlamp illumination pattern produced when ADB is active as compared to the lower beam pattern evaluated for this repeatability study. With such modifications (designing a lamp to meet the requirements of this final rule) the agency anticipates that similar repeatability will be obtained for the right curve scenarios as is obtained for the other scenarios.

Test Outcome Repeatability Analysis

With regard to test outcome repeatability, measured values for most NHTSA test scenarios were consistently compliant with respective glare limits. NHTSA ADB test scenario numbers 1 to 5 and 7 showed consistent test outcomes for all test set repetitions. For these scenarios, glare limits were consistently met for all measurement distance sub-ranges for all test repetitions resulting in passing outcomes. However, for NHTSA test scenario numbers 6 and 8, both oncoming right curve scenarios, some or all repetitions showed glare limit exceedances for

some measurement distance sub-ranges at the car driver eye point location. For NHTSA test scenario 6, all 10 repetitions had at least one receptor head with a maximum illuminance value exceeding the glare limit for the 50 m to 30 m measurement distance sub-range. For NHTSA test scenario 8, all 10 repetitions had at least one receptor head with a maximum illuminance value exceeding the glare limits for both the 70 m to 60 m and 59.9 m to 30 m measurement distance sub-ranges. For NHTSA test scenario 8, for the 59.9 m to 30 m measurement distance sub-range, 5 repetitions had at least one receptor head with a maximum illuminance value exceeding the glare limit.

The upper value of the prediction interval provides an upper limit estimate that 95 percent of all future values should not surpass. This value was evaluated with respect to each glare limit to assess whether it is expected that future values will exceed a given glare limit. In general, the prediction intervals for the test procedure repeatability analysis were not wide enough to exceed the FMVSS No. 108-derived glare limits. It is unlikely that the values of the repetitions analyzed do not capture the most likely range of values. The exceptions to this were for NHTSA test scenarios 6 and 8 and SAE test drive 3.

SAE J3069 test scenarios showed consistent test outcome repeatability for SAE test drives 1, 2, 10, and 11. Illuminance measurements for all receptor heads did not exceed glare limits for SAE test drives 1, 2, 10, 11, and 12. However, for SAE test drive 3, multiple receptor heads had illuminance measurements exceeding glare limits, particularly for the 155 m, 120 m, and 60 m measurement distances. All 10 test repetitions of SAE test drive 3 had at least one receptor head with an illuminance value exceeding the glare limit for the 155 m measurement distance. Nine of the 10 test repetitions of SAE test drive 3 had at least one receptor head with an illuminance value exceeding the glare limits for the 120 m and 60 m measurement distances.

Limited Assessment of Test Reproducibility

A reproducibility analysis was conducted to examine the effects of different operators performing headlamp aiming prior to running a test set. This analysis found only small differences in illuminance measurements between datasets associated with different headlamp aiming operators, the only variable in this analysis. All other aspects of these tests, including test equipment and test setup, remained the same such that the headlamp aiming process could be examined to determine if different operators following a headlight aiming procedure would result in the same test outcomes. Thus, this examination determined whether the headlight aiming procedure was reproducible, by comparison of test outcome results.

Reproducibility: Standard Deviation Results

	Oncoming NHTSA Test Scenarios 1, 3, 4, 6, 7, 8	**Same-Direction NHTSA Test Scenarios 2, 5**
Measurement Distance Sub-Range	**All standard deviations were at or below:**	
220 m - 120 m	0.0054 lux	-
150 m - 120 m	0.0068 lux	-
119.9 m - 60 m	0.0122 lux	-
100 m - 60 m	-	0.0152 lux
70 m - 60 m	0.0121 lux	-
59.9 m - 30 m	0.0365 lux	0.0520 lux
50 m - 30 m	0.0354 lux	-
29.9 m - 15 m	0.0932 lux	0.1263 lux

The maximum range of expected values for the test procedure performed by different aimers over 8 NHTSA test scenarios, including each of the measurement distance sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Expected Range of Values of the Measurement System With Different Aimers (NHTSA Test)

95th Percentile Prediction Interval Margin of Error								
Measurement Distance Sub-Range	**Test Scenario 1**	**Test Scenario 3**	**Test Scenario 4**	**Test Scenario 6**	**Test Scenario 7**	**Test Scenario 8**	**Test Scenario 2**	**Test Scenario 5**
	Car Eye Point (RH4) (lux)						**Car PSM (RH7) (lux)**	
220 m - 120 m	+/- 0.0134				+/- 0.0095			
150 m - 120 m			+/- 0.0148					
119.9 m - 60 m	+/- 0.0247		+/- 0.0301		+/- 0.0181			
100 m - 60 m							+/- 0.0183	+/- 0.0197
70 m - 60 m						+/- 0.0300		
50 m - 30 m				+/- 0.0819				
59.9 m - 30 m	+/- 0.0767	+/- 0.0407	+/- 0.0577		+/- 0.0408	+/- 0.0460	+/- 0.0787	+/- 0.0548
29.9 m - 15 m	+/- 0.2111	+/- 0.1331	+/- 0.1917	+/- 0.2310	+/- 0.1638	+/- 0.1337	+/- 0.3133	+/- 0.2786

1.0 INTRODUCTION

In 2018 NHTSA published an NPRM (FR 83, No. 198) that would revise FMVSS No. 108 [2] to allow Adaptive Driving Beam (ADB) headlighting systems as optional equipment on light vehicles in the U.S. In association with that rulemaking effort, this research was initiated for the purposes of providing data needed to support resolution of comments on NHTSA's proposal.

ADB headlighting systems use advanced technology that actively modifies the headlamp beams to provide more illumination while not glaring other vehicle drivers. The goal of the ADB system is to improve long-range visibility for the driver without causing discomfort, distraction, or glare to other road users. The automatic adaptation of the beam pattern may not only serve as a convenience feature for drivers, but could result in increased, safety-beneficial upper beam use.

The NPRM proposed a compliance test procedure involving full-vehicle, dynamic test scenarios performed on a test track in dry and dark ambient lighting conditions and corresponding compliance criteria. The proposed compliance test procedure used stimulus vehicles to evaluate the performance of an ADB system in preventing glare to other vehicles. The work described in this report involved modifying the test procedure proposed in the NPRM to use stimulus test fixtures instead of stimulus vehicles. A modified set of fewer test scenarios was also used. Testing per that modified test procedure was conducted to provide the data needed for this analysis and to support resolution of comments on NHTSA's proposal. Testing was also conducted per SAE's Surface Vehicle Recommended J3069 (2016) Adaptive Driving Beam test procedure and the data obtained were analyzed. This document summarizes analyses that assessed repeatability for both the NHTSA and SAE test procedures and reproducibility for the modified NHTSA test procedure.

1.1 Objectives and Scope

The objectives of this assessment were to:

- Characterize repeatability associated with NHTSA ADB test procedure;
- Characterize repeatability associated with SAE J3069 test procedure; and
- Characterize reproducibility effects of multiple individuals performing headlamp aiming prior to testing using the same procedure at the same site.

1.2 Repeatability Analysis Approach

Based upon the aspect of repeatability being addressed, the approach of the repeatability testing assessment performed can be summarized using four main categories:

- Repeatability associated with the measurement system used (i.e., gauge repeatability; assesses variability introduced by components of the measurement system: illuminance meter, data acquisition equipment, cables, power source, fixture, and stimulus lamps, etc.) where test vehicle headlighting system output and all else are held constant to the extent possible.
    - NHTSA ADB test procedure
    - SAE test procedure
- Repeatability associated with the test procedures (i.e., assesses variability introduced by measurement system as well as the test setup, test maneuver performance, environmental conditions, etc. at the same test facility, using the same test equipment) with test vehicle headlighting system output held constant.
    - NHTSA ADB test procedure
    - SAE J3069 test procedure

- Repeatability of test outcome (i.e., consistency in test outcomes when comparing the results of measurement distance sub-ranges to the glare limits, using data from test scenarios performed multiple times)
- Reproducibility of test procedures (analysis of test results as a function of different test technicians performing pre-test headlamp aiming; all other aspects of testing remained the same)
    - NHTSA ADB test procedure

2.0 METHOD

This section describes the specified test procedures, equipment used, and approach for testing used in this effort.

2.1 Test Scenarios

2.1.1 Modified NHTSA ADB Test Scenarios

Test scenarios performed were a modified set, shown in Table 1, that was based on the test scenarios proposed in the NPRM. The NPRM – which proposed to use actual vehicles as the stimulus for the ADB system –proposed a wide range of track test scenarios, including a wide range of potential stimulus vehicles, varying road geometries (curves, straight paths), and varying vehicle speeds. This included a variety of scenarios in which the stimulus vehicle was in motion. The major modification made for the testing done for this report is that scenarios involving a moving stimulus vehicle have been eliminated and replaced with scenarios involving a stationary test fixture. In addition, some of the curved-path scenarios were eliminated and radii of curvature for curve scenarios were revised.

Table 1. Modified NHTSA ADB Test Matrix

Test Scenario	Test Vehicle Speed	Orientation	Radius of Curve (m)	Curve Direction	Superelevation (%)	Measurement Distance
1	60-70 mph (96.6-112.7 kph)	Oncoming	Straight	N/A	0-2	49.2-721.8 ft (15-220 m)
2	60-70 mph (96.6-112.7 kph)	Same Direction	Straight	N/A	0-2	49.2-328.1 ft (15-100 m)
3	25-30 mph (40.2-48.3 kph)	Oncoming	85-115	Left	0-2	49.2-196.5 ft (15-59.9 m)
4	40-45 mph (64.4-72.4 kph)	Oncoming	210-250	Left	0-2	49.2-492.1 ft (15-150 m)
5	40-45 mph (64.4-72.4 kph)	Same Direction	210-250	Left	0-2	49.2-328.1 ft (15-100 m)
6	40-45 mph (64.4-72.4 kph)	Oncoming	210-250	Right	0-2	49.2-164.0 ft (15-50 m)
7	50-55 mph (80.5-88.5 kph)	Oncoming	335-400	Left	0-2	49.2-721.8 ft (15-220 m)
8	50-55 mph (80.5-88.5 kph)	Oncoming	335-400	Right	0-2	49.2-229.7 ft (15-70 m)

For the purposes of repeatability testing, it was desirable to hold constant the headlighting system output. As such, the test vehicle was operated with its headlighting system in lower beam mode and the use of stimulus lamps on the fixture was unnecessary. As a result, test scenarios 1 and 2 data were collected using the same trials, and test scenarios 4 and 5 data were obtained from the same trials, since the difference in tests is just a matter of using a different subset of receptor heads and measurement distances when analyzing the data collected from those trials.

Test vehicle speed throughout the test was within +/-1 mph of the selected target speed. The test driver was able to maintain this speed range without use of cruise control or other aid. Once the target speed was achieved and maintained, no sudden steering inputs, acceleration, braking occurred.

2.1.2 SAE J3069 ADB Test Drives

Testing was also conducted based on the SAE Surface Vehicle Recommended Practice J3069, Adaptive Driving Beam, test procedure for comparison. The SAE J3069 "test drive" conditions are shown below and consist of only straight-path scenarios in which the test vehicle drives toward a test fixture equipped with lamps to simulate another vehicle in nearby lane and elicit a response from the ADB system. The test procedure uses three fixture positions to represent a vehicle in the lane to lanes over the left (position 1), the left adjacent lane (position 2), and second lane to the right (position 3). There is no right adjacent lane fixture position. The procedure involves four stimulus lamp sets: car/truck front lamps, car/truck rear lamps, motorcycle front lamp, and motorcycle rear lamp. Each lamp condition specific mounting locations on test fixture. Stimulus lamps are steady burning in a majority of trails and illuminated "suddenly" in six trials all involving motorcycle fixtures.

The SAE J3069 "test drive" conditions performed for the analyses reported in this document are shown in Table 2. See SAE J3069 for specific lamp presentation and fixture details. Rather than using a single vehicle path and three different test fixture positions as indicated in J3069, one fixture location and three test vehicle paths were used as this reduced test setup time. Having one fixed fixture location simplified the calculation of distances between the test vehicle and fixture. Data for SAE test drives 1 and 10, 2 and 11, and 3 and 12 use data from different receptor heads collected during the same test trials.

Table 2. SAE J3069 ADB Test Matrix

Test No.	Direction (of test vehicle and stimulus)	Fixture Position	Vehicle/Fixture Type (indicates stimulus lamps used)	Lamp Presentation
1	Opposing	1	Car/Truck	Steady
2	Opposing	2	Car/Truck	Steady
3	Opposing	3	Car/Truck	Steady
4	Opposing	1	Motorcycle	Steady
5	Opposing	1	Motorcycle	Sudden
6	Opposing	2	Motorcycle	Steady
7	Opposing	2	Motorcycle	Sudden
8	Opposing	3	Motorcycle	Steady
9	Opposing	3	Motorcycle	Sudden
10	Preceding	1	Car/Truck	Steady
11	Preceding	2	Car/Truck	Steady
12	Preceding	3	Car/Truck	Steady
13	Preceding	1	Motorcycle	Steady
14	Preceding	1	Motorcycle	Sudden
15	Preceding	2	Motorcycle	Steady
16	Preceding	2	Motorcycle	Sudden
17	Preceding	3	Motorcycle	Steady
18	Preceding	3	Motorcycle	Sudden

2.2 Test Procedure Compliance Criteria

The goal of ADB is to aid the driver in seeing the roadway environment by providing upper beam illumination in some parts of the roadway, while shading the area in which another vehicle is located so as to not expose them to more glare than would be seen with lower beam headlamps. As such, applying maximum illuminance, or glare limit, values to illuminance data measured at points on the other/stimulus vehicle or test fixture can provide information as to whether ADB succeeds in achieving its goal.

2.2.1 NHTSA ADB Compliance Test Criteria

The NPRM (FR 83, No. 198) proposed a set of maximum allowed illuminance values (glare limits) derived from information provided in FMVSS No. 108. These are numeric illuminance values that would be the maximum illuminance the ADB system would be permitted to cast on the stimulus vehicle in the specified test scenarios. The maximum illuminance is the single highest illuminance recorded within each measurement distance range specified in Table 3 or Table 4 that is applicable to the scenario being tested (see Table 1), excluding consecutive illuminance values that exceed the applicable glare limit lasting no longer than 0.1 second or spanning a distance range of 1 m. Information regarding the application of these criteria to test data is presented in Sections 2.11 and 2.12.

The following table summarizes glare limit illuminance values for each measurement range for both oncoming and same-direction test scenarios.

Table 3. NHTSA Glare Limits, Derived From FMVSS No. 108, Oncoming Maneuvers

Range (m)	Maximum Illuminance (lux)
15.0 - 29.9	3.1
30.0 - 59.9	1.8
60.0 - 119.9	0.6
120.0 - 220	0.3

Table 4. NHTSA Glare Limits, Derived From FMVSS No. 108, Same-Direction Maneuvers

Range (m)	Maximum Illuminance (lux)
15.0 - 29.9	18.9
30.0 - 59.9	18.9
60.0 - 119.9	4.0
120.0 - 220	N/A

2.2.2 SAE J3069 Compliance Test Criteria

The following tables summarize the SAE J3069 glare limit values. The data required to assess glare exposure per SAE J3069 are illuminance values and the corresponding distance or range from the ADB (test) vehicle's headlamps to the relevant illuminance meter receptor heads mounted on the test fixture. While the NHTSA glare limits presented in Tables 3 and 4 apply throughout the entirety of the corresponding measurement range, the glare limits used in the SAE test (Tables 5 and 6) only apply at the specified distance. If there is no illuminance measurement at that distance, interpolation is used. For sudden appearance tests, the system is given a maximum of 2.5 seconds to react and adjust the beam to reduce illumination to a

level within the applicable maximum. If any recorded (or interpolated) illuminance value exceeds the applicable maximum illuminance, SAE J3069 provides for an allowance: the same test drive scenario is run with the lower beam activated. The ADB system can still be deemed to have passed the test if any of the ADB exceedances do not exceed 125 percent (or 1.25 times) of the measured (or interpolated) illuminance values for the lower beam.

Table 5. SAE J3069 Glare Limits, Opposing Maneuvers

Distance: ADB Vehicle to Opposing Vehicle Driver/Rider's Eye (m)	**Maximum Illuminance Opposing Vehicle Driver/Rider's Eye (lux)**
155	0.3
120	0.3
60	0.7
30	1.8

Table 6. SAE J3069 Glare Limits [3], Preceding Maneuvers

Distance: ADB Vehicle to Opposing Vehicle Driver/Rider's Eye (m)	**Maximum Illuminance Preceding Vehicle Rear View Mirror, Driver Side View Mirror, and Passenger Side View Mirror (lux)**
155	4.0
120	4.0
60	8.9
30	18.9

2.3 Testing

In this effort, each test procedure was run on one vehicle multiple times, with the headlighting system in lower beam mode. The repetition scheme was as follows:

- Measurement System Repeatability (i.e., gauge repeatability) Assessment:
  - Ten repetitions were conducted of each test scenario/drive (Test No. 1 conducted 10 times in a row, then Test No. 2 conducted 10 times in a row, etc.).
  - Each test scenario/drive was executed 10 times in a row without changing anything about the test setup or headlamp aim in between trials.
- Test Procedure Repeatability Assessment:
  - A single instance of the full test procedure was run on each of 10 different nights.
  - The full test procedure including setup and performance of the full set of test scenarios/drives was conducted in one night and again on 9 other nights. The test vehicle's headlamps were aimed prior to carrying out the first set of 10 trials and not adjusted again over the additional 9 repetitions.
- Test Reproducibility Assessment:
  - Headlamp aiming was performed by multiple individuals separately, multiple times each, before a full set of NHTSA test scenarios was performed. All other aspects of test setup and test performance remained the same.

The following table shows the NHTSA test scenarios examined in the repeatability assessment.

Table 7. NHTSA Repeatability Assessment Scenario Conditions

Test No.	Curve Direction	Radius of Curve (m)	Speed (mph)
1	Straight	N/A	65
2	Straight	N/A	65
3	Left	85	27
4	Left	210	42
5	Left	210	42
6	Right	210	42
7	Left	335	52
8	Right	335	52

The following table shows the SAE test drive numbers examined in the repeatability assessment.

Table 8. SAE Repeatability Assessment Scenario Conditions

Test Drive No.	Radius of Curve (m)	Speed (mph)	Fixture Position
1	Straight	65	1
2	Straight	65	2
3	Straight	65	3
10	Straight	65	1
11	Straight	65	2
12	Straight	65	3

2.4 Test Fixture

While the NPRM (FR 83, No. 198) proposed a compliance test procedure involving the use of stimulus vehicles to evaluate the performance of an ADB system in preventing glare to other vehicles, testing conducted in this effort used a modified test procedure involving stimulus test fixtures instead of stimulus vehicles. A test fixture was created that could accommodate both the NHTSA and SAE test procedures, for which the fixture only differs in terms of which stimulus lamps are mounted on the fixture. The single fixture was also designed to permit conduct of both oncoming/opposing and same-direction/preceding scenarios. The test fixture layout included a vertical array of illuminance meter receptor heads, coupled with the necessary lamp mounting locations. However, no stimulus lamps were used for this testing.

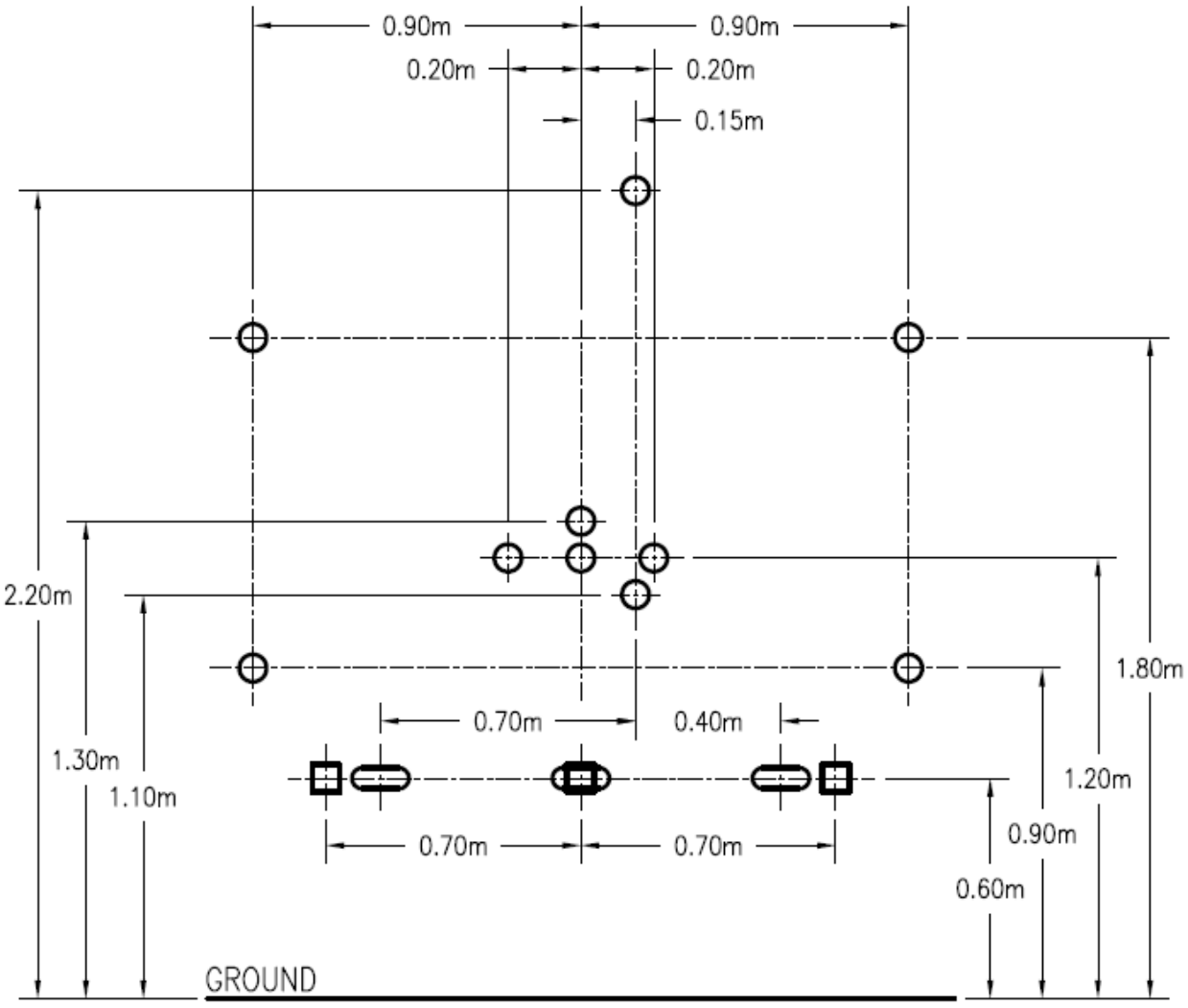
The test fixture was constructed from 80/20 T-slot aluminum framing, brackets, and associated fasteners. The aluminum had a matte black finish to minimize light reflection.

For ease of assembly and transport, the test fixture was designed to have three sections that could be easily connected. The main section and rearmost section consisted of a tall vertical structure on which a vertical array of illuminance meter receptor heads was mounted with a low, horizontally-oriented structure on which stimulus lamps could be mounted. The second, center section was a rectangular piece that laid directly on the ground and connected the first section to the third section while maintaining proper alignment and distance between them. The third section consisted of a low, horizontal assembly on which taillamps could be positioned. The

three fixture sections could be transported and stored in a small trailer and quickly assembled at the test site.

To permit assessment of whether test outcomes would be the same for testing with a stimulus test fixture as it would with a stimulus vehicle, a portion of testing also involved performing the NHTSA test procedure using a stimulus vehicle and with both the test fixtures for one test vehicle to allow results for each to be compared and examine the validity of using a test fixture in lieu of actual vehicles to provide stimuli for use in eliciting a response from ADB systems. The stimulus vehicle used was a United States market 2018 Ford F-150 pickup truck serving as a stimulus vehicle.

All necessary illuminance meter receptor heads were configured on the test fixture as depicted in the following test fixture drawings and renderings.



END VIEW

Figure 1. Test Fixture End View, Receptor Head Layout

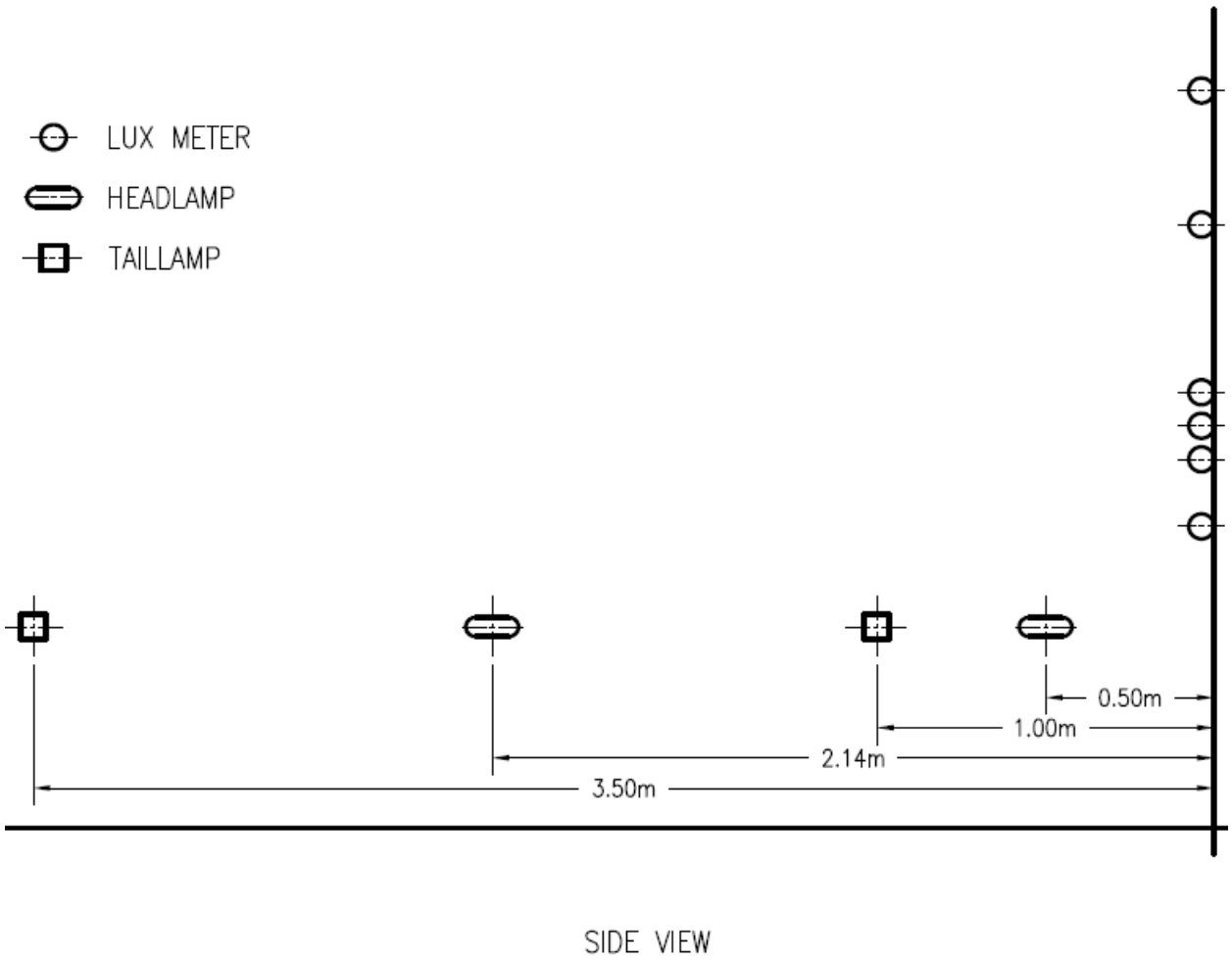


Figure 2. Test Fixture Side View, Receptor Head Layout

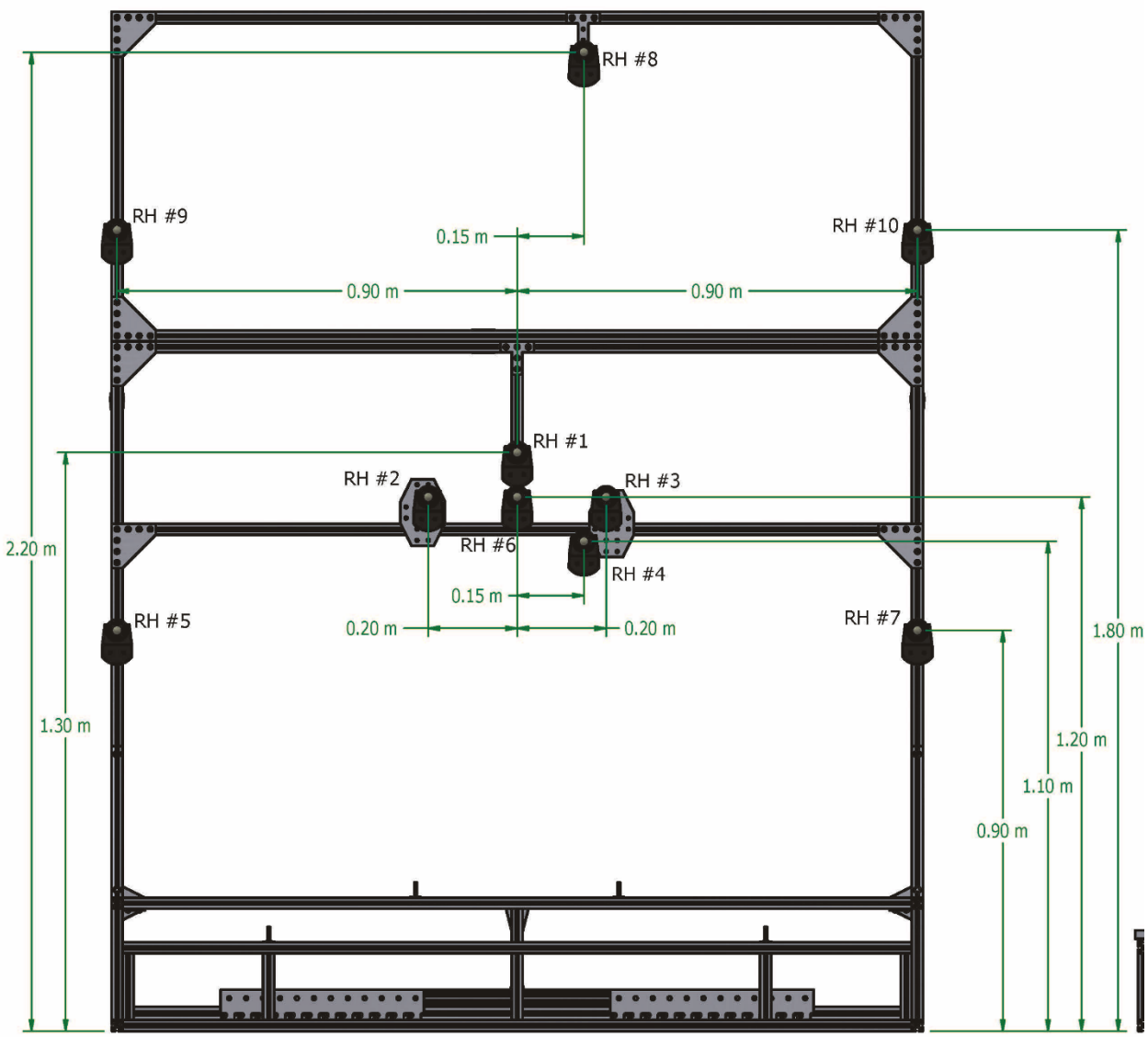


Figure 3. Test Fixture End View, Receptor Locations and Fixture Structure

Table 9. Illuminance Meter Receptor Head Locations

Stimulus	Scenario	Receptor Head #	Location
Fixture	Oncoming (opposing)	4	Car driver eye point
		1	Motorcycle eye point
		8	Truck driver eye point
	Same direction (preceding)	5	Car driver-side mirror
		7	Car passenger-side mirror
		6	Car inside mirror
		2	Motorcycle left mirror
		3	Motorcycle right mirror
		9	Truck driver-side mirror
		10	Truck passenger-side mirror

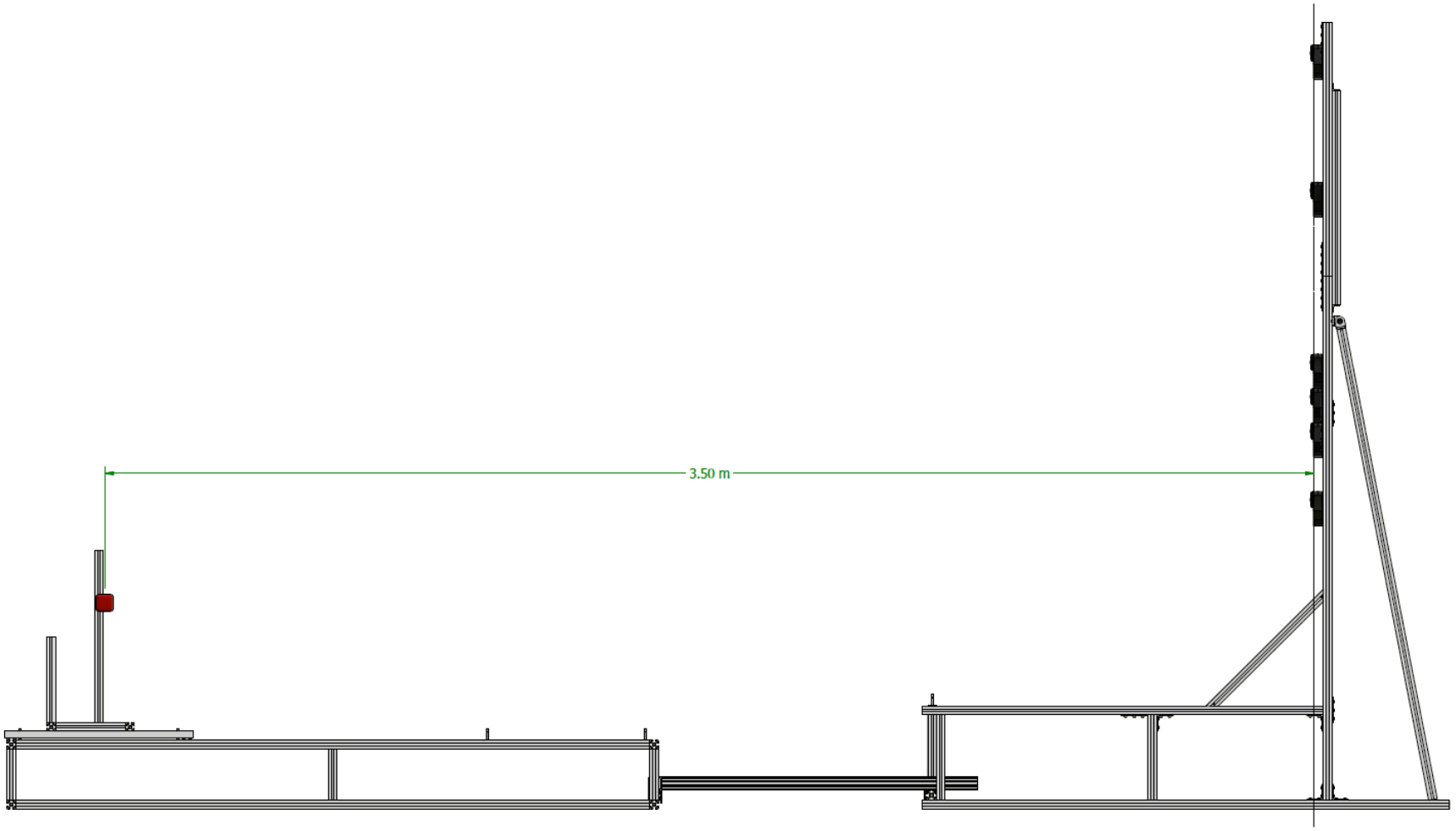


Figure 4. Test Fixture Side View, Receptor Head, Example Test Lamp and Fixture Structure

2.5 Test Surface

The test surface specifications in the NPRM included the following:

- S14.9.3.12.4.1 *Test Scenario Geometry.* Test scenarios shall involve straight roads and curved roads.
- S14.9.3.12.4.2 The curves shall be of a constant radius within the range listed in the ADB test matrix table.
- S14.9.3.12.4.3 The test road shall have a longitudinal grade (slope) that does not exceed 2 percent.
    - The test surface used had a 1% slope downward in the south-southeast direction to facilitate drainage
- S14.9.3.12.4.4 The lane width shall be from 3.05 m (10 ft.) to 3.66 m (12 ft.).
    - A lane width of 10 ft was used for NHTSA test procedure trials.
- S14.9.3.12.4.6 The lanes shall be adjacent, but may have a median of up to 6.1 m (20 ft.) wide, and shall not have any barrier taller than 0.3 m (12 in.) less than the mounting height of the stimulus vehicle's headlamps.
    - No median or barriers were used.
- S14.9.3.12.4.7 The tests are conducted on a dry, uniform, solid paved surface. The road surface shall have an International Roughness Index (IRI) of less than 1.5 m/km.
    - The test surface met all the proposed specifications outlined in the NPRM (FR 83, No. 198) except surface roughness. The IRI values for the area traversed in the various test scenario paths ranged from 1.43 to 1.86 m/km.
- S14.9.3.12.4.8 The road surface may be concrete or asphalt, and shall not be bright white.
    - The surface used in testing was asphalt.
- S14.9.3.12.4.9 The test road surface may have pavement markings, and shall be free of retroreflective material or elements that affect the outcome of the test."
    - No lane markings were used to delineate test scenario paths. A programmable steering robot was used to control the vehicle path (see Section 2.9).

The Vehicle Dynamics Area (VDA) facility at the Transportation Research Center (TRC) was the surface on which both the NHTSA ADB test procedure and SAE J3069 test procedure were carried out. There were no medians or barriers separating the lanes and no pavement markings delineating the lanes.

The test surface met all of the proposed specifications outlined in the NPRM (FR 83, No. 198) except surface roughness. The IRI values for the area traversed in the various test scenario paths ranged from 1.43 to 1.86 m/km. Since the VDA is a large surface without specific lanes for this testing, the specific (IRI) of each straight and curved path was not known. The following table shows the general IRI measurements recorded of four courses that are delineated on the VDA.

Table 10. VDA International Roughness Index Measurements (July 2019)

Vehicle Dynamics Area	Course	IRI (m/km)
Main Surface	Winding Course East	1.86
Main Surface	Winding Course West	1.43
Main Surface	Diagonal EW	1.46
Main Surface	Diagonal NS	1.61

The following figure shows the locations of the straight and curved paths overlaid on an image of the VDA, with the IRI measurements listed on the four delineated courses, for reference.

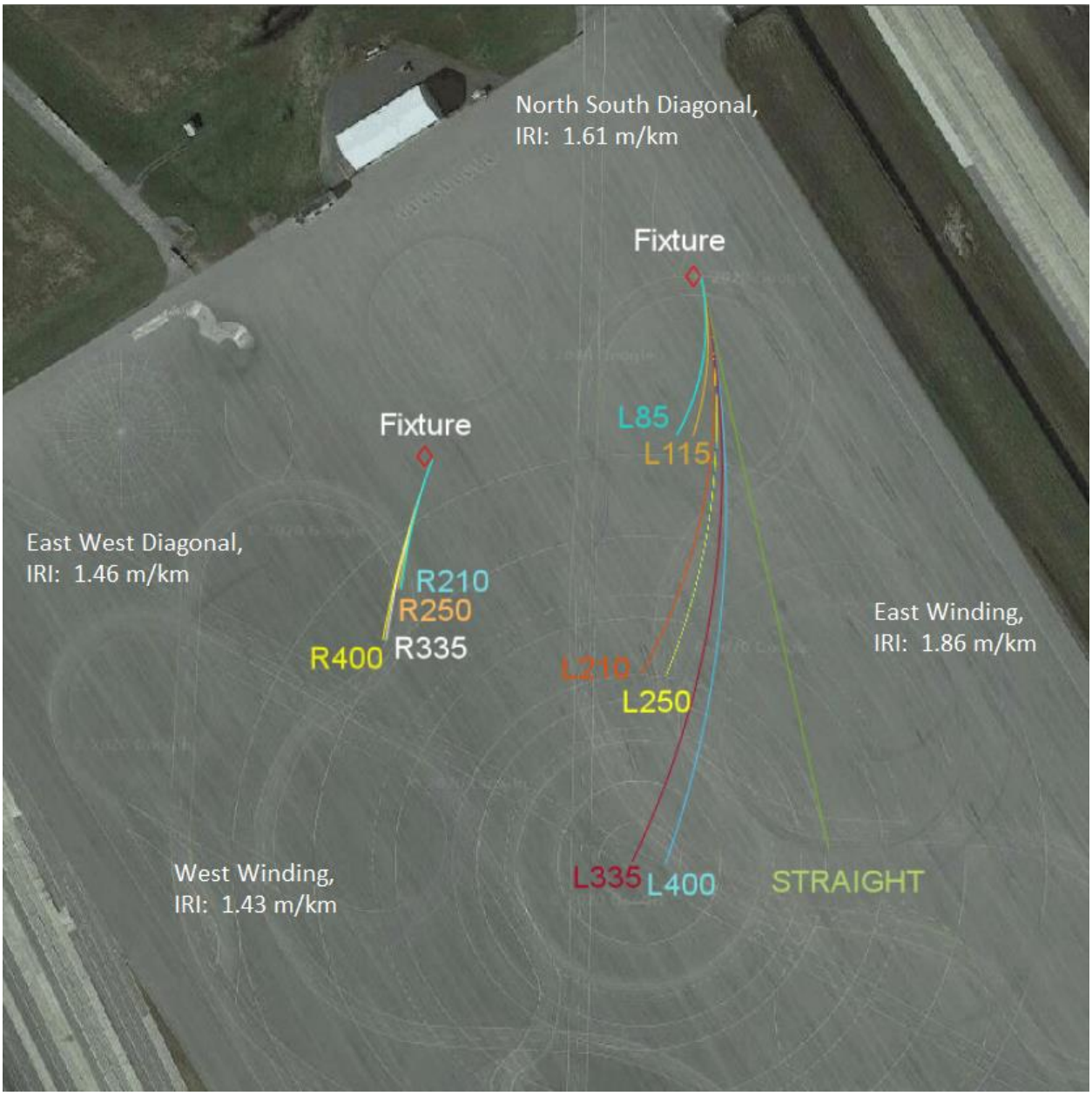


Figure 5. VDA, IRI Measurements and Straight/Curved Paths Overlay. Copyright 2021 Maxar Technologies, Ohio Statewide Imagery Program, USDA Farm Service Agency

The test surface was free of any painted reflective lane markings or reflectors. The area in which testing was conducted was free of post-mounted signs.

2.6 Test Fixture Positioning

Testing was conducted with the test fixture positioned in one of two specific locations (and orientations) on the TRC VDA to achieve all test trials. Fixture locations were selected to allow the most scenarios to be able to be performed without needing to move the fixture. One location accommodated straight (both NHTSA and SAE J3069) and left curve test scenarios while the other location was used for right curve scenarios. The test fixture was centered in its lane and oriented such that the longitudinal centerlines of the text fixture and receptor heads, as well as the fixture lamps' optical axes, were parallel with the vehicle path centerline at the point that the vehicle passed the fixture. For all NHTSA test scenarios, whether opposing or same direction, the scenario path ended with the test vehicle passing the fixture on the right in an adjacent lane orientation. The SAE test drive scenarios ended with the test vehicle passing the fixture on either the left or the right in adjacent lane and non-adjacent lane scenarios.

2.7 Tested Vehicle and Headlighting System

One test vehicle was used for all testing supporting this assessment. The test vehicle was a U.S. model year 2016 Volvo XC90 with LED headlamps. To allow isolation of variability relating to the test procedure and measurement system, the vehicle's headlighting system was operated in lower beam mode and the active bending feature was turned off for all testing related to this assessment. The vehicle's owner manual did not contain information regarding headlamp aiming and, therefore, the lamps were aimed as per SAE J599.

2.8 Vehicle Preparation

Test vehicle headlamps were wiped clean before each test session to ensure they were free of dirt or other substances that might affect performance. Each test vehicle's tires were set to the pressure values recommended by the vehicle manufacturer. The test vehicle's fuel tank was filled before testing and maintained to a level of at least three-fourths of a tank throughout each night of testing to achieve a standard vehicle pitch. All other vehicle fluids were checked to ensure they were properly filled. Prior to each test session, the test vehicle's battery level was confirmed to be within normal operating range. During testing, all vehicle doors, hatches, hood, and trunk lid (as appropriate) were closed.

Headlamp aiming was performed in a laboratory setting and documented with photographs. Test vehicle headlamps were adjusted following SAE J599 headlamp aiming procedures. As per SAE J599, the driver was present in the vehicle during aiming. Test instrumentation was also present in the vehicle and would be present during testing, that equipment was also in the vehicle during the aiming procedure. The test vehicle was positioned on a level surface 25 feet away from a vertical wall containing a dimensioned grid. Photographs were made of the headlamp pattern projected on the wall grid for the lower beam settings. Test vehicle headlamps were aimed once initially and not aimed again during testing supporting the repeatability analyses. For testing supporting reproducibility analysis, headlamps were aimed by different individuals for each test set. The status of any test vehicle headlamp aiming will be described as needed in the results sections of a specific test.

2.9 Measurement System and Related Equipment

Illuminance data were collected with a Konica Minolta T-10A illuminance meter. The unit is a multi-function illuminance meter with detachable receptor head. The unit was configured in multi-point measurement mode using 10 receptor heads connected in series to permit the measurement of separate illuminance values at the specified locations on the test fixture. The analog output signals of the 10 receptor heads were converted to controller area network (CAN) format and sent to a data acquisition system (DAS) to be recorded.

The T-10A has an operating temperature range of 14 to 104 °F (-10 to 40 °C) and specified operating conditions of 85 percent or less (at 35 °C/95 °F) relative humidity with no condensation. Temperature and humidity were monitored each night to make sure the tests were conducted when temperature and humidity were within the operating conditions of the illuminance meter.

RT-range monitoring systems were installed in the test vehicle and at the fixture location. These systems were used to detect and record the relative positions of the test vehicle and the illuminance meter receptor heads.

The test vehicle's measurement devices consisted of an RT 3003 (target) unit with a NovAtel GPS antenna. The data and relative measurements were transmitted to a stationary data collection system (located near the fixture) through an XLAN long range wireless LAN, with corrections coming from a Freewave, wireless data transceiver. The real-time vehicle-to-vehicle telemetry was transmitted by a TrackFI antenna. The test hardware in the test vehicle was powered by two lithium batteries (12V 50Ah), isolated from the vehicle's electrical system.

At the fixture location, equipment included a RT-Range (Hunter, Oxford Technical Solutions [OXTS]) unit receiving data through an XLAN, long range wireless LAN. An AB Dynamics Synchro system was also used to provide real-time vehicle-to-vehicle data received through their TrackFI antenna, providing wireless telemetry. Most of the data acquisition hardware was powered by two lithium batteries (12V, 50Ah). All laptops and the illuminance meter used their original manufacturer's power supply which were plugged into a gas-powered generator.

Data acquisition equipment at the fixture location was housed in a stationary vehicle for ease of transport and setup. During testing, this vehicle was positioned a distance away from the fixture and covered with a non-reflective car cover.

Used as a stationary data collection system, the VCDAS (Video CAN Data Acquisition System, a data acquisition system developed in-house at NHTSA's Vehicle Research and Test Center) was the main component of the data collection system, with most inputs coming in as CAN or converted to CAN internally. The separate illuminance data channels and all other data were recorded to the DAS at a frequency of 200 Hz.

In order to achieve such radii of curvature on a large surface, it was found more efficient and effective for test repeatability to use a programmable steering controller robot to guide the vehicle along the intended curved paths, instead of attempting to delineate multiple curved lane lines for a driver to follow. Thus, the test vehicle was equipped with an Anthony Best Dynamics (ABD) SR15 Orbit Steering Robot, which was programmed to navigate a specific path based on GPS coordinates with centimeter accuracy. The steering controller programs were designed to achieve a specified distance from the test fixture's position (10 feet center-to-center for the NHTSA tests and multiples of 12 feet center-to-center for the three J3069 test paths) at the end of each test trial path.

Test vehicle speed was managed by the driver through direct accelerator pedal input, which was deemed more feasible versus cruise control during pre-testing (in some vehicles, the steering controller blocked the driver's ability to effectively engage the cruise control features).

The following figure is a data acquisition system diagram, showing an overview of the instrumentation, equipment, and vehicle setup, with the various connections between devices. For simplicity, references to the data collection system will be referred to as DAS throughout the rest of this report.

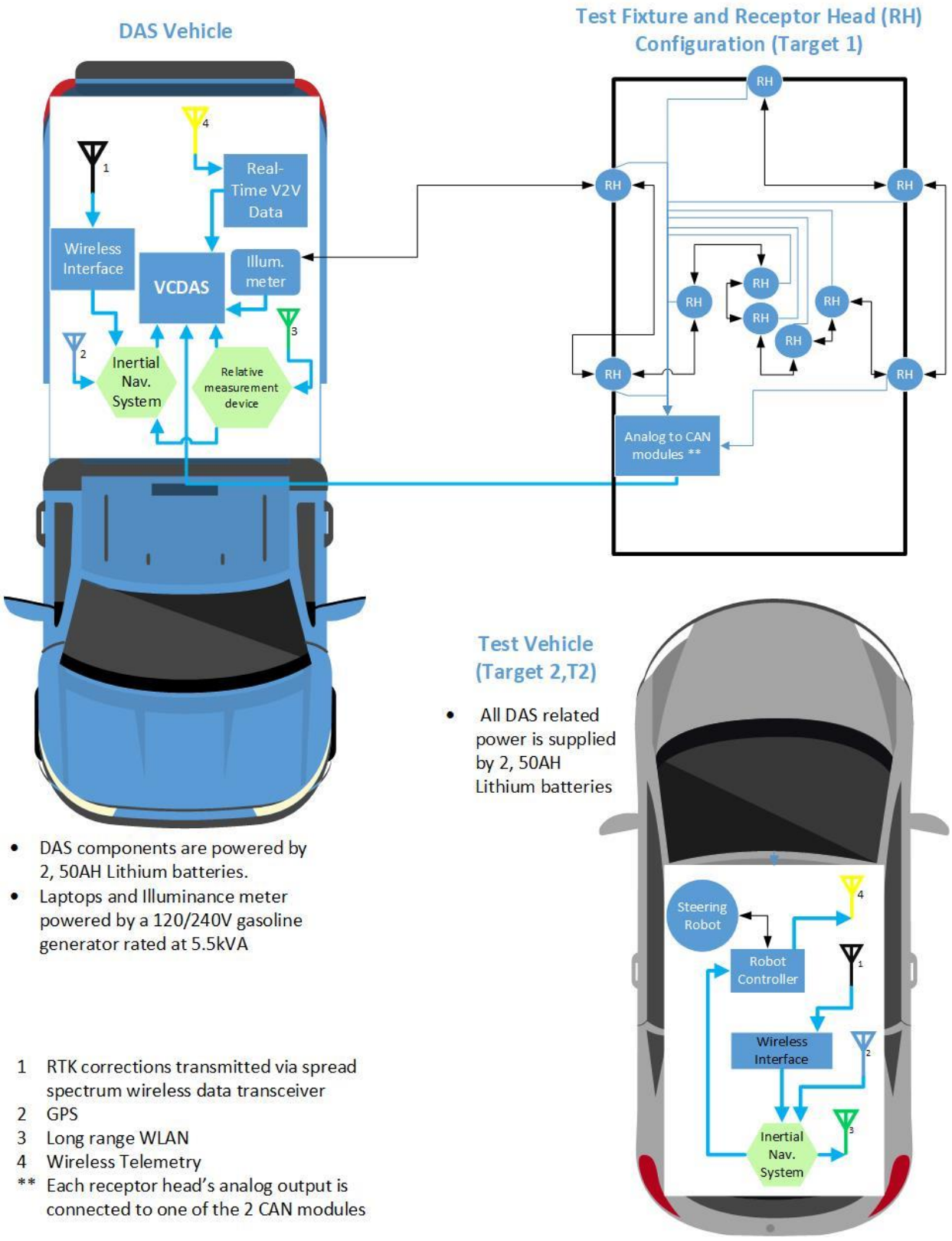


Figure 6. Data Acquisition System Diagram

2.10 Environmental Conditions During Testing

Testing was conducted in darkness as indicated by measured ambient illuminance of 0.2 lux or less. Testing was not conducted when precipitation, fog, or other vehicles were present in the test area. As stated previously, the T-10A illuminance meter has an operating temperature range of 14 to 104 °F (-10 to 40 °C) and specified operating conditions of 85 percent or less (at 35 °C/95 °F) relative humidity with no condensation. Ambient temperature and humidity values were monitored to ensure test conditions complied with the operating conditions of the illuminance meter. Testing was stopped if the humidity level exceeded 85 percent at any point during testing.

The ambient temperature, humidity and wind speed conditions were obtained for each test night based on proving grounds condition information maintained by the facility manager (Transportation Research Center Inc.).

2.11 Criteria for a Valid Test Trial

During testing, test trial data were reviewed after completion of each trial to ensure that test trial validity criteria were met and that all needed data were successfully recorded. After completion of each test trial, a member of the research staff accessed recorded test data using a laptop connected to the DAS. Data channels including vehicle speed, range, pitch, and illuminance were plotted and examined. Test vehicle speed was checked to ensure that it was maintained within 1 mph of the target speed throughout the measurement distance. Pitch data were scanned to ensure there were no pitch spikes. Range data were checked to make sure no measurement drop-outs were observed in the data. Illuminance data were checked to make sure that recorded values appeared reasonable. Trials were repeated as needed based on this review of data.

2.12 Data Processing

2.12.1 Illuminance Data Zeroing

Illuminance data were adjusted to remove from the measured values any contribution of environmental ambient illumination present during a test scenario. To isolate the illuminance produced by the lighting system under test from any ambient illumination, the measured illuminance data for each receptor head data channel was zeroed. The illuminance meter did not have a zeroing function for multiple receptor heads; therefore, this zeroing was accomplished by measuring ambient illumination via the test fixture and later subtracting this value from the test data. This was performed on a per-trial basis. A 2-second sample of ambient illuminance was recorded nominally 3 seconds after the vehicle had passed the test fixture. An average over the 2-second sample of ambient illuminance was calculated and subtracted from the entirety of the illuminance data channels for the corresponding trial.

2.12.2 Illuminance Data Range Calculation

Since the actual measured distance was that between GPS antennas mounted on the roofs of the DAS and test vehicles, the longitudinal distance had to be adjusted to obtain the distance from each receptor head's position on the test fixture to the test vehicle's headlamp locations.

Range was calculated using the Pythagorean distance formula. The base coordinate system used the Anthony Best Dynamics Steering Robot path maps, which placed the (0,0) origin at the end of the path, and measured to the location of the test vehicle reference point. The test

vehicle reference point was located at “the intersection of a horizontal plane through the headlamp light sources, a vertical plane through the headlamp light sources and a vertical plane through the vehicle’s centerline to the forward most point of the relevant photometric receptor head mounted on the test fixture” (as per the NPRM). These reference points were found using Faro arm measurements.

To find the range from the test vehicle to the fixture, the origin was translated to a Faro-arm-measured center point on the test fixture. The fixture was offset from the origin by 10 ft, or 3.048 m. Therefore, the range measurements were calculated using an origin of (0, -3.048).

OthRefYPosAdj = OthRefYPos – 3.048;

Range to Fixture = sqrt((OthRefXPos)^2+(OthRefYPosAdj)^2)

For each individual receptor head range, the origin was again translated by the lateral distance between the receptor head and the fixture center point, as measured by a Faro arm.

As an example, the car passenger side mirror receptor head is offset from the center of the fixture by 0.1484 m, therefore

Car Eye Point Y (CEPY) = OthRefYPosAdj + 0.1484 m, and

Range to Car Eye Point meter = sqrt((OthRefXPos)^2+(CEPY)^2)

For the SAE test procedure range data calculations, the FARO arm measured center point on the test fixture is offset from the adjacent path origin (Fixture Position 2) by 12 feet (3.66 meters). Test fixture offsets of 24 feet (7.32 meters) in each direction were used to calculate the ranges for the other two SAE text fixture positions (Fixture Position 1 and Fixture Position 3).

To trim the collected data to fit within the designated measurement range, a find function is used that locates the first value less than the maximum measurement range. Due to varying speeds and sampling rates of the DAS, this means that the maximum range of each data set can vary slightly.

2.12.3 Illuminance Data Filtering

All illuminance meter data was filtered by applying a low-pass Butterworth filter. Data were passed through a Mathworks Matlab ButterFilter function with 12 poles and a cutoff frequency of 35hz (allowing for accurate measurements of pulse width modulated light sources, such as an LED), at the DAS sampling rate of 200hz.

Example:

Motor Cycle Eye Point Filtered (Cycle_eye_pt_fltd) =
ButterFilter(Cycle_eye_pt_zrd,12,35,200)

2.12.4 Illuminance Data Compliance Criteria, Glare Limits

The NPRM (FR 83, No. 198) proposed a set of maximum allowed illuminance values (glare limits) derived from information provided in FMVSS No. 108. These are numeric illuminance values that would be the maximum illuminance the ADB system would be permitted to cast on the stimulus vehicle in the specified test scenarios within the measurement distance range specified in Table 1. The maximum illuminance is the single highest illuminance recorded in each measurement distance range when the vehicle is in steady state motion (i.e., excluding consecutive illuminance values that exceed the applicable glare limit lasting no longer than 0.1 s or spanning a distance range of 1 m.

2.12.5 Test Vehicle Speed

Velocity was recorded by the DAS in m/s units. For analysis, velocity data were converted into mph using the following formula:

V(mph) = V(m/s) * (3600 s/hour)/(1609.34 m/mile)

Or, V(mph) = V(m/s) * 2.234694(mph/(m/s))

Test vehicle speed throughout the test was within +/-1 mph of the target speed.

2.12.6 DAS Logged Channels

The following channels were collected from the test vehicle using an Oxford RT Range Inertial/GNSS system:

Forward_Vel_T2	Vehicle velocity (meters per second)
Lat_T2	GNSS Latitude in decimal format
Long_T2	GNSS Longitude in decimal format
Pitch_T2	Vehicle pitch (degrees)

The following channels were collected from the ABD Steering Robot using an ABD Sync-Omni for telemetry to pull them into the DAS on CAN:

OthRefXPos	Vehicle X position on Steering Robot path (meters)
OthRefYPos	Vehicle Y position on Steering Robot path (meters)

The following channels were recorded via the DAS from the analog output channels of the illuminance meter receptor heads:

Car_DS_mirror	Car driver side mirror (lux)
Car_PS_mirror	Car passenger side mirror (lux)
Car_eye_pt	Car driver eye point (lux)
Car_inside_mirror	Car rearview mirror point (lux)
Cycle_eye_pt	Motorcycle driver eye point (lux)
Cycle_left_mirror	Motorcycle left mirror (lux)
Cycle_right_mirror	Motorcycle right mirror (lux)
Truck_DS_mirror	Truck driver side mirror (lux)
Truck_PS_mirror	Truck passenger side mirror (lux)
Truck_eye_pt	Truck driver eye point (lux)

2.13 Analysis

The general objective of the data analyses described in this report was to assess the ability of the test procedures to produce repeatable measured values and test outcomes. Data analysis involved summarizing measured illuminance values by scenario and distance, for comparison to a set of glare limit values.

2.13.1 Vehicle Pitch

Vehicle pitch was examined to assess whether pitch could be adequately controlled in a dynamic lighting test such that repeatability test outcomes could be achieved. Pitch refers to rotation of a vehicle about its transverse axis appearing as an opposing vertical motion of the front and rear ends of a vehicle. Pitch increases or reduces the angle of headlamp beam projection depending on its upward or downward rotation. When a vehicle's pitch increases, the vehicle's front end, and therefore the angle of its headlamps, will raise in an upward direction

away from the road surface. Conversely, when pitch decreases, the vehicle's front end will lower, and the headlamps light will be cast downward towards the road surface.

The amount of glare perceived by other roadway users may be more pronounced when the vehicle (and headlamps) is pitched upward. Pitch changes occur with dynamic vehicle motions due to dynamic interaction between wheel and road surface (governed by vehicle speed, road surface conditions, and dynamic characteristics of vehicle system). Some other common causes of changes in vehicle pitch angle include vehicle loading condition or weight distribution, tire inflation that deviates from specifications, vehicle suspension characteristics, and vehicle acceleration.

The NPRM did not propose any adjustments to correct directly for or take vehicle pitch into account as part of the compliance track testing, although it did seek comment on whether pitch correction should be addressed directly. The test procedures in the NPRM controlled for the following factors that could affect pitch:

- Vehicle loading and suspension – the headlamps will be aimed when the vehicle is loaded as it will be during testing, and the gas tank (if the vehicle is equipped with one) is maintained at lease three-quarters full. The tires will be within 1 psi of recommended cold pressure.
- Road surface – the road surface must have an IRI measurement of less than 1.5 m/km. Imperfections in the roadway are also addressed by the 0.1 second momentary glare allowance (broader waves in the road are addressed by the pitch correction procedure).
- Vehicle acceleration – the vehicle speed must be maintained within 1 mph of the target test speed throughout the test run.

Prior Section 2.9 of this report described how vehicle loading condition was maintained during testing. Section 2.5 described the test surface and related roughness measurements. In addition to these procedures, as explained in 2.11.4 and 2.2, the proposal also contained an allowance for momentary glare exceedances that was intended to account for variations in illumination due to uncontrolled testing variables, including minor imperfections in the road surface that can cause glare exceedances by affecting vehicle pitch. Also as noted in Section 11.4, the modified test procedures contained a specific pitch allowance criterion for valid test scenario trials.

Analyses of vehicle pitch were performed to assess the degree to which vehicle pitch affected measured illuminance values. In addition to calculating descriptive statistics, the following three pitch metrics were examined:

1) Average pitch across each scenario's full measurement distance: This is the average of vehicle pitch values measured throughout the performance of a test scenario. This value gives an indication of the slope of the test surface area traversed over the test trial measurement range.

2) Maximum pitch over each scenario's measurement distance sub-ranges: This is the maximum of vehicle pitch values measured over each test scenario measurement distance sub-range. This represents the combined effects of test surface slope and dynamic vehicle pitch during performance of a test trial.

3) The difference between these two pitch values is taken to give an indication of how much the vehicle pitched independent of the pavement's overall slope. This difference highlights how well the vehicle dynamics were able to be maintained at an essentially constant level throughout a scenario to limit the effect of vehicle dynamics on the

illuminance measurements. The largest pitch difference recorded for all tests was 0.32 degrees.

Pitch information is presented with respect to the scenarios of both the NHTSA and SAE test procedures. However, the SAE test procedure does not have any test specifications to control for pitch.

3.0 RESULTS

The following analysis characterizes data collected to assess the repeatability of the measurement system used in this testing, as well as the NHTSA and SAE ADB test procedures as carried out in this effort.

For both the NHTSA and SAE test procedures, illuminance and vehicle dynamics measures (e.g., speed, pitch, accelerations) were recorded and later analyzed to assess the accuracy and precision of measurements across all repetitions. The set of measurements and statistics calculated for this report were based upon the previously published NHTSA report, "Repeatability, Reproducibility, and Sameness of Quiet Vehicle Test Data" (Garrott et al., 2016). That published report provides a framework for performing and analyzing repeatability, reproducibility, and variability for "compliance type" testing. As was done by Garrott et al., means, standard deviations, and prediction intervals were calculated for the illuminance data in this report in order to assess the repeatability of the ADB test procedures.

Results relevant to these analyses are presented in tables throughout this chapter. For NHTSA test scenarios reported values include the maximum illuminance value for each measurement distance sub-range. For SAE test drives, the illuminance value at the point closest to the specified J3069 measurement distance is reported. Test vehicle pitch throughout the measurement range is also reported. Pitch maximum refers to the maximum pitch value, in degrees, across all receptor heads for that particular measurement distance or distance sub-range. Pitch average refers to the average pitch, in degrees, over the entire measurement distance range for that test scenario or test drive. Summary statistics are presented including the average, standard deviation, maximum, and minimum for each test scenario. The 95th percentile confidence interval and the 95th percentile prediction interval are presented.

The standard deviation is a measurement of the variation within the data set. The 95th percentile confidence interval is the estimate of the upper and lower illuminance values in which there is a 95 percent probability that the true mean falls within this interval. The confidence interval is calculated using the equation:

$$CI_{95\%} = \bar{x} \pm t_{0.975,n-1} s \sqrt{\frac{1}{n}}$$

where

$CI_{95\%}$	is the 95th percentile confidence interval
$\bar{x}$	is the mean illuminance for each receptor head
$t_{0.975,n-1} s \sqrt{\frac{1}{n}}$	is the margin of error (MOE) for the confidence interval

To calculate the confidence interval margin of error:

n	is the number of repeatability data values (in these tables, n = 10)
s	is the standard deviation for each receptor head
$t_{0.975,n-1}$	is the 95th percentile of the t distribution with n-1 degrees of freedom

The confidence interval is then calculated by summing or subtracting the margin of error and the mean ($\bar{x}$).

The 95th percentile prediction interval is the estimate of the interval of which there is a 95 percent probability that future measurements will be within. The prediction interval is calculated using the equation:

$$PI_{95\%} = \bar{x} \pm t_{0.975,n-1} s \sqrt{1 + \left(\frac{1}{n}\right)}$$

where

$PI_{95\%}$	is the 95th percentile prediction interval
$\bar{x}$	is the mean illuminance for each receptor head
$t_{0.975,n-1} s \sqrt{1 + \left(\frac{1}{n}\right)}$	is the margin of error (MOE) for the prediction interval

To calculate the prediction interval margin of error:

n	is the number of repeatability data values (in these tables, n = 10)
s	is the standard deviation for each receptor head
$t_{0.975,n-1}$	is the 95th percentile of the t distribution with n-1 degrees of freedom

and the prediction interval is calculated by summing or subtracting the margin of error and the mean($\bar{x}$) .

Prediction intervals were used to determine how much total variation we would expect from the test procedure. The upper value of the prediction interval provides an upper limit estimate that 95 percent of all future values are not expected to surpass.

Taken together, the standard deviation and the prediction interval can be used to quantify the repeatability of the test procedure. The smaller the standard deviations and the tighter the prediction interval, the smaller the range of values we will expect future values to be within, indicating a tighter precision of measurement system. Note that $CI_{95\%}$ and $PI_{95\%}$ are dependent on the number of values collected ($t_{0.975}$ is large for small sample sizes and decreases as more data are collected). That is to say, the more data collected for a distribution, the more evidence builds that indicates where the true mean is located and where future measurement values will fall. While a standard deviation can be calculated for a very small sample size, CI and PI will be large for small samples, even if the population standard deviation is small.

3.1 NHTSA Test Procedure - Gauge (Measurement System) Repeatability Assessment

To assess how the measurement system used may have contributed to test results' variability , each test scenario was run 10 times in sequence in a single night and later analyzed. This isolated variability to only that associated with the measurement system as test repetitions were conducted without moving the fixture between repetitions, thus eliminating any measurement error which may result from moving the fixture or any other part of test setup, as well as weather conditions on different nights. Standard deviations were calculated to measure the spread of the values and the degree to which values deviate from each other and then subsequently, the prediction interval indicates what interval we expect 95 percent of future values to be within. Taken together, standard deviation and the prediction interval indicate the repeatability of the

test procedure. The smaller the standard deviations, the tighter the prediction interval, and the smaller range of values we will expect future values to be within, indicating a tighter precision of measurement.

In general, the NHTSA results were repeatable with most standard deviations under 0.04 lux for NHTSA test scenarios 1, 2, 3, 4, 5 and 7. More specifically for the oncoming test scenarios, NHTSA test scenarios 1, 3, 4 and 7, standard deviations were 0.034 lux or less. For the 220 m - 120 m measurement distance sub-range, all standard deviations were 0.005 lux or less. For the 150 m to 120 m measurement distance sub-range, all standard deviations were 0.0101 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all standard deviations were 0.0091 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0156 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0338 lux or less.

For the same-direction NHTSA test scenarios 2 and 5, standard deviations were 0.06 lux or less. For the 100 m to 60 m measurement distance sub-range, all standard deviations were 0.0144 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0221 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0570 lux or less.

NHTSA test scenarios 6 and 8 were less repeatable than the other test scenarios. For NHTSA test scenario 6, standard deviations were 0.5593 lux or less for the 50 m to 30 m measurement distance sub-range. The standard deviation for receptor head 4 for test scenario 6 with the 50 m to 30 m measurement distance sub-range was particularly high, with a standard deviation of 0.5593 lux. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0270 lux or less. For NHTSA test scenario 8, standard deviations were 0.2185 lux or less for the 70 m to 60 m measurement distance sub-range. The standard deviation for receptor head 4 for test scenario 8 for the 70 m to 60 m measurement distance sub-range was particularly high, with a standard deviation of 0.2185 lux. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.1805 lux or less. Again, the standard deviation for receptor head 4 for test scenario 8, 59.9 m to 30 m measurement distance sub-range was particularly high, with a standard deviation of 0.1805 lux. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0346 lux or less.

Most prediction interval margins of error were under +/- 0.1352 lux for NHTSA test scenarios 1, 2, 3, 4, 5 and 7. More specifically for the oncoming test scenarios, NHTSA test scenarios 1, 3, 4 and 7, prediction interval margins of error were +/- 0.0802 lux or less. For the 220 m -120 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0117 lux or less. For the 150 m to 120 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0241 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0216 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0369 lux or less. For the 29.9 m to 15 m measurement distance sub-range, prediction interval margins of error were +/- 0.0802 lux or less.

For the same-direction NHTSA test scenarios 2 and 5 prediction interval margins of error were +/- 0.1352 lux or less. For the 100 m to 60 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0343 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0525 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all prediction interval margins of error were +/- 0.1352 lux or less.

NHTSA test scenarios 6 and 8 were less repeatable than the other test scenarios. For NHTSA test scenario 6, prediction interval margins of error were +/- 1.3270 lux or less for the 50 m to 30 m measurement distance sub-range. The prediction interval margins of error for receptor head 4 for test scenario 6 with the 50 m to 30 m measurement distance sub-range was particularly high, with a prediction interval margin of error of +/- 1.3270 lux. For the 29.9 m to 15 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0641 lux or less. For NHTSA test scenario 8 prediction interval margins of error were +/- 0.5184 lux or less for the 70 m to 60 m measurement distance sub-range. The prediction interval margins of error for receptor head 4 for test scenario 8 for the 70 m to 60 m measurement distance sub-range was particularly high, with a prediction interval margins of error of +/- 0.5184 lux. For the 59.9 m to 30 m measurement distance sub-range, all prediction interval margins of error were +/- 0.4283 lux or less. Again, the prediction interval margins of error for receptor head 4 for test scenario 8, 59.9 m to 30 m measurement distance sub-range was particularly high, with prediction interval margins of error of +/- 0.4283 lux. For the 29.9 m to 15 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0822 lux or less.

The repeatability of test vehicle pitch as measured during the NHTSA test procedure was assessed. Test vehicle pitch in test scenarios can be affected by the roughness of the pavement as well as any changes in test vehicle speed. The roughness of the test surface used for testing was noted in Section 2.5. Low standard deviations for pitch provide evidence of experimental consistency when carrying out the test procedure. Pitch standard deviations ranged from 1.0 to 1.20 degrees for all test scenarios.

The prediction interval margin of error indicates the range within which a similar vehicle's measured illuminance value is 95 percent likely to fall (5 percent chance of not falling within the range). Having performed the test procedure for 10 repetitions which resulted in standard deviations of 0.0570 lux or less for most test scenarios, it is reasonable to assume that the magnitude of the calculated prediction intervals can be applied when assessing different manufacturer headlighting systems, as the test procedure should always result in comparable variability. The variability of the illuminance values should not differ, even if the maximum illuminance value for other headlighting systems is higher. This assumption holds true provided the headlamp beam pattern under test demonstrates similar gradients in and around the measurement locations.

An extreme example: for NHTSA test scenario 1, with the 220 m to 120 m measurement distance sub-range, the prediction interval margin of error for Receptor Head 4 is +/- 0.0117 lux, which means that 95 percent of future measurements should not vary by more than 0.0117 lux from the measured mean illuminance, assuming the standard deviation of the measurement system and procedure will remain the same. Therefore, if a manufacturer measures 0.2883 lux or lower for Receptor Head 4, they can be confident that their system will pass the test procedure when NHTSA performs a single trial. If NHTSA performs a single test, there is a 95 percent probability that NHTSA will measure 0.2883 +/- 0.0117, meaning NHTSA should only measure more than 0.3 lux 5 percent of the time.

Tables 11 through 35 provide the measurement system (gauge) repeatability results for the NHTSA test procedure.

Table 11. NHTSA Test No. 1, 220 m to 120 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 1, Oncoming Straight, 220 m - 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0688	0.0751	0.0652	1.3000	1.2100	0.0900
	2	0.0666	0.0802	0.0602	1.3800	1.2200	0.1600
	3	0.0751	0.0724	0.0618	1.3400	1.2000	0.1400
	4	0.0665	0.0764	0.0560	1.3100	1.2100	0.1000
	5	0.0686	0.0675	0.0561	1.3200	1.2100	0.1100
	6	0.0711	0.0722	0.0599	1.3000	1.2000	0.1000
	7	0.0709	0.0730	0.0542	1.2900	1.1800	0.1100
	8	0.0830	0.0763	0.0590	1.3000	1.2000	0.1000
	9	0.0693	0.0822	0.0574	1.2800	1.1900	0.0900
	10	0.0736	0.0822	0.0625	1.3500	1.2100	0.1400
Mean		0.0714	0.0758	0.0592	1.3170	1.2030	0.1140
StdDev		0.0049	0.0048	0.0034	0.0309	0.0116	0.0241
Min		0.0665	0.0675	0.0542	1.2800	1.1800	0.0900
Max		0.0830	0.0822	0.0652	1.3800	1.2200	0.1600
95% C.I. MOE (+/-)		0.0035	0.0034	0.0024	0.0221	0.0083	0.0173
95% C.I. Upper Limit		0.0749	0.0791	0.0617	1.3391	1.2113	0.1313
95% C.I. Lower Limit		0.0678	0.0724	0.0568	1.2949	1.1947	0.0967
95% P.I. MOE (+/-)		0.0117	0.0113	0.0080	0.0734	0.0275	0.0572
95% P.I. Upper Limit		0.0831	0.0870	0.0673	1.3904	1.2305	0.1712
95% P.I. Lower Limit		0.0596	0.0645	0.0512	1.2436	1.1755	0.0568

Table 12. NHTSA Test No. 1, 119.9 m to 60 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 1, Oncoming Straight, 119.9 m - 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.2155	0.2044	0.2010	1.3800	1.2100	0.1700
	2	0.2071	0.1957	0.2083	1.3300	1.2200	0.1100
	3	0.1975	0.1912	0.2159	1.3300	1.2000	0.1300
	4	0.2025	0.2050	0.2061	1.3400	1.2100	0.1300
	5	0.2071	0.2068	0.2084	1.3100	1.2100	0.1000
	6	0.2127	0.2050	0.2059	1.3300	1.2000	0.1300
	7	0.2147	0.1943	0.2057	1.2900	1.1800	0.1100
	8	0.2120	0.1925	0.2064	1.3200	1.2000	0.1200
	9	0.2040	0.2101	0.2044	1.3100	1.1900	0.1200
	10	0.2141	0.2133	0.2108	1.3100	1.2100	0.1000
Mean		0.2087	0.2018	0.2073	1.3250	1.2030	0.1220
StdDev		0.0061	0.0078	0.0040	0.0242	0.0116	0.0204
Min		0.1975	0.1912	0.2010	1.2900	1.1800	0.1000
Max		0.2155	0.2133	0.2159	1.3800	1.2200	0.1700
95% C.I. MOE (+/-)		0.0043	0.0056	0.0029	0.0173	0.0083	0.0146
95% C.I. Upper Limit		0.2131	0.2074	0.2102	1.3423	1.2113	0.1366
95% C.I. Lower Limit		0.2044	0.1962	0.2044	1.3077	1.1947	0.1074
95% P.I. MOE (+/-)		0.0144	0.0185	0.0095	0.0573	0.0275	0.0485
95% P.I. Upper Limit		0.2231	0.2203	0.2168	1.3823	1.2305	0.1705
95% P.I. Lower Limit		0.1944	0.1833	0.1978	1.2677	1.1755	0.0735

Table 13. NHTSA Test No. 1, 59.9 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 1, Oncoming Straight, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.6857	0.5963	0.9067	1.2900	1.2100	0.0800
	2	0.6775	0.6284	0.9168	1.3000	1.2200	0.0800
	3	0.6719	0.6233	0.9246	1.2800	1.2000	0.0800
	4	0.6831	0.6247	0.9285	1.2900	1.2100	0.0800
	5	0.6889	0.6317	0.9266	1.2900	1.2100	0.0800
	6	0.6630	0.6350	0.9211	1.2700	1.2000	0.0700
	7	0.6874	0.6174	0.9276	1.2400	1.1800	0.0600
	8	0.6967	0.6382	0.9276	1.2400	1.2000	0.0400
	9	0.6946	0.6230	0.9396	1.2300	1.1900	0.0400
	10	0.6882	0.6570	0.9452	1.2700	1.2100	0.0600
Mean		0.6837	0.6275	0.9264	1.2700	1.2030	0.0670
StdDev		0.0103	0.0156	0.0108	0.0249	0.0116	0.0164
Min		0.6630	0.5963	0.9067	1.2300	1.1800	0.0400
Max		0.6967	0.6570	0.9452	1.3000	1.2200	0.0800
95% C.I. MOE (+/-)		0.0074	0.0111	0.0077	0.0178	0.0083	0.0117
95% C.I. Upper Limit		0.6911	0.6386	0.9341	1.2878	1.2113	0.0787
95% C.I. Lower Limit		0.6763	0.6164	0.9187	1.2522	1.1947	0.0553
95% P.I. MOE (+/-)		0.0245	0.0369	0.0256	0.0592	0.0275	0.0388
95% P.I. Upper Limit		0.7082	0.6644	0.9520	1.3292	1.2305	0.1058
95% P.I. Lower Limit		0.6592	0.5906	0.9008	1.2108	1.1755	0.0282

Table 14. NHTSA Test No. 1, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 1, Oncoming Straight, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.0088	1.8468	1.4811	1.3000	1.2100	0.0900
	2	2.0648	1.8840	1.5102	1.3000	1.2200	0.0800
	3	2.1045	1.9449	1.5369	1.2900	1.2000	0.0900
	4	2.0555	1.8885	1.5076	1.3000	1.2100	0.0900
	5	2.0870	1.9027	1.5257	1.2900	1.2100	0.0800
	6	2.0864	1.9503	1.5397	1.2600	1.2000	0.0600
	7	2.0502	1.9157	1.5297	1.2400	1.1800	0.0600
	8	2.0839	1.9273	1.5220	1.2600	1.2000	0.0600
	9	2.0770	1.9534	1.5350	1.2500	1.1900	0.0600
	10	2.1105	1.9232	1.5444	1.2800	1.2100	0.0700
Mean		2.0729	1.9137	1.5232	1.2770	1.2030	0.0740
StdDev		0.0297	0.0338	0.0191	0.0226	0.0116	0.0135
Min		2.0088	1.8468	1.4811	1.2400	1.1800	0.0600
Max		2.1105	1.9534	1.5444	1.3000	1.2200	0.0900
95% C.I. MOE (+/-)		0.0212	0.0242	0.0137	0.0162	0.0083	0.0097
95% C.I. Upper Limit		2.0941	1.9379	1.5369	1.2932	1.2113	0.0837
95% C.I. Lower Limit		2.0516	1.8895	1.5096	1.2608	1.1947	0.0643
95% P.I. MOE (+/-)		0.0704	0.0802	0.0453	0.0537	0.0275	0.0320
95% P.I. Upper Limit		2.1432	1.9939	1.5685	1.3307	1.2305	0.1060
95% P.I. Lower Limit		2.0025	1.8335	1.4779	1.2233	1.1755	0.0420

Table 15. NHTSA Test No. 2, 100 m to 60 m, Gauge (Measurement System) Repeatability

NHTSA Test No 2, Same Direction Straight, 100 m to 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1774	0.2187	0.1937	0.1899	0.1950	0.1893	0.2033	1.3800	1.2202	0.1598
	2	0.1861	0.2366	0.2024	0.2145	0.2117	0.1930	0.2107	1.3300	1.2157	0.1143
	3	0.1858	0.2370	0.1933	0.1964	0.2017	0.1887	0.2111	1.3300	1.2060	0.1240
	4	0.1680	0.2381	0.1927	0.1936	0.2077	0.1864	0.2064	1.3400	1.2188	0.1212
	5	0.1852	0.2358	0.2011	0.1955	0.2026	0.1981	0.2104	1.3100	1.2114	0.0986
	6	0.1801	0.2495	0.2061	0.2041	0.2094	0.1944	0.2270	1.3300	1.2081	0.1219
	7	0.1758	0.2349	0.1999	0.2079	0.1989	0.1892	0.2216	1.2900	1.1757	0.1143
	8	0.1714	0.2317	0.1977	0.2027	0.2068	0.1998	0.2167	1.3200	1.1942	0.1258
	9	0.1903	0.2402	0.2042	0.1962	0.2150	0.1905	0.2206	1.3100	1.1873	0.1227
	10	0.2023	0.2469	0.2040	0.2067	0.1962	0.1948	0.2212	1.3100	1.1987	0.1113
Mean		0.1822	0.2369	0.1995	0.2008	0.2045	0.1924	0.2149	1.3250	1.2036	0.1214
StdDev		0.0100	0.0084	0.0049	0.0077	0.0067	0.0044	0.0076	0.0242	0.0145	0.0157
Min		0.1680	0.2187	0.1927	0.1899	0.1950	0.1864	0.2033	1.2900	1.1757	0.0986
Max		0.2023	0.2495	0.2061	0.2145	0.2150	0.1998	0.2270	1.3800	1.2202	0.1598
95% C.I. MOE (+/-)		0.0071	0.0060	0.0035	0.0055	0.0048	0.0031	0.0055	0.0173	0.0104	0.0112
95% C.I. Upper Limit		0.1894	0.2430	0.2030	0.2062	0.2093	0.1955	0.2204	1.3423	1.2140	0.1326
95% C.I. Lower Limit		0.1751	0.2309	0.1960	0.1953	0.1997	0.1893	0.2094	1.3077	1.1932	0.1101
95% P.I. MOE (+/-)		0.0236	0.0199	0.0117	0.0182	0.0159	0.0104	0.0181	0.0573	0.0344	0.0373
95% P.I. Upper Limit		0.2059	0.2569	0.2112	0.2189	0.2204	0.2028	0.2330	1.3823	1.2380	0.1587
95% P.I. Lower Limit		0.1586	0.2170	0.1878	0.1826	0.1886	0.1820	0.1968	1.2677	1.1692	0.0841

Table 16. NHTSA Test No. 2, 59.9 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No 2, Same Direction Straight, 59.9 m to 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.7102	0.8865	0.6421	0.6114	0.6258	0.9693	0.6581	1.2900	1.2202	0.0698
	2	0.7398	0.9057	0.6604	0.6242	0.6496	1.0060	0.6762	1.3000	1.2157	0.0843
	3	0.7590	0.9062	0.6640	0.6202	0.6499	1.0107	0.6795	1.2800	1.2060	0.0740
	4	0.7643	0.8979	0.6577	0.6200	0.6472	0.9943	0.6759	1.2900	1.2188	0.0712
	5	0.7633	0.9092	0.6689	0.6392	0.6645	1.0111	0.6968	1.2900	1.2114	0.0786
	6	0.7730	0.8859	0.6742	0.6181	0.6478	1.0373	0.6659	1.2700	1.2081	0.0619
	7	0.7418	0.9079	0.6651	0.6228	0.6419	1.0165	0.6652	1.2400	1.1757	0.0643
	8	0.7572	0.8720	0.6557	0.6245	0.6355	1.0305	0.6800	1.2400	1.1942	0.0458
	9	0.7598	0.9199	0.6766	0.6259	0.6431	1.0310	0.6758	1.2300	1.1873	0.0427
	10	0.7637	0.9239	0.6869	0.6406	0.6526	1.0430	0.7033	1.2700	1.1987	0.0713
Mean		0.7532	0.9015	0.6652	0.6247	0.6458	1.0150	0.6777	1.2700	1.2036	0.0664
StdDev		0.0182	0.0161	0.0125	0.0090	0.0103	0.0221	0.0138	0.0249	0.0145	0.0133
Min		0.7102	0.8720	0.6421	0.6114	0.6258	0.9693	0.6581	1.2300	1.1757	0.0427
Max		0.7730	0.9239	0.6869	0.6406	0.6645	1.0430	0.7033	1.3000	1.2202	0.0843
95% C.I. MOE (+/-)		0.0130	0.0115	0.0089	0.0065	0.0074	0.0158	0.0099	0.0178	0.0104	0.0095
95% C.I. Upper Limit		0.7662	0.9131	0.6741	0.6311	0.6532	1.0308	0.6875	1.2878	1.2140	0.0759
95% C.I. Lower Limit		0.7402	0.8900	0.6562	0.6182	0.6384	0.9991	0.6678	1.2522	1.1932	0.0569
95% P.I. MOE (+/-)		0.0432	0.0382	0.0296	0.0214	0.0245	0.0525	0.0327	0.0592	0.0344	0.0316
95% P.I. Upper Limit		0.7964	0.9397	0.6948	0.6461	0.6703	1.0675	0.7104	1.3292	1.2380	0.0980
95% P.I. Lower Limit		0.7100	0.8633	0.6355	0.6033	0.6213	0.9625	0.6450	1.2108	1.1692	0.0348

Table 17. NHTSA Test No. 2, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No 2, Same Direction Straight, 29.9 m to 15 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.3557	2.8207	2.0178	1.7449	1.8871	2.3243	1.9009	1.3000	1.2202	0.0798
	2	1.3971	2.8920	2.0584	1.7857	1.8931	2.4093	1.9425	1.3000	1.2157	0.0843
	3	1.4052	2.9153	2.0866	1.8192	1.9527	2.4406	1.9394	1.2900	1.2060	0.0840
	4	1.3961	2.8569	2.0701	1.7949	1.8970	2.3732	1.9340	1.3000	1.2188	0.0812
	5	1.4519	2.9183	2.0942	1.8358	1.9418	2.4683	1.9907	1.2900	1.2114	0.0786
	6	1.3915	2.8861	2.0952	1.8042	1.9319	2.4077	1.9114	1.2600	1.2081	0.0519
	7	1.3932	2.8738	2.0783	1.7865	1.9135	2.4073	1.9252	1.2400	1.1757	0.0643
	8	1.4053	2.7547	2.0259	1.7641	1.8553	2.4220	1.9404	1.2600	1.1942	0.0658
	9	1.4214	2.9235	2.0858	1.8366	1.9487	2.4287	1.9335	1.2500	1.1873	0.0627
	10	1.4282	2.9483	2.1313	1.8398	1.9562	2.4646	1.9916	1.2800	1.1987	0.0813
Mean		1.4046	2.8790	2.0744	1.8012	1.9177	2.4146	1.9410	1.2770	1.2036	0.0734
StdDev		0.0256	0.0570	0.0336	0.0322	0.0339	0.0426	0.0296	0.0226	0.0145	0.0113
Min		1.3557	2.7547	2.0178	1.7449	1.8553	2.3243	1.9009	1.2400	1.1757	0.0519
Max		1.4519	2.9483	2.1313	1.8398	1.9562	2.4683	1.9916	1.3000	1.2202	0.0843
95% C.I. MOE (+/-)		0.0183	0.0408	0.0241	0.0230	0.0242	0.0304	0.0212	0.0162	0.0104	0.0080
95% C.I. Upper Limit		1.4229	2.9197	2.0984	1.8242	1.9420	2.4451	1.9621	1.2932	1.2140	0.0814
95% C.I. Lower Limit		1.3863	2.8382	2.0503	1.7781	1.8935	2.3842	1.9198	1.2608	1.1932	0.0653
95% P.I. MOE (+/-)		0.0607	0.1352	0.0798	0.0763	0.0804	0.1010	0.0702	0.0537	0.0344	0.0267
95% P.I. Upper Limit		1.4653	3.0142	2.1541	1.8775	1.9981	2.5156	2.0112	1.3307	1.2380	0.1001
95% P.I. Lower Limit		1.3438	2.7437	1.9946	1.7249	1.8373	2.3136	1.8708	1.2233	1.1692	0.0467

Table 18. NHTSA Test No. 3, 59.9 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 3, Oncoming Left Curve 85 m Radius, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4426	0.3895	0.3478	1.2900	1.0447	0.2453
	2	0.4404	0.3857	0.3507	1.3000	1.0529	0.2471
	3	0.4550	0.3794	0.3485	1.2800	1.0470	0.2330
	4	0.4436	0.3901	0.3519	1.2900	1.0430	0.2470
	5	0.4455	0.3798	0.3463	1.2900	1.0591	0.2309
	6	0.4400	0.3829	0.3523	1.2700	1.0492	0.2208
	7	0.4534	0.3754	0.3585	1.2400	1.0702	0.1698
	8	0.4453	0.3902	0.3475	1.2400	1.0672	0.1728
	9	0.4637	0.3733	0.3529	1.2300	1.0578	0.1722
	10	0.4507	0.3789	0.3556	1.2700	1.0660	0.2040
Mean		0.4480	0.3825	0.3512	1.2700	1.0557	0.2143
StdDev		0.0076	0.0062	0.0039	0.0249	0.0098	0.0322
Min		0.4400	0.3733	0.3463	1.2300	1.0430	0.1698
Max		0.4637	0.3902	0.3585	1.3000	1.0702	0.2471
95% C.I. MOE (+/-)		0.0054	0.0044	0.0028	0.0178	0.0070	0.0231
95% C.I. Upper Limit		0.4534	0.3869	0.3540	1.2878	1.0628	0.2373
95% C.I. Lower Limit		0.4426	0.3781	0.3484	1.2522	1.0487	0.1912
95% P.I. MOE (+/-)		0.0179	0.0146	0.0092	0.0592	0.0233	0.0765
95% P.I. Upper Limit		0.4659	0.3971	0.3604	1.3292	1.0791	0.2907
95% P.I. Lower Limit		0.4301	0.3679	0.3420	1.2108	1.0324	0.1378

Table 19. NHTSA Test No. 3, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 3, Oncoming Left Curve 85 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.5050	1.4329	1.2144	1.2000	1.0447	0.1553
	2	1.5081	1.4382	1.2121	1.2300	1.0529	0.1771
	3	1.5038	1.4532	1.2069	1.2200	1.0470	0.1730
	4	1.4940	1.4085	1.1987	1.2100	1.0430	0.1670
	5	1.5287	1.4079	1.2131	1.2500	1.0591	0.1909
	6	1.5065	1.4214	1.2035	1.2300	1.0492	0.1808
	7	1.5192	1.4365	1.2096	1.2300	1.0702	0.1598
	8	1.5123	1.3971	1.2014	1.2400	1.0672	0.1728
	9	1.5146	1.4016	1.2123	1.2300	1.0578	0.1722
	10	1.5340	1.4523	1.2141	1.2400	1.0660	0.1740
Mean		1.5126	1.4250	1.2086	1.2280	1.0557	0.1723
StdDev		0.0120	0.0206	0.0057	0.0148	0.0098	0.0101
Min		1.4940	1.3971	1.1987	1.2000	1.0430	0.1553
Max		1.5340	1.4532	1.2144	1.2500	1.0702	0.1909
95% C.I. MOE (+/-)		0.0086	0.0147	0.0041	0.0106	0.0070	0.0072
95% C.I. Upper Limit		1.5212	1.4397	1.2127	1.2386	1.0628	0.1795
95% C.I. Lower Limit		1.5040	1.4102	1.2045	1.2174	1.0487	0.1650
95% P.I. MOE (+/-)		0.0286	0.0489	0.0135	0.0350	0.0233	0.0240
95% P.I. Upper Limit		1.5412	1.4738	1.2221	1.2630	1.0791	0.1963
95% P.I. Lower Limit		1.4840	1.3761	1.1951	1.1930	1.0324	0.1483

Table 20. NHTSA Test No. 4, 150 m to 120 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 150 m to 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0522	0.0572	0.0354	1.0200	1.0550	0.0350
	2	0.0759	0.0625	0.0486	1.0400	1.0629	0.0229
	3	0.0529	0.0796	0.0385	1.0500	1.0678	0.0178
	4	0.0475	0.0667	0.0370	1.0000	1.0284	0.0284
	5	0.0530	0.0658	0.0393	1.0000	1.0457	0.0457
	6	0.0507	0.0737	0.0379	1.0100	1.0526	0.0426
	7	0.0601	0.0584	0.0378	1.0300	1.0545	0.0245
	8	0.0495	0.0520	0.0405	1.0200	1.0623	0.0423
	9	0.0578	0.0494	0.0413	1.0300	1.0671	0.0371
	10	0.0472	0.0498	0.0339	1.0200	1.0442	0.0242
Mean		0.0547	0.0615	0.0390	1.0220	1.0541	0.0321
StdDev		0.0085	0.0101	0.0040	0.0162	0.0122	0.0098
Min		0.0472	0.0494	0.0339	1.0000	1.0284	0.0178
Max		0.0759	0.0796	0.0486	1.0500	1.0678	0.0457
95% C.I. MOE (+/-)		0.0061	0.0073	0.0029	0.0116	0.0087	0.0070
95% C.I. Upper Limit		0.0608	0.0688	0.0419	1.0336	1.0628	0.0390
95% C.I. Lower Limit		0.0486	0.0543	0.0361	1.0104	1.0453	0.0251
95% P.I. MOE (+/-)		0.0202	0.0241	0.0095	0.0384	0.0289	0.0231
95% P.I. Upper Limit		0.0749	0.0856	0.0486	1.0604	1.0830	0.0552
95% P.I. Lower Limit		0.0345	0.0374	0.0295	0.9836	1.0252	0.0089

Table 21. NHTSA Test No. 4, 119.9 m to 60 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 119.9 m to 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1425	0.1389	0.1206	1.3600	1.0550	0.3050
	2	0.1701	0.1518	0.1197	1.3600	1.0629	0.2971
	3	0.1540	0.1627	0.1251	1.3700	1.0678	0.3022
	4	0.1425	0.1471	0.1190	1.3300	1.0284	0.3016
	5	0.1505	0.1328	0.1212	1.3400	1.0457	0.2943
	6	0.1467	0.1439	0.1217	1.3600	1.0526	0.3074
	7	0.1588	0.1495	0.1293	1.3500	1.0545	0.2955
	8	0.1642	0.1568	0.1251	1.3800	1.0623	0.3177
	9	0.1535	0.1560	0.1243	1.3800	1.0671	0.3129
	10	0.1515	0.1561	0.1229	1.3500	1.0442	0.3058
Mean		0.1534	0.1496	0.1229	1.3580	1.0541	0.3039
StdDev		0.0089	0.0091	0.0031	0.0162	0.0122	0.0075
Min		0.1425	0.1328	0.1190	1.3300	1.0284	0.2943
Max		0.1701	0.1627	0.1293	1.3800	1.0678	0.3177
95% C.I. MOE (+/-)		0.0064	0.0065	0.0022	0.0116	0.0087	0.0054
95% C.I. Upper Limit		0.1598	0.1561	0.1251	1.3696	1.0628	0.3093
95% C.I. Lower Limit		0.1470	0.1430	0.1207	1.3464	1.0453	0.2986
95% P.I. MOE (+/-)		0.0212	0.0216	0.0074	0.0384	0.0289	0.0178
95% P.I. Upper Limit		0.1747	0.1712	0.1303	1.3964	1.0830	0.3217
95% P.I. Lower Limit		0.1322	0.1279	0.1155	1.3196	1.0252	0.2861

Table 22. NHTSA Test No. 4, 59.9 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.5845	0.5595	0.6408	1.2500	1.0550	0.1950
	2	0.5805	0.5537	0.6354	1.2500	1.0629	0.1871
	3	0.5821	0.5766	0.6383	1.2500	1.0678	0.1822
	4	0.5702	0.5527	0.6337	1.2100	1.0284	0.1816
	5	0.5822	0.5474	0.6404	1.2400	1.0457	0.1943
	6	0.5865	0.5488	0.6425	1.2400	1.0526	0.1874
	7	0.6037	0.5398	0.6355	1.2600	1.0545	0.2055
	8	0.5675	0.5598	0.6379	1.2400	1.0623	0.1777
	9	0.5897	0.5541	0.6441	1.2600	1.0671	0.1929
	10	0.5948	0.5471	0.6358	1.2300	1.0442	0.1858
Mean		0.5842	0.5540	0.6384	1.2430	1.0541	0.1889
StdDev		0.0107	0.0100	0.0034	0.0149	0.0122	0.0081
Min		0.5675	0.5398	0.6337	1.2100	1.0284	0.1777
Max		0.6037	0.5766	0.6441	1.2600	1.0678	0.2055
95% C.I. MOE (+/-)		0.0076	0.0071	0.0024	0.0107	0.0087	0.0058
95% C.I. Upper Limit		0.5918	0.5611	0.6409	1.2537	1.0628	0.1948
95% C.I. Lower Limit		0.5765	0.5468	0.6360	1.2323	1.0453	0.1831
95% P.I. MOE (+/-)		0.0253	0.0237	0.0081	0.0355	0.0289	0.0193
95% P.I. Upper Limit		0.6095	0.5777	0.6465	1.2785	1.0830	0.2082
95% P.I. Lower Limit		0.5589	0.5303	0.6303	1.2075	1.0252	0.1696

Table 23. NHTSA Test No. 4, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.9477	1.7788	1.4600	1.2400	1.0550	0.1850
	2	1.9749	1.7297	1.4439	1.2500	1.0629	0.1871
	3	1.9752	1.7883	1.4675	1.2400	1.0678	0.1722
	4	1.9550	1.7592	1.4404	1.2000	1.0284	0.1716
	5	1.9915	1.7602	1.4589	1.2300	1.0457	0.1843
	6	1.9694	1.8005	1.4613	1.2400	1.0526	0.1874
	7	2.0028	1.8077	1.4523	1.2500	1.0545	0.1955
	8	1.9910	1.7812	1.4572	1.2400	1.0623	0.1777
	9	1.9904	1.7795	1.4580	1.2500	1.0671	0.1829
	10	1.9848	1.7547	1.4680	1.2200	1.0442	0.1758
Mean		1.9783	1.7740	1.4568	1.2360	1.0541	0.1819
StdDev		0.0173	0.0233	0.0090	0.0158	0.0122	0.0075
Min		1.9477	1.7297	1.4404	1.2000	1.0284	0.1716
Max		2.0028	1.8077	1.4680	1.2500	1.0678	0.1955
95% C.I. MOE (+/-)		0.0124	0.0167	0.0065	0.0113	0.0087	0.0054
95% C.I. Upper Limit		1.9907	1.7907	1.4632	1.2473	1.0628	0.1873
95% C.I. Lower Limit		1.9659	1.7573	1.4503	1.2247	1.0453	0.1765
95% P.I. MOE (+/-)		0.0411	0.0553	0.0214	0.0374	0.0289	0.0179
95% P.I. Upper Limit		2.0194	1.8293	1.4782	1.2734	1.0830	0.1998
95% P.I. Lower Limit		1.9372	1.7186	1.4354	1.1986	1.0252	0.1640

Table 24. NHTSA Test No. 5, 100 m to 60 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 100 m to 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1340	0.1575	0.1422	0.1487	0.1392	0.1233	0.1517	1.3600	1.1152	0.2448
	2	0.1673	0.1509	0.1336	0.1564	0.1618	0.1334	0.1772	1.3600	1.1204	0.2396
	3	0.1573	0.1530	0.1386	0.1443	0.1515	0.1362	0.1831	1.3700	1.1238	0.2462
	4	0.1601	0.1603	0.1392	0.1512	0.1422	0.1251	0.1729	1.3300	1.0850	0.2450
	5	0.1425	0.1640	0.1418	0.1368	0.1490	0.1322	0.1541	1.3400	1.1061	0.2339
	6	0.1655	0.1604	0.1465	0.1363	0.1539	0.1270	0.1659	1.3600	1.1151	0.2449
	7	0.1513	0.1529	0.1391	0.1737	0.1639	0.1343	0.1778	1.3500	1.1130	0.2370
	8	0.1804	0.1671	0.1374	0.1571	0.1588	0.1439	0.1873	1.3800	1.1202	0.2598
	9	0.1449	0.1623	0.1404	0.1625	0.1481	0.1293	0.1786	1.3800	1.1306	0.2494
	10	0.1399	0.1582	0.1378	0.1471	0.1623	0.1550	0.1704	1.3500	1.0997	0.2503
Mean		0.1543	0.1586	0.1397	0.1514	0.1531	0.1340	0.1719	1.3580	1.1129	0.2451
StdDev		0.0144	0.0052	0.0034	0.0115	0.0086	0.0095	0.0117	0.0162	0.0131	0.0073
Min		0.1340	0.1509	0.1336	0.1363	0.1392	0.1233	0.1517	1.3300	1.0850	0.2339
Max		0.1804	0.1671	0.1465	0.1737	0.1639	0.1550	0.1873	1.3800	1.1306	0.2598
95% C.I. MOE (+/-)		0.0103	0.0037	0.0024	0.0083	0.0062	0.0068	0.0084	0.0116	0.0094	0.0053
95% C.I. Upper Limit		0.1647	0.1624	0.1421	0.1597	0.1592	0.1408	0.1803	1.3696	1.1223	0.2504
95% C.I. Lower Limit		0.1440	0.1549	0.1372	0.1432	0.1469	0.1272	0.1635	1.3464	1.1035	0.2398
95% P.I. MOE (+/-)		0.0343	0.0124	0.0081	0.0274	0.0204	0.0226	0.0278	0.0384	0.0311	0.0174
95% P.I. Upper Limit		0.1886	0.1711	0.1478	0.1788	0.1735	0.1565	0.1997	1.3964	1.1440	0.2625
95% P.I. Lower Limit		0.1201	0.1462	0.1316	0.1240	0.1327	0.1114	0.1441	1.3196	1.0818	0.2277

Table 25. NHTSA Test No. 5, 59.9 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 59.9 m to 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4469	0.7268	0.5779	0.5600	0.5646	0.6590	0.6084	1.2500	1.1152	0.1348
	2	0.4893	0.7128	0.5673	0.5663	0.5605	0.6642	0.6228	1.2500	1.1204	0.1296
	3	0.4587	0.7321	0.5716	0.5600	0.5812	0.6575	0.6293	1.2500	1.1238	0.1262
	4	0.4877	0.7293	0.5830	0.5694	0.5473	0.6693	0.6318	1.2100	1.0850	0.1250
	5	0.4888	0.7489	0.6027	0.5432	0.5793	0.6617	0.6300	1.2400	1.1061	0.1339
	6	0.4540	0.7246	0.5820	0.5380	0.5692	0.6724	0.6206	1.2400	1.1151	0.1249
	7	0.4815	0.7354	0.5775	0.5558	0.5688	0.6515	0.6282	1.2600	1.1130	0.1470
	8	0.4970	0.7361	0.5700	0.5484	0.5600	0.6591	0.6180	1.2400	1.1202	0.1198
	9	0.4858	0.7329	0.5750	0.5499	0.5556	0.6607	0.6224	1.2600	1.1306	0.1294
	10	0.4609	0.7478	0.5710	0.5638	0.5416	0.6566	0.6396	1.2300	1.0997	0.1303
Mean		0.4750	0.7327	0.5778	0.5555	0.5628	0.6612	0.6251	1.2430	1.1129	0.1301
StdDev		0.0179	0.0106	0.0102	0.0103	0.0127	0.0061	0.0086	0.0149	0.0131	0.0074
Min		0.4469	0.7128	0.5673	0.5380	0.5416	0.6515	0.6084	1.2100	1.0850	0.1198
Max		0.4970	0.7489	0.6027	0.5694	0.5812	0.6724	0.6396	1.2600	1.1306	0.1470
95% C.I. MOE (+/-)		0.0128	0.0076	0.0073	0.0074	0.0091	0.0044	0.0062	0.0107	0.0094	0.0053
95% C.I. Upper Limit		0.4879	0.7403	0.5851	0.5629	0.5719	0.6656	0.6313	1.2537	1.1223	0.1354
95% C.I. Lower Limit		0.4622	0.7251	0.5705	0.5481	0.5537	0.6568	0.6190	1.2323	1.1035	0.1248
95% P.I. MOE (+/-)		0.0425	0.0252	0.0241	0.0245	0.0301	0.0145	0.0204	0.0355	0.0311	0.0176
95% P.I. Upper Limit		0.5176	0.7579	0.6019	0.5800	0.5929	0.6758	0.6455	1.2785	1.1440	0.1477
95% P.I. Lower Limit		0.4325	0.7074	0.5537	0.5310	0.5327	0.6467	0.6047	1.2075	1.0818	0.1125

Table 26. NHTSA Test No. 5, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 29.9 m to 15 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.2831	2.8485	1.9121	1.6401	1.7726	2.1227	1.9623	1.2400	1.1152	0.1248
	2	1.2880	2.8708	1.8911	1.6624	1.7614	2.1314	1.9885	1.2500	1.1204	0.1296
	3	1.2810	2.8952	1.9281	1.6509	1.7700	2.1510	1.9754	1.2400	1.1238	0.1162
	4	1.2977	2.8255	1.9029	1.6250	1.7784	2.1002	1.9185	1.2000	1.0850	0.1150
	5	1.2844	2.9204	1.9169	1.6685	1.7666	2.1575	1.9798	1.2300	1.1061	0.1239
	6	1.2945	2.8716	1.9355	1.6490	1.7733	2.1486	1.9606	1.2400	1.1151	0.1249
	7	1.3155	2.8637	1.9081	1.6661	1.7970	2.1448	1.9672	1.2500	1.1130	0.1370
	8	1.2971	2.8523	1.9100	1.6692	1.7902	2.1403	1.9917	1.2400	1.1202	0.1198
	9	1.3069	2.8981	1.9068	1.6499	1.7973	2.1604	1.9976	1.2500	1.1306	0.1194
	10	1.2856	2.9111	1.9076	1.6744	1.7719	2.1382	1.9941	1.2200	1.0997	0.1203
Mean		1.2934	2.8757	1.9119	1.6556	1.7779	2.1395	1.9736	1.2360	1.1129	0.1231
StdDev		0.0112	0.0300	0.0126	0.0154	0.0126	0.0179	0.0235	0.0158	0.0131	0.0066
Min		1.2810	2.8255	1.8911	1.6250	1.7614	2.1002	1.9185	1.2000	1.0850	0.1150
Max		1.3155	2.9204	1.9355	1.6744	1.7973	2.1604	1.9976	1.2500	1.1306	0.1370
95% C.I. MOE (+/-)		0.0080	0.0215	0.0090	0.0110	0.0090	0.0128	0.0168	0.0113	0.0094	0.0047
95% C.I. Upper Limit		1.3014	2.8972	1.9209	1.6666	1.7869	2.1523	1.9904	1.2473	1.1223	0.1278
95% C.I. Lower Limit		1.2853	2.8542	1.9029	1.6445	1.7688	2.1267	1.9568	1.2247	1.1035	0.1184
95% P.I. MOE (+/-)		0.0266	0.0712	0.0298	0.0366	0.0300	0.0426	0.0557	0.0374	0.0311	0.0156
95% P.I. Upper Limit		1.3200	2.9470	1.9417	1.6921	1.8079	2.1821	2.0293	1.2734	1.1440	0.1387
95% P.I. Lower Limit		1.2667	2.8045	1.8821	1.6190	1.7479	2.0969	1.9179	1.1986	1.0818	0.1075

Table 27. NHTSA Test No. 6, 50 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 6, Oncoming Right Curve 210 m Radius, 50 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	5.2431	1.6331	1.3254	1.1200	1.0193	0.1007
	2	4.7009	1.2857	1.3061	1.1500	1.0313	0.1187
	3	4.7295	1.3355	1.2992	1.1600	1.0431	0.1169
	4	3.8350	0.9534	1.2894	1.1700	1.0519	0.1181
	5	4.8124	1.3393	1.2961	1.1800	1.0640	0.1160
	6	4.2385	1.0088	1.3162	1.1700	1.0644	0.1056
	7	3.7036	0.8527	1.3039	1.1700	1.0553	0.1147
	8	3.5045	0.8592	1.2927	1.1700	1.0589	0.1111
	9	4.0524	1.0198	1.3221	1.1800	1.0632	0.1168
	10	4.0768	1.0556	1.3197	1.1600	1.0427	0.1173
Mean		4.2897	1.1343	1.3071	1.1630	1.0494	0.1136
StdDev		0.5593	0.2532	0.0130	0.0177	0.0152	0.0060
Min		3.5045	0.8527	1.2894	1.1200	1.0193	0.1007
Max		5.2431	1.6331	1.3254	1.1800	1.0644	0.1187
95% C.I. MOE (+/-)		0.4001	0.1811	0.0093	0.0126	0.0109	0.0043
95% C.I. Upper Limit		4.6898	1.3154	1.3164	1.1756	1.0603	0.1179
95% C.I. Lower Limit		3.8895	0.9532	1.2978	1.1504	1.0385	0.1093
95% P.I. MOE (+/-)		1.3270	0.6007	0.0308	0.0419	0.0361	0.0142
95% P.I. Upper Limit		5.6166	1.7350	1.3379	1.2049	1.0855	0.1278
95% P.I. Lower Limit		2.9627	0.5336	1.2763	1.1211	1.0134	0.0994

Table 28. NHTSA Test No. 6, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 6, Oncoming Right Curve 210 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.2625	2.3547	1.5675	1.1100	1.0193	0.0907
	2	2.2300	2.3534	1.5585	1.1200	1.0313	0.0887
	3	2.2248	2.3501	1.5716	1.1200	1.0431	0.0769
	4	2.2237	2.3736	1.5483	1.1400	1.0519	0.0881
	5	2.2295	2.3429	1.5536	1.1500	1.0640	0.0860
	6	2.2786	2.3576	1.5784	1.1600	1.0644	0.0956
	7	2.2869	2.3952	1.5831	1.1400	1.0553	0.0847
	8	2.2533	2.3947	1.5827	1.1300	1.0589	0.0711
	9	2.2892	2.3891	1.5926	1.1500	1.0632	0.0868
	10	2.2794	2.4204	1.5908	1.1300	1.0427	0.0873
Mean		2.2558	2.3732	1.5727	1.1350	1.0494	0.0856
StdDev		0.0270	0.0255	0.0155	0.0158	0.0152	0.0069
Min		2.2237	2.3429	1.5483	1.1100	1.0193	0.0711
Max		2.2892	2.4204	1.5926	1.1600	1.0644	0.0956
95% C.I. MOE (+/-)		0.0193	0.0183	0.0111	0.0113	0.0109	0.0050
95% C.I. Upper Limit		2.2751	2.3914	1.5838	1.1463	1.0603	0.0905
95% C.I. Lower Limit		2.2365	2.3549	1.5616	1.1237	1.0385	0.0806
95% P.I. MOE (+/-)		0.0641	0.0605	0.0367	0.0375	0.0361	0.0164
95% P.I. Upper Limit		2.3199	2.4337	1.6094	1.1725	1.0855	0.1020
95% P.I. Lower Limit		2.1917	2.3126	1.5360	1.0975	1.0134	0.0691

Table 29. NHTSA Test No. 7, 220 m to 120 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 220 m to 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0558	0.0501	0.0410	1.2900	1.0916	0.1984
	2	0.0527	0.0514	0.0359	1.3000	1.1085	0.1915
	3	0.0513	0.0467	0.0340	1.2800	1.1046	0.1754
	4	0.0457	0.0548	0.0352	1.3000	1.0985	0.2015
	5	0.0523	0.0541	0.0325	1.2900	1.0963	0.1937
	6	0.0484	0.0515	0.0384	1.2600	1.0988	0.1612
	7	0.0552	0.0549	0.0380	1.3100	1.1005	0.2095
	8	0.0486	0.0584	0.0379	1.2600	1.0816	0.1784
	9	0.0583	0.0549	0.0342	1.2900	1.1011	0.1889
	10	0.0482	0.0515	0.0407	1.2600	1.0723	0.1877
Mean		0.0517	0.0528	0.0368	1.2840	1.0954	0.1886
StdDev		0.0040	0.0033	0.0029	0.0184	0.0109	0.0140
Min		0.0457	0.0467	0.0325	1.2600	1.0723	0.1612
Max		0.0583	0.0584	0.0410	1.3100	1.1085	0.2095
95% C.I. MOE (+/-)		0.0028	0.0023	0.0021	0.0131	0.0078	0.0100
95% C.I. Upper Limit		0.0545	0.0552	0.0388	1.2971	1.1032	0.1987
95% C.I. Lower Limit		0.0488	0.0505	0.0347	1.2709	1.0875	0.1786
95% P.I. MOE (+/-)		0.0094	0.0077	0.0068	0.0436	0.0259	0.0332
95% P.I. Upper Limit		0.0611	0.0606	0.0436	1.3276	1.1213	0.2218
95% P.I. Lower Limit		0.0422	0.0451	0.0300	1.2404	1.0695	0.1554

Table 30. NHTSA Test No. 7, 119.9 m to 60 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 119.9 m to 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1557	0.1516	0.1525	1.3700	1.0916	0.2784
	2	0.1527	0.1531	0.1497	1.3900	1.1085	0.2815
	3	0.1530	0.1497	0.1559	1.3800	1.1046	0.2754
	4	0.1711	0.1435	0.1572	1.3700	1.0985	0.2715
	5	0.1558	0.1459	0.1512	1.3800	1.0963	0.2837
	6	0.1523	0.1596	0.1562	1.3600	1.0988	0.2612
	7	0.1627	0.1550	0.1560	1.3700	1.1005	0.2695
	8	0.1593	0.1459	0.1549	1.3500	1.0816	0.2684
	9	0.1635	0.1444	0.1620	1.4000	1.1011	0.2989
	10	0.1575	0.1554	0.1632	1.3400	1.0723	0.2677
Mean		0.1583	0.1504	0.1559	1.3710	1.0954	0.2756
StdDev		0.0060	0.0054	0.0043	0.0179	0.0109	0.0107
Min		0.1523	0.1435	0.1497	1.3400	1.0723	0.2612
Max		0.1711	0.1596	0.1632	1.4000	1.1085	0.2989
95% C.I. MOE (+/-)		0.0043	0.0039	0.0031	0.0128	0.0078	0.0076
95% C.I. Upper Limit		0.1626	0.1543	0.1589	1.3838	1.1032	0.2833
95% C.I. Lower Limit		0.1541	0.1465	0.1528	1.3582	1.0875	0.2680
95% P.I. MOE (+/-)		0.0141	0.0129	0.0102	0.0425	0.0259	0.0254
95% P.I. Upper Limit		0.1725	0.1633	0.1660	1.4135	1.1213	0.3010
95% P.I. Lower Limit		0.1442	0.1375	0.1457	1.3285	1.0695	0.2503

Table 31. NHTSA Test No. 7, 59.9 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 59.9 m to 30m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.6017	0.5803	0.7389	1.2500	1.0916	0.1584
	2	0.6018	0.5821	0.7498	1.2700	1.1085	0.1615
	3	0.6173	0.5800	0.7455	1.2700	1.1046	0.1654
	4	0.6083	0.5785	0.7446	1.2500	1.0985	0.1515
	5	0.6112	0.5684	0.7531	1.2500	1.0963	0.1537
	6	0.6090	0.6049	0.7593	1.2700	1.0988	0.1712
	7	0.6171	0.5971	0.7480	1.2700	1.1005	0.1695
	8	0.6043	0.5757	0.7500	1.2400	1.0816	0.1584
	9	0.6306	0.5814	0.7775	1.2800	1.1011	0.1789
	10	0.6123	0.5899	0.7602	1.2200	1.0723	0.1477
Mean		0.6114	0.5838	0.7527	1.2570	1.0954	0.1616
StdDev		0.0088	0.0107	0.0109	0.0183	0.0109	0.0097
Min		0.6017	0.5684	0.7389	1.2200	1.0723	0.1477
Max		0.6306	0.6049	0.7775	1.2800	1.1085	0.1789
95% C.I. MOE (+/-)		0.0063	0.0076	0.0078	0.0104	0.0078	0.0062
95% C.I. Upper Limit		0.6176	0.5915	0.7605	1.2701	1.1032	0.1686
95% C.I. Lower Limit		0.6051	0.5762	0.7449	1.2439	1.0875	0.1547
95% P.I. MOE (+/-)		0.0208	0.0253	0.0257	0.0434	0.0259	0.0230
95% P.I. Upper Limit		0.6321	0.6091	0.7784	1.3004	1.1213	0.1847
95% P.I. Lower Limit		0.5906	0.5585	0.7270	1.2136	1.0695	0.1386

Table 32. NHTSA Test No. 7, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.0034	1.7836	1.4674	1.0400	1.2268	0.1868
	2	1.9976	1.8131	1.4874	1.1100	1.2380	0.1280
	3	2.0249	1.7971	1.4918	1.1200	1.2355	0.1155
	4	2.0181	1.8407	1.5006	1.1000	1.2220	0.1220
	5	2.0332	1.8274	1.5042	1.1100	1.2206	0.1106
	6	2.0466	1.8618	1.5226	1.0900	1.2411	0.1511
	7	2.0242	1.8211	1.5154	1.0900	1.2389	0.1489
	8	2.0307	1.8440	1.5118	1.0500	1.2146	0.1646
	9	2.0832	1.8344	1.5140	1.0600	1.2416	0.1816
	10	2.0650	1.8215	1.5091	1.1200	1.1983	0.0783
Mean		2.0327	1.8245	1.5024	1.0890	1.2277	0.1387
StdDev		0.0263	0.0229	0.0164	0.0292	0.0141	0.0341
Min		1.9976	1.7836	1.4674	1.0400	1.1983	0.0783
Max		2.0832	1.8618	1.5226	1.1200	1.2416	0.1868
95% C.I. MOE (+/-)		0.0188	0.0164	0.0117	0.0131	0.0078	0.0069
95% C.I. Upper Limit		2.0515	1.8409	1.5141	1.1099	1.2378	0.1631
95% C.I. Lower Limit		2.0139	1.8081	1.4907	1.0681	1.2177	0.1144
95% P.I. MOE (+/-)		0.0624	0.0543	0.0388	0.0693	0.0334	0.0809
95% P.I. Upper Limit		2.0951	1.8788	1.5413	1.1583	1.2611	0.2196
95% P.I. Lower Limit		1.9703	1.7702	1.4636	1.0197	1.1944	0.0579

Table 33. NHTSA Test No. 8, 70 m to 60 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 70 m to 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire D) (degrees)**
	1	2.2824	0.9726	0.2487	1.1400	1.0425	0.0975
	2	2.3368	0.9614	0.2426	1.1900	1.0457	0.1443
	3	2.4099	1.0396	0.2492	1.1600	1.0426	0.1174
	4	2.7830	1.2843	0.2505	1.1800	1.0321	0.1479
	5	2.7450	1.2406	0.2562	1.1600	1.0391	0.1209
	6	2.4477	1.0158	0.2455	1.1500	1.0206	0.1294
	7	2.2080	0.8346	0.2467	1.1800	1.0424	0.1376
	8	2.6119	1.1396	0.2479	1.1800	1.0517	0.1283
	9	2.4993	1.0603	0.2592	1.1700	1.0478	0.1222
	10	2.8306	1.3499	0.2617	1.1600	1.0231	0.1369
Mean		2.5155	1.0899	0.2508	1.1670	1.0388	0.1282
StdDev		0.2185	0.1616	0.0062	0.0157	0.0103	0.0148
Min		2.2080	0.8346	0.2426	1.1400	1.0206	0.0975
Max		2.8306	1.3499	0.2617	1.1900	1.0517	0.1479
95% C.I. MOE (+/-)		0.1563	0.1156	0.0044	0.0112	0.0074	0.0106
95% C.I. Upper Limit		2.6718	1.2055	0.2553	1.1782	1.0462	0.1388
95% C.I. Lower Limit		2.3592	0.9743	0.2464	1.1558	1.0314	0.1177
95% P.I. MOE (+/-)		0.5184	0.3833	0.0147	0.0372	0.0245	0.0350
95% P.I. Upper Limit		3.0338	1.4732	0.2656	1.2042	1.0633	0.1633
95% P.I. Lower Limit		1.9971	0.7066	0.2361	1.1298	1.0143	0.0932

Table 34. NHTSA Test No. 8, 59.9 m to 30 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.4172	0.6712	1.1121	1.1800	1.0425	0.1375
	2	1.2814	0.6670	1.1079	1.1900	1.0457	0.1443
	3	1.5310	0.6977	1.1227	1.1800	1.0426	0.1374
	4	1.6936	0.6913	1.1174	1.1600	1.0321	0.1279
	5	1.7055	0.6931	1.1475	1.1700	1.0391	0.1309
	6	1.4347	0.6989	1.1340	1.1600	1.0206	0.1394
	7	1.1748	0.6836	1.1205	1.1700	1.0424	0.1276
	8	1.6191	0.7152	1.1547	1.2000	1.0517	0.1483
	9	1.4408	0.7125	1.1520	1.1800	1.0478	0.1322
	10	1.6742	0.7130	1.1439	1.1500	1.0231	0.1269
Mean		1.4972	0.6943	1.1313	1.1740	1.0388	0.1352
StdDev		0.1805	0.0168	0.0173	0.0151	0.0103	0.0074
Min		1.1748	0.6670	1.1079	1.1500	1.0206	0.1269
Max		1.7055	0.7152	1.1547	1.2000	1.0517	0.1483
95% C.I. MOE (+/-)		0.1291	0.0121	0.0124	0.0108	0.0074	0.0053
95% C.I. Upper Limit		1.6264	0.7064	1.1437	1.1848	1.0462	0.1405
95% C.I. Lower Limit		1.3681	0.6823	1.1189	1.1632	1.0314	0.1299
95% P.I. MOE (+/-)		0.4283	0.0400	0.0411	0.0357	0.0245	0.0175
95% P.I. Upper Limit		1.9255	0.7343	1.1724	1.2097	1.0633	0.1527
95% P.I. Lower Limit		1.0689	0.6544	1.0902	1.1383	1.0143	0.1177

Table 35. NHTSA Test No. 8, 29.9 m to 15 m, Gauge (Measurement System) Repeatability

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.1017	2.0863	1.4955	1.1400	1.0425	0.0975
	2	2.1200	2.1318	1.4830	1.1300	1.0457	0.0843
	3	2.1273	2.1115	1.4868	1.1400	1.0426	0.0974
	4	2.1036	2.1016	1.4847	1.1200	1.0321	0.0879
	5	2.1586	2.1077	1.5162	1.1400	1.0391	0.1009
	6	2.1709	2.1489	1.5096	1.1200	1.0206	0.0994
	7	2.1753	2.1662	1.5358	1.1400	1.0424	0.0976
	8	2.1582	2.1690	1.5198	1.1400	1.0517	0.0883
	9	2.1974	2.1929	1.5233	1.1500	1.0478	0.1022
	10	2.1631	2.1545	1.5197	1.1200	1.0231	0.0969
Mean		2.1476	2.1370	1.5074	1.1340	1.0388	0.0952
StdDev		0.0325	0.0346	0.0186	0.0107	0.0103	0.0061
Min		2.1017	2.0863	1.4830	1.1200	1.0206	0.0843
Max		2.1974	2.1929	1.5358	1.1500	1.0517	0.1022
95% C.I. MOE (+/-)		0.0232	0.0248	0.0133	0.0077	0.0074	0.0044
95% C.I. Upper Limit		2.1708	2.1618	1.5208	1.1417	1.0462	0.0996
95% C.I. Lower Limit		2.1244	2.1123	1.4941	1.1263	1.0314	0.0909
95% P.I. MOE (+/-)		0.0770	0.0822	0.0442	0.0255	0.0245	0.0145
95% P.I. Upper Limit		2.2246	2.2192	1.5517	1.1595	1.0633	0.1097
95% P.I. Lower Limit		2.0706	2.0549	1.4632	1.1085	1.0143	0.0807

3.2 NHTSA Test Procedure to Repeatability of Test Results

To assess the repeatability of the NHTSA test procedure results, the full test procedure was run once each night for 10 nights. The test procedure repeatability results generally replicated the measurement system (gauge) repeatability results. Standard deviations across test repetitions were under 0.1 lux for NHTSA test scenarios 1, 3, 4, and 7. More specifically, for the 220 m- 120 m measurement distance sub-range, all standard deviations were 0.0076 lux or less. For the 150 m to 120 m measurement distance sub-range, all standard deviations were 0.0068 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all standard deviations were 0.0156 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0599 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0713 lux or less.

Standard deviations were under 0.15 lux for NHTSA test scenarios 2 and 5. More specifically, for the 100 m to 60 m measurement distance sub-range, all standard deviations were 0.0153 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0494 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.1324 lux or less.

Like the measurement system (gauge) repeatability results, NHTSA test scenarios 6 and 8 were less repeatable than the other test scenarios. More specifically, for test scenario 6 for the 50 m to 30 m measurement distance sub-range, all standard deviations were 0.9648 lux or less, with receptor head 4 having a particularly high standard deviation of 0.9648 lux. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0651 lux or less. Standard deviations were also high for NHTSA test scenario 8. More specifically, for the 70 m to 60 m measurement distance sub-range, all standard deviations were 0.5996 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.5921 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0602 lux or less.

Prediction interval margins of error were under +/- 0.1693 lux for NHTSA test scenarios 1, 3, 4, and 7. More specifically, for the 220 m- 120 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0181 lux or less. For the 150 m to 120 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0162 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0369 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all prediction interval margins of error were +/- 0.1421 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all prediction interval margins of error were +/- 0.1693 lux or less.

Prediction interval margins of error were under +/- lux for NHTSA test scenarios 2 and 5. More specifically, for the 100 m to 60 m measurement distance sub-range, all prediction interval margins of error were +/- 0.0363 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all prediction interval margins of error were +/- 0.1171 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all prediction interval margins of error were +/- 0.3141 lux or less.

Like the measurement system (gauge) repeatability results, NHTSA test scenarios 6 and 8 were less repeatable than the other test scenarios. More specifically, for test scenario 6 for the 50 m to 30 m measurement distance sub-range, all prediction interval margins of error were +/- 2.2890 lux or less, with receptor head 4 having the highest margin of error. For the 29.9 m to 15

m measurement distance sub-range, all prediction interval margins of error were +/- 0.1544 lux or less. Prediction interval margins of error were also high for NHTSA test scenario 8. More specifically, for the 70 m to 60 m measurement distance sub-range, all prediction interval margins of error were +/- 1.4225 or less. For the 59.9 m to 30 m measurement distance sub-range, all prediction interval margins of error were +/- 1.4047 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all prediction interval margins of error were +/- 0.1427 lux or less.

In order to further investigate the repeatability of the NHTSA test procedure, the repeatability of the pitch measured during the test procedure was assessed. Pitch standard deviations were 0.035 degrees or less for all test scenarios. The maximum pitch values did not vary from the mean by more than 0.035 degrees. The difference values between maximum pitch and average pitch did not vary from the mean by more than 0.022 degrees.

Tables 36 to 60 provide the results for the repeatability of the NHTSA test procedure.

Table 36. NHTSA Test No. 1, 220 m to 120 m, Test Procedure Repeatability

NHTSA Test No. 1, Oncoming Straight, 220 m to 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0839	0.0905	0.0774	1.3100	1.2052	0.1048
	2	0.0847	0.0805	0.0564	1.3100	1.2028	0.1072
	3	0.0796	0.0857	0.0662	1.3200	1.2170	0.1030
	4	0.0713	0.0772	0.0522	1.3600	1.2287	0.1313
	5	0.0745	0.0865	0.0634	1.2800	1.1739	0.1061
	6	0.0777	0.0865	0.0614	1.2900	1.1640	0.1260
	7	0.0717	0.0745	0.0554	1.3200	1.1974	0.1226
	8	0.0794	0.0718	0.0559	1.3000	1.1729	0.1271
	9	0.0817	0.0884	0.0679	1.3100	1.1890	0.1210
	10	0.0815	0.0686	0.0581	1.2500	1.1510	0.0990
Mean		0.0786	0.0810	0.0614	1.3050	1.1902	0.1148
StdDev		0.0048	0.0076	0.0076	0.0288	0.0245	0.0119
Min		0.0713	0.0686	0.0522	1.2500	1.1510	0.0990
Max		0.0847	0.0905	0.0774	1.3600	1.2287	0.1313
95% C.I. MOE (+/-)		0.0034	0.0055	0.0054	0.0206	0.0176	0.0085
95% C.I. Upper Limit		0.0820	0.0865	0.0668	1.3256	1.2077	0.1233
95% C.I. Lower Limit		0.0752	0.0755	0.0560	1.2844	1.1726	0.1063
95% P.I. MOE (+/-)		0.0113	0.0181	0.0179	0.0683	0.0582	0.0282
95% P.I. Upper Limit		0.0899	0.0991	0.0794	1.3733	1.2484	0.1430
95% P.I. Lower Limit		0.0673	0.0629	0.0435	1.2367	1.1320	0.0866

Table 37. NHTSA Test No. 1, 119.9 m to 60 m, Test Procedure Repeatability

NHTSA Test No. 1, Oncoming Straight, 119.9 m to 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.2164	0.1886	0.2027	1.3100	1.2052	0.1048
	2	0.2117	0.2197	0.2007	1.3100	1.2028	0.1072
	3	0.2540	0.2111	0.2146	1.3200	1.2170	0.1030
	4	0.2003	0.1802	0.2043	1.3200	1.2287	0.0913
	5	0.2224	0.2220	0.2417	1.3300	1.1739	0.1561
	6	0.2207	0.2021	0.2187	1.2800	1.1640	0.1160
	7	0.2126	0.2032	0.2099	1.3100	1.1974	0.1126
	8	0.2070	0.1967	0.2078	1.2700	1.1729	0.0971
	9	0.2263	0.2285	0.2140	1.3000	1.1890	0.1110
	10	0.2062	0.1941	0.2174	1.2700	1.1510	0.1190
Mean		0.2178	0.2046	0.2132	1.3020	1.1902	0.1118
StdDev		0.0150	0.0156	0.0118	0.0215	0.0245	0.0177
Min		0.2003	0.1802	0.2007	1.2700	1.1510	0.0913
Max		0.2540	0.2285	0.2417	1.3300	1.2287	0.1561
95% C.I. MOE (+/-)		0.0108	0.0111	0.0084	0.0154	0.0176	0.0126
95% C.I. Upper Limit		0.2285	0.2157	0.2216	1.3174	1.2077	0.1245
95% C.I. Lower Limit		0.2070	0.1935	0.2048	1.2866	1.1726	0.0992
95% P.I. MOE (+/-)		0.0357	0.0369	0.0279	0.0510	0.0582	0.0419
95% P.I. Upper Limit		0.2534	0.2415	0.2411	1.3530	1.2484	0.1537
95% P.I. Lower Limit		0.1821	0.1677	0.1853	1.2510	1.1320	0.0699

Table 38. NHTSA Test No. 1, 59.9 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 1, Oncoming Straight, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.6612	0.6101	0.8944	1.3000	1.2052	0.0948
	2	0.6966	0.6223	0.9296	1.2900	1.2028	0.0872
	3	0.7458	0.6724	0.9829	1.2800	1.2170	0.0630
	4	0.6696	0.6189	0.9084	1.3000	1.2287	0.0713
	5	0.7578	0.6904	1.0446	1.2400	1.1739	0.0661
	6	0.7183	0.6732	0.9823	1.2500	1.1640	0.0860
	7	0.6881	0.6271	0.9345	1.2300	1.1974	0.0326
	8	0.6906	0.6289	0.9351	1.2700	1.1729	0.0971
	9	0.7159	0.6450	0.9659	1.2500	1.1890	0.0610
	10	0.6864	0.6292	0.9558	1.2200	1.1510	0.0690
Mean		0.7030	0.6417	0.9534	1.2630	1.1902	0.0728
StdDev		0.0312	0.0274	0.0434	0.0291	0.0245	0.0193
Min		0.6612	0.6101	0.8944	1.2200	1.1510	0.0326
Max		0.7578	0.6904	1.0446	1.3000	1.2287	0.0971
95% C.I. MOE (+/-)		0.0224	0.0196	0.0310	0.0208	0.0176	0.0138
95% C.I. Upper Limit		0.7254	0.6613	0.9844	1.2838	1.2077	0.0867
95% C.I. Lower Limit		0.6807	0.6222	0.9223	1.2422	1.1726	0.0590
95% P.I. MOE (+/-)		0.0741	0.0650	0.1029	0.0690	0.0582	0.0459
95% P.I. Upper Limit		0.7771	0.7067	1.0563	1.3320	1.2484	0.1187
95% P.I. Lower Limit		0.6289	0.5768	0.8504	1.1940	1.1320	0.0269

Table 39. NHTSA Test No. 1, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 1, Oncoming Straight, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.0289	1.8674	1.4975	1.2400	1.2052	0.0348
	2	2.0849	1.9467	1.5481	1.3000	1.2028	0.0972
	3	2.1389	1.9467	1.6041	1.3000	1.2170	0.0830
	4	2.0344	1.8627	1.4906	1.3200	1.2287	0.0913
	5	2.2345	2.0505	1.6129	1.2600	1.1739	0.0861
	6	2.1589	2.0081	1.5958	1.2600	1.1640	0.0960
	7	2.0775	1.9306	1.5257	1.2400	1.1974	0.0426
	8	2.0986	1.9632	1.5525	1.2600	1.1729	0.0871
	9	2.1214	1.9585	1.5668	1.2700	1.1890	0.0810
	10	2.1124	2.0240	1.5753	1.2300	1.1510	0.0790
Mean		2.1090	1.9558	1.5569	1.2680	1.1902	0.0778
StdDev		0.0605	0.0612	0.0426	0.0297	0.0245	0.0215
Min		2.0289	1.8627	1.4906	1.2300	1.1510	0.0348
Max		2.2345	2.0505	1.6129	1.3200	1.2287	0.0972
95% C.I. MOE (+/-)		0.0433	0.0438	0.0305	0.0213	0.0176	0.0154
95% C.I. Upper Limit		2.1523	1.9996	1.5874	1.2893	1.2077	0.0932
95% C.I. Lower Limit		2.0658	1.9121	1.5265	1.2467	1.1726	0.0624
95% P.I. MOE (+/-)		0.1436	0.1452	0.1010	0.0706	0.0582	0.0511
95% P.I. Upper Limit		2.2526	2.1011	1.6579	1.3386	1.2484	0.1289
95% P.I. Lower Limit		1.9655	1.8106	1.4559	1.1974	1.1320	0.0268

Table 40. NHTSA Test No. 2, 100 m to 60 m, Test Procedure Repeatability

NHTSA Test No. 2, Same Direction Straight, 100 m to 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1742	0.2265	0.2036	0.1928	0.2076	0.1905	0.2142	1.3100	1.2134	0.0966
	2	0.1879	0.2443	0.2006	0.2237	0.2034	0.1933	0.2376	1.3100	1.2054	0.1046
	3	0.2047	0.2614	0.2249	0.2163	0.2268	0.2105	0.2372	1.3200	1.2168	0.1032
	4	0.1676	0.2212	0.1904	0.2311	0.1883	0.1884	0.2088	1.3200	1.2228	0.0972
	5	0.2033	0.2592	0.2264	0.1955	0.2236	0.2206	0.2338	1.3300	1.1800	0.1500
	6	0.1849	0.2475	0.2161	0.2124	0.2128	0.1998	0.2181	1.2800	1.1679	0.1121
	7	0.1898	0.2313	0.2022	0.1937	0.1994	0.1926	0.2104	1.3100	1.1830	0.1270
	8	0.1803	0.2318	0.1959	0.1982	0.2075	0.1882	0.2103	1.2700	1.1752	0.0948
	9	0.2134	0.2453	0.2041	0.2130	0.2371	0.2015	0.2484	1.3000	1.1894	0.1106
	10	0.1765	0.2277	0.1988	0.1959	0.2118	0.1932	0.2055	1.2700	1.1546	0.1154
Mean		0.1883	0.2396	0.2063	0.2073	0.2119	0.1979	0.2224	1.3020	1.1909	0.1111
StdDev		0.0148	0.0140	0.0121	0.0138	0.0142	0.0105	0.0153	0.0215	0.0228	0.0169
Min		0.1676	0.2212	0.1904	0.1928	0.1883	0.1882	0.2055	1.2700	1.1546	0.0948
Max		0.2134	0.2614	0.2264	0.2311	0.2371	0.2206	0.2484	1.3300	1.2228	0.1500
95% C.I. MOE (+/-)		0.0106	0.0100	0.0087	0.0099	0.0102	0.0075	0.0109	0.0154	0.0163	0.0121
95% C.I. Upper Limit		0.1988	0.2496	0.2150	0.2172	0.2220	0.2054	0.2334	1.3174	1.2072	0.1232
95% C.I. Lower Limit		0.1777	0.2296	0.1976	0.1974	0.2017	0.1903	0.2115	1.2866	1.1746	0.0991
95% P.I. MOE (+/-)		0.0351	0.0331	0.0288	0.0328	0.0337	0.0250	0.0363	0.0510	0.0541	0.0400
95% P.I. Upper Limit		0.2233	0.2727	0.2351	0.2401	0.2456	0.2229	0.2587	1.3530	1.2450	0.1511
95% P.I. Lower Limit		0.1532	0.2065	0.1775	0.1744	0.1781	0.1729	0.1862	1.2510	1.1368	0.0711

Table 41. NHTSA Test No. 2, 59.9 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 2, Same Direction Straight, 59.9 m to 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.7277	0.8773	0.6469	0.6375	0.6288	0.9714	0.6579	1.3000	1.2134	0.0866
	2	0.7495	0.9380	0.6674	0.6331	0.6614	0.9969	0.7065	1.2900	1.2054	0.0846
	3	0.8046	0.9690	0.7042	0.6693	0.7073	1.0606	0.7475	1.2800	1.2168	0.0632
	4	0.7055	0.8856	0.6467	0.6093	0.6132	0.9510	0.6627	1.3000	1.2228	0.0772
	5	0.8611	0.9981	0.7435	0.6959	0.7106	1.1131	0.7416	1.2400	1.1800	0.0600
	6	0.7971	0.9554	0.6999	0.6638	0.7012	1.0751	0.7193	1.2500	1.1679	0.0821
	7	0.7617	0.8820	0.6641	0.6234	0.6495	1.0332	0.6712	1.2300	1.1830	0.0470
	8	0.7503	0.8993	0.6677	0.6265	0.6455	1.0189	0.6894	1.2700	1.1752	0.0948
	9	0.7900	0.9327	0.6897	0.6624	0.6787	1.0536	0.7143	1.2500	1.1894	0.0606
	10	0.7671	0.9161	0.6689	0.6548	0.6510	1.0564	0.6996	1.2200	1.1546	0.0654
Mean		0.7715	0.9253	0.6799	0.6476	0.6647	1.0330	0.7010	1.2630	1.1909	0.0721
StdDev		0.0440	0.0406	0.0298	0.0261	0.0336	0.0494	0.0311	0.0291	0.0228	0.0151
Min		0.7055	0.8773	0.6467	0.6093	0.6132	0.9510	0.6579	1.2200	1.1546	0.0470
Max		0.8611	0.9981	0.7435	0.6959	0.7106	1.1131	0.7475	1.3000	1.2228	0.0948
95% C.I. MOE (+/-)		0.0315	0.0291	0.0213	0.0187	0.0241	0.0353	0.0222	0.0208	0.0163	0.0108
95% C.I. Upper Limit		0.8030	0.9544	0.7012	0.6663	0.6888	1.0683	0.7232	1.2838	1.2072	0.0829
95% C.I. Lower Limit		0.7400	0.8963	0.6586	0.6289	0.6407	0.9977	0.6788	1.2422	1.1746	0.0614
95% P.I. MOE (+/-)		0.1044	0.0963	0.0707	0.0620	0.0798	0.1171	0.0738	0.0690	0.0541	0.0357
95% P.I. Upper Limit		0.8759	1.0217	0.7506	0.7096	0.7445	1.1502	0.7747	1.3320	1.2450	0.1079
95% P.I. Lower Limit		0.6670	0.8290	0.6092	0.5856	0.5849	0.9159	0.6272	1.1940	1.1368	0.0364

Table 42. NHTSA Test No. 2, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 2, Same Direction Straight, 29.9 m to 15 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.3818	2.8020	2.0299	1.7567	1.9039	2.3340	1.8805	1.2400	1.2134	0.0266
	2	1.4225	2.9685	2.0892	1.7936	1.9548	2.4511	1.9900	1.3000	1.2054	0.0946
	3	1.5010	3.0301	2.1462	1.8666	1.9644	2.5601	2.0225	1.3000	1.2168	0.0832
	4	1.3759	2.8490	2.0167	1.7714	1.8863	2.3576	1.9202	1.3200	1.2228	0.0972
	5	1.4768	3.1229	2.1820	1.9133	2.0336	2.6120	2.0751	1.2600	1.1800	0.0800
	6	1.4680	3.0239	2.1735	1.8648	2.0133	2.5324	2.0367	1.2600	1.1679	0.0921
	7	1.4157	2.8659	2.0910	1.8174	1.9059	2.3902	1.9460	1.2400	1.1830	0.0570
	8	1.4444	2.8723	2.0833	1.8672	1.9488	2.4440	1.9543	1.2600	1.1752	0.0848
	9	1.4899	2.9796	2.1075	1.8390	1.9661	2.4827	1.9616	1.2700	1.1894	0.0806
	10	1.4305	2.9359	2.1285	1.8727	1.9753	2.4293	1.9383	1.2300	1.1546	0.0754
Mean		1.4407	2.9450	2.1048	1.8363	1.9552	2.4593	1.9725	1.2680	1.1909	0.0771
StdDev		0.0433	0.0990	0.0550	0.0502	0.0471	0.0891	0.0587	0.0297	0.0228	0.0211
Min		1.3759	2.8020	2.0167	1.7567	1.8863	2.3340	1.8805	1.2300	1.1546	0.0266
Max		1.5010	3.1229	2.1820	1.9133	2.0336	2.6120	2.0751	1.3200	1.2228	0.0972
95% C.I. MOE (+/-)		0.0310	0.0708	0.0393	0.0359	0.0337	0.0637	0.0420	0.0213	0.0163	0.0151
95% C.I. Upper Limit		1.4716	3.0158	2.1441	1.8722	1.9889	2.5230	2.0145	1.2893	1.2072	0.0922
95% C.I. Lower Limit		1.4097	2.8742	2.0654	1.8003	1.9215	2.3956	1.9306	1.2467	1.1746	0.0620
95% P.I. MOE (+/-)		0.1027	0.2348	0.1305	0.1191	0.1118	0.2113	0.1392	0.0706	0.0541	0.0501
95% P.I. Upper Limit		1.5433	3.1798	2.2353	1.9553	2.0670	2.6706	2.1117	1.3386	1.2450	0.1272
95% P.I. Lower Limit		1.3380	2.7102	1.9743	1.7172	1.8435	2.2480	1.8333	1.1974	1.1368	0.0271

Table 43. NHTSA Test No. 3, 59.9 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 3, Oncoming Left Curve 85 m Radius, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4289	0.3729	0.3203	1.1600	1.0341	0.1259
	2	0.4544	0.3725	0.3390	1.1500	1.0353	0.1147
	3	0.4757	0.4031	0.3552	1.1400	1.0422	0.0978
	4	0.4185	0.3491	0.3183	1.1200	1.0467	0.0733
	5	0.5173	0.4497	0.4438	1.1300	1.0110	0.1190
	6	0.4614	0.3985	0.3536	1.1000	1.0098	0.0902
	7	0.4349	0.3703	0.3369	1.1300	1.0091	0.1209
	8	0.4361	0.3921	0.3460	1.1000	0.9984	0.1016
	9	0.4469	0.3946	0.3459	1.1000	0.9940	0.1060
	10	0.4299	0.3642	0.3318	1.1200	1.0256	0.0944
Mean		0.4504	0.3867	0.3491	1.1250	1.0206	0.1044
StdDev		0.0291	0.0280	0.0355	0.0212	0.0186	0.0163
Min		0.4185	0.3491	0.3183	1.1000	0.9940	0.0733
Max		0.5173	0.4497	0.4438	1.1600	1.0467	0.1259
95% C.I. MOE (+/-)		0.0208	0.0200	0.0254	0.0152	0.0133	0.0116
95% C.I. Upper Limit		0.4712	0.4067	0.3745	1.1402	1.0339	0.1160
95% C.I. Lower Limit		0.4296	0.3667	0.3236	1.1098	1.0073	0.0927
95% P.I. MOE (+/-)		0.0690	0.0664	0.0843	0.0503	0.0441	0.0386
95% P.I. Upper Limit		0.5194	0.4532	0.4334	1.1753	1.0647	0.1430
95% P.I. Lower Limit		0.3814	0.3203	0.2647	1.0747	0.9765	0.0658

Table 44. NHTSA Test No. 3, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 3, Oncoming Left Curve 85 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.3736	1.2871	1.1060	1.2100	1.0341	0.1759
	2	1.4577	1.3566	1.1759	1.2200	1.0353	0.1847
	3	1.5710	1.4012	1.2259	1.2300	1.0422	0.1878
	4	1.3907	1.2840	1.1071	1.2300	1.0467	0.1833
	5	1.5804	1.4223	1.2364	1.1800	1.0110	0.1690
	6	1.5410	1.3794	1.2115	1.1700	1.0098	0.1602
	7	1.4526	1.3607	1.1652	1.1800	1.0091	0.1709
	8	1.4862	1.3788	1.1897	1.1800	0.9984	0.1816
	9	1.5071	1.3817	1.1805	1.1700	0.9940	0.1760
	10	1.4438	1.3668	1.1523	1.2100	1.0256	0.1844
Mean		1.4804	1.3619	1.1750	1.1980	1.0206	0.1774
StdDev		0.0705	0.0446	0.0446	0.0244	0.0186	0.0087
Min		1.3736	1.2840	1.1060	1.1700	0.9940	0.1602
Max		1.5804	1.4223	1.2364	1.2300	1.0467	0.1878
95% C.I. MOE (+/-)		0.0504	0.0319	0.0319	0.0175	0.0133	0.0062
95% C.I. Upper Limit		1.5308	1.3937	1.2070	1.2155	1.0339	0.1836
95% C.I. Lower Limit		1.4300	1.3300	1.1431	1.1805	1.0073	0.1712
95% P.I. MOE (+/-)		0.1672	0.1058	0.1059	0.0579	0.0441	0.0206
95% P.I. Upper Limit		1.6476	1.4676	1.2809	1.2559	1.0647	0.1979
95% P.I. Lower Limit		1.3132	1.2561	1.0692	1.1401	0.9765	0.1568

Table 45. NHTSA Test No. 4, 150 m to 120 m, Test Procedure Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 150 m to 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0564	0.0571	0.0365	1.0300	1.0484	0.0184
	2	0.0471	0.0477	0.0341	1.0100	1.0513	0.0413
	3	0.0589	0.0633	0.0370	1.0300	1.0622	0.0322
	4	0.0545	0.0509	0.0314	1.0100	1.0702	0.0602
	5	0.0479	0.0571	0.0333	0.9900	1.0209	0.0309
	6	0.0565	0.0585	0.0386	0.9600	1.0136	0.0536
	7	0.0418	0.0667	0.0303	1.0000	1.0257	0.0257
	8	0.0452	0.0467	0.0320	0.9900	1.0328	0.0428
	9	0.0581	0.0635	0.0473	1.0100	1.0294	0.0194
	10	0.0556	0.0533	0.0321	1.0000	1.0238	0.0238
Mean		0.0522	0.0565	0.0353	1.0030	1.0378	0.0348
StdDev		0.0061	0.0068	0.0050	0.0206	0.0190	0.0143
Min		0.0418	0.0467	0.0303	0.9600	1.0136	0.0184
Max		0.0589	0.0667	0.0473	1.0300	1.0702	0.0602
95% C.I. MOE (+/-)		0.0044	0.0049	0.0036	0.0147	0.0136	0.0102
95% C.I. Upper Limit		0.0565	0.0614	0.0388	1.0177	1.0514	0.0451
95% C.I. Lower Limit		0.0478	0.0516	0.0317	0.9883	1.0242	0.0246
95% P.I. MOE (+/-)		0.0145	0.0162	0.0119	0.0488	0.0451	0.0339
95% P.I. Upper Limit		0.0666	0.0727	0.0471	1.0518	1.0829	0.0687
95% P.I. Lower Limit		0.0377	0.0403	0.0234	0.9542	0.9928	0.0010

Table 46. NHTSA Test No. 4, 119.9 m to 60 m, Test Procedure Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 119.9 m to 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1574	0.1315	0.1133	1.0300	1.0484	0.0184
	2	0.1431	0.1324	0.1140	1.0100	1.0513	0.0413
	3	0.1587	0.1505	0.1323	1.0300	1.0622	0.0322
	4	0.1275	0.1450	0.1200	1.0100	1.0702	0.0602
	5	0.1586	0.1475	0.1301	0.9900	1.0209	0.0309
	6	0.1542	0.1478	0.1281	0.9600	1.0136	0.0536
	7	0.1570	0.1324	0.1172	1.0000	1.0257	0.0257
	8	0.1441	0.1358	0.1183	0.9900	1.0328	0.0428
	9	0.1520	0.1448	0.1196	1.0100	1.0294	0.0194
	10	0.1436	0.1368	0.1210	1.0000	1.0238	0.0238
Mean		0.1496	0.1404	0.1214	1.0030	1.0378	0.0348
StdDev		0.0100	0.0074	0.0066	0.0206	0.0190	0.0143
Min		0.1275	0.1315	0.1133	0.9600	1.0136	0.0184
Max		0.1587	0.1505	0.1323	1.0300	1.0702	0.0602
95% C.I. MOE (+/-)		0.0072	0.0053	0.0047	0.0147	0.0136	0.0102
95% C.I. Upper Limit		0.1568	0.1457	0.1261	1.0177	1.0514	0.0451
95% C.I. Lower Limit		0.1424	0.1351	0.1166	0.9883	1.0242	0.0246
95% P.I. MOE (+/-)		0.0238	0.0175	0.0157	0.0488	0.0451	0.0339
95% P.I. Upper Limit		0.1734	0.1580	0.1371	1.0518	1.0829	0.0687
95% P.I. Lower Limit		0.1258	0.1229	0.1057	0.9542	0.9928	0.0010

Table 47. NHTSA Test No. 4, 59.9 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.5320	0.4950	0.5874	1.2400	1.0484	0.1916
	2	0.5646	0.5379	0.6122	1.2400	1.0513	0.1887
	3	0.6034	0.5684	0.6480	1.2600	1.0622	0.1978
	4	0.5339	0.5215	0.5750	1.2800	1.0702	0.2098
	5	0.6671	0.6582	0.7888	1.2100	1.0209	0.1891
	6	0.6013	0.5499	0.6558	1.2000	1.0136	0.1864
	7	0.5662	0.5371	0.6203	1.2100	1.0257	0.1843
	8	0.5635	0.5437	0.6228	1.2200	1.0328	0.1872
	9	0.5780	0.5581	0.6348	1.2100	1.0294	0.1806
	10	0.5639	0.5158	0.5993	1.2000	1.0238	0.1762
Mean		0.5774	0.5486	0.6345	1.2270	1.0378	0.1892
StdDev		0.0393	0.0440	0.0599	0.0271	0.0190	0.0093
Min		0.5320	0.4950	0.5750	1.2000	1.0136	0.1762
Max		0.6671	0.6582	0.7888	1.2800	1.0702	0.2098
95% C.I. MOE (+/-)		0.0281	0.0315	0.0428	0.0194	0.0136	0.0067
95% C.I. Upper Limit		0.6055	0.5801	0.6773	1.2464	1.0514	0.1958
95% C.I. Lower Limit		0.5492	0.5171	0.5916	1.2076	1.0242	0.1825
95% P.I. MOE (+/-)		0.0933	0.1045	0.1421	0.0643	0.0451	0.0221
95% P.I. Upper Limit		0.6707	0.6531	0.7765	1.2913	1.0829	0.2113
95% P.I. Lower Limit		0.4841	0.4441	0.4924	1.1627	0.9928	0.1670

Table 48. NHTSA Test No. 4, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.8284	1.6695	1.3826	1.2300	1.0484	0.1816
	2	1.9250	1.7467	1.4164	1.2300	1.0513	0.1787
	3	2.0040	1.7824	1.4749	1.2500	1.0622	0.1878
	4	1.8392	1.6663	1.3478	1.2800	1.0702	0.2098
	5	2.0471	1.8057	1.4883	1.2100	1.0209	0.1891
	6	2.0109	1.7888	1.4725	1.2000	1.0136	0.1864
	7	1.9220	1.7542	1.4164	1.2100	1.0257	0.1843
	8	1.9476	1.7605	1.4310	1.2200	1.0328	0.1872
	9	1.9556	1.7803	1.4441	1.2100	1.0294	0.1806
	10	1.8975	1.7280	1.3917	1.2200	1.0238	0.1962
Mean		1.9377	1.7483	1.4265	1.2260	1.0378	0.1882
StdDev		0.0713	0.0479	0.0449	0.0237	0.0190	0.0091
Min		1.8284	1.6663	1.3478	1.2000	1.0136	0.1787
Max		2.0471	1.8057	1.4883	1.2800	1.0702	0.2098
95% C.I. MOE (+/-)		0.0510	0.0343	0.0321	0.0169	0.0136	0.0065
95% C.I. Upper Limit		1.9888	1.7825	1.4587	1.2429	1.0514	0.1947
95% C.I. Lower Limit		1.8867	1.7140	1.3944	1.2091	1.0242	0.1817
95% P.I. MOE (+/-)		0.1693	0.1137	0.1065	0.0561	0.0451	0.0215
95% P.I. Upper Limit		2.1070	1.8619	1.5331	1.2821	1.0829	0.2097
95% P.I. Lower Limit		1.7685	1.6346	1.3200	1.1699	0.9928	0.1666

Table 49. NHTSA Test No. 5, 100 m to 60 m, Test Procedure Repeatability

NHTSA Test No. 5, Same Direction Left Curve 210m Radius, 100 m to 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1535	0.1423	0.1290	0.1531	0.1538	0.1239	0.1671	1.3500	1.1058	0.2442
	2	0.1333	0.1489	0.1310	0.1467	0.1496	0.1349	0.1655	1.3500	1.1083	0.2417
	3	0.1425	0.1622	0.1318	0.1541	0.1423	0.1495	0.1616	1.3500	1.1214	0.2286
	4	0.1332	0.1468	0.1320	0.1428	0.1417	0.1169	0.1547	1.3600	1.1369	0.2231
	5	0.1443	0.1667	0.1408	0.1554	0.1596	0.1358	0.1634	1.3200	1.0796	0.2404
	6	0.1513	0.1605	0.1424	0.1529	0.1484	0.1376	0.1800	1.3300	1.0746	0.2554
	7	0.1437	0.1512	0.1304	0.1450	0.1405	0.1274	0.1632	1.3400	1.0822	0.2578
	8	0.1374	0.1469	0.1307	0.1370	0.1355	0.1315	0.1473	1.3300	1.0929	0.2371
	9	0.1513	0.1585	0.1386	0.1475	0.1573	0.1329	0.1755	1.3400	1.0881	0.2519
	10	0.1300	0.1562	0.1310	0.1471	0.1369	0.1274	0.1572	1.3400	1.0843	0.2557
Mean		0.1420	0.1540	0.1338	0.1482	0.1466	0.1318	0.1636	1.3410	1.0974	0.2436
StdDev		0.0084	0.0079	0.0049	0.0058	0.0085	0.0088	0.0095	0.0120	0.0202	0.0118
Min		0.1300	0.1423	0.1290	0.1370	0.1355	0.1169	0.1473	1.3200	1.0746	0.2231
Max		0.1535	0.1667	0.1424	0.1554	0.1596	0.1495	0.1800	1.3600	1.1369	0.2578
95% C.I. MOE (+/-)		0.0060	0.0057	0.0035	0.0041	0.0061	0.0063	0.0068	0.1103	0.0086	0.0144
95% C.I. Upper Limit		0.1480	0.1597	0.1373	0.1523	0.1526	0.1381	0.1704	1.3496	1.1119	0.2520
95% C.I. Lower Limit		0.1361	0.1483	0.1303	0.1440	0.1405	0.1255	0.1568	1.3324	1.0830	0.2351
95% P.I. MOE (+/-)		0.0199	0.0189	0.0116	0.0137	0.0201	0.0209	0.0226	0.0284	0.0479	0.0280
95% P.I. Upper Limit		0.1619	0.1729	0.1453	0.1619	0.1667	0.1527	0.1861	1.3694	1.1453	0.2716
95% P.I. Lower Limit		0.1222	0.1352	0.1222	0.1345	0.1264	0.1109	0.1410	1.3126	1.0495	0.2155

Table 50. NHTSA Test No. 5, 59.9 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 59.9 m to 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4660	0.6635	0.5281	0.5022	0.5065	0.6139	0.5971	1.2400	1.1058	0.1342
	2	0.4669	0.6998	0.5623	0.5332	0.5517	0.6332	0.6263	1.2400	1.1083	0.1317
	3	0.5039	0.7540	0.5968	0.5841	0.5842	0.6686	0.6667	1.2600	1.1214	0.1386
	4	0.4509	0.6737	0.5385	0.4897	0.5250	0.6130	0.5892	1.2800	1.1369	0.1431
	5	0.5879	0.8131	0.6663	0.6351	0.6535	0.7696	0.7005	1.2100	1.0796	0.1304
	6	0.4663	0.7569	0.5860	0.5794	0.5701	0.6691	0.6375	1.2000	1.0746	0.1254
	7	0.4748	0.6922	0.5571	0.5225	0.5580	0.6447	0.6095	1.2100	1.0822	0.1278
	8	0.5054	0.6818	0.5473	0.5369	0.5301	0.6411	0.6190	1.2200	1.0929	0.1271
	9	0.4836	0.7027	0.5687	0.5493	0.5682	0.6599	0.5994	1.2100	1.0881	0.1219
	10	0.4523	0.6854	0.5327	0.5261	0.5366	0.6359	0.5958	1.2000	1.0843	0.1157
Mean		0.4858	0.7123	0.5684	0.5458	0.5584	0.6549	0.6241	1.2270	1.0974	0.1296
StdDev		0.0404	0.0472	0.0410	0.0432	0.0409	0.0449	0.0356	0.0271	0.0202	0.0080
Min		0.4509	0.6635	0.5281	0.4897	0.5065	0.6130	0.5892	1.2000	1.0746	0.1157
Max		0.5879	0.8131	0.6663	0.6351	0.6535	0.7696	0.7005	1.2800	1.1369	0.1431
95% C.I. MOE (+/-)		0.0289	0.0338	0.0293	0.0309	0.0293	0.0321	0.0255	0.0194	0.0144	0.0057
95% C.I. Upper Limit		0.5147	0.7461	0.5977	0.5767	0.5877	0.6870	0.6496	1.2464	1.1119	0.1353
95% C.I. Lower Limit		0.4569	0.6785	0.5391	0.5149	0.5291	0.6228	0.5986	1.2076	1.0830	0.1239
95% P.I. MOE (+/-)		0.0960	0.1121	0.0972	0.1025	0.0971	0.1065	0.0845	0.0643	0.0479	0.0189
95% P.I. Upper Limit		0.5818	0.8244	0.6656	0.6483	0.6555	0.7614	0.7086	1.2913	1.1453	0.1485
95% P.I. Lower Limit		0.3899	0.6002	0.4712	0.4434	0.4613	0.5484	0.5396	1.1627	1.0495	0.1107

Table 51. NHTSA Test No. 5, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 29.9 m to 15 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.2061	2.6178	1.7898	1.5564	1.6755	1.9502	1.8555	1.2300	1.1058	0.1242
	2	1.2466	2.7851	1.8783	1.6064	1.7620	2.0717	1.9436	1.2300	1.1083	0.1217
	3	1.3208	2.9569	1.9335	1.6646	1.7933	2.1832	2.0235	1.2500	1.1214	0.1286
	4	1.1901	2.6469	1.7767	1.5449	1.6700	1.9746	1.8502	1.2800	1.1369	0.1431
	5	1.3113	3.0147	1.9613	1.7225	1.8204	2.2062	2.0497	1.2100	1.0796	0.1304
	6	1.2861	2.9197	1.9229	1.6944	1.8211	2.1571	2.0111	1.2000	1.0746	0.1254
	7	1.2629	2.7734	1.8659	1.6045	1.7321	2.0592	1.9127	1.2100	1.0822	0.1278
	8	1.2381	2.7550	1.8871	1.6255	1.7558	2.0591	1.8930	1.2200	1.0929	0.1271
	9	1.2510	2.8194	1.8799	1.6450	1.7819	2.0879	1.9358	1.2100	1.0881	0.1219
	10	1.2116	2.6870	1.8162	1.5878	1.7496	2.0186	1.8722	1.2200	1.0843	0.1357
Mean		1.2525	2.7976	1.8712	1.6252	1.7562	2.0768	1.9347	1.2260	1.0974	0.1286
StdDev		0.0439	0.1324	0.0611	0.0573	0.0527	0.0851	0.0719	0.0237	0.0202	0.0066
Min		1.1901	2.6178	1.7767	1.5449	1.6700	1.9502	1.8502	1.2000	1.0746	0.1217
Max		1.3208	3.0147	1.9613	1.7225	1.8211	2.2062	2.0497	1.2800	1.1369	0.1431
95% C.I. MOE (+/-)		0.0314	0.0947	0.0437	0.0410	0.0377	0.0608	0.0515	0.0169	0.0144	0.0047
95% C.I. Upper Limit		1.2839	2.8923	1.9149	1.6662	1.7938	2.1376	1.9862	1.2429	1.1119	0.1333
95% C.I. Lower Limit		1.2211	2.7029	1.8274	1.5842	1.7185	2.0159	1.8833	1.2091	1.0830	0.1239
95% P.I. MOE (+/-)		0.1041	0.3141	0.1451	0.1360	0.1250	0.2018	0.1707	0.0561	0.0479	0.0156
95% P.I. Upper Limit		1.3566	3.1117	2.0162	1.7612	1.8811	2.2786	2.1054	1.2821	1.1453	0.1442
95% P.I. Lower Limit		1.1484	2.4835	1.7261	1.4892	1.6312	1.8750	1.7641	1.1699	1.0495	0.1129

Table 52. NHTSA Test No. 6, 50 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 6, Oncoming Right Curve 210 m Radius, 50 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	4.2510	1.0675	1.3199	1.1700	1.0573	0.1127
	2	4.3778	1.1769	1.2635	1.2200	1.0956	0.1244
	3	4.3198	1.1548	1.2526	1.2100	1.0665	0.1435
	4	4.6592	1.3263	1.2832	1.1800	1.0636	0.1164
	5	5.4189	1.7226	1.3128	1.1500	1.0190	0.1310
	6	5.2271	1.5926	1.3329	1.1900	1.0318	0.1582
	7	6.3615	2.2153	1.4435	1.1500	1.0253	0.1247
	8	3.1957	0.8230	1.2628	1.1600	1.0324	0.1276
	9	4.1388	1.0883	1.2982	1.1500	1.0475	0.1025
	10	3.2442	0.8314	1.3128	1.1500	1.0464	0.1036
Mean		4.5194	1.2999	1.3082	1.1730	1.0485	0.1245
StdDev		0.9648	0.4327	0.0547	0.0263	0.0231	0.0172
Min		3.1957	0.8230	1.2526	1.1500	1.0190	0.1025
Max		6.3615	2.2153	1.4435	1.2200	1.0956	0.1582
95% C.I. MOE (+/-)		0.6902	0.3095	0.0391	0.0188	0.0165	0.0123
95% C.I. Upper Limit		5.2096	1.6094	1.3474	1.1918	1.0651	0.1368
95% C.I. Lower Limit		3.8292	0.9904	1.2691	1.1542	1.0320	0.1121
95% P.I. MOE (+/-)		2.2890	1.0265	0.1298	0.0623	0.0548	0.0409
95% P.I. Upper Limit		6.8084	2.3263	1.4381	1.2353	1.1033	0.1654
95% P.I. Lower Limit		2.2304	0.2734	1.1784	1.1107	0.9937	0.0836

Table 53. NHTSA Test No. 6, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 6, Oncoming Right Curve 210 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.2759	2.3415	1.5723	1.1400	1.0573	0.0827
	2	2.2133	2.3166	1.5431	1.1900	1.0956	0.0944
	3	2.1969	2.3135	1.5314	1.1300	1.0665	0.0635
	4	2.2492	2.3582	1.5647	1.1300	1.0636	0.0664
	5	2.2610	2.3248	1.5844	1.1000	1.0190	0.0810
	6	2.2948	2.4009	1.6015	1.0800	1.0318	0.0482
	7	2.4332	2.5329	1.6771	1.1100	1.0253	0.0847
	8	2.2695	2.3888	1.5808	1.1100	1.0324	0.0776
	9	2.2493	2.3926	1.5657	1.1300	1.0475	0.0825
	10	2.3022	2.4061	1.5906	1.1300	1.0464	0.0836
Mean		2.2745	2.3776	1.5812	1.1250	1.0485	0.0765
StdDev		0.0646	0.0651	0.0398	0.0292	0.0231	0.0134
Min		2.1969	2.3135	1.5314	1.0800	1.0190	0.0482
Max		2.4332	2.5329	1.6771	1.1900	1.0956	0.0944
95% C.I. MOE (+/-)		0.0462	0.0465	0.0284	0.0209	0.0165	0.0096
95% C.I. Upper Limit		2.3208	2.4241	1.6096	1.1459	1.0651	0.0860
95% C.I. Lower Limit		2.2283	2.3310	1.5527	1.1041	1.0320	0.0669
95% P.I. MOE (+/-)		0.1534	0.1544	0.0943	0.0692	0.0548	0.0317
95% P.I. Upper Limit		2.4279	2.5320	1.6755	1.1942	1.1033	0.1082
95% P.I. Lower Limit		2.1212	2.2232	1.4868	1.0558	0.9937	0.0448

Table 54. NHTSA Test No. 7, 220 m to 120 m, Test Procedure Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 220 m to 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0600	0.0611	0.0378	1.3200	1.0932	0.2268
	2	0.0565	0.0550	0.0348	1.2900	1.0906	0.1994
	3	0.0576	0.0603	0.0434	1.2400	1.0633	0.1767
	4	0.0467	0.0541	0.0365	1.2700	1.0867	0.1833
	5	0.0566	0.0498	0.0377	1.2300	1.0588	0.1712
	6	0.0487	0.0559	0.0406	1.2000	1.0432	0.1568
	7	0.0499	0.0564	0.0395	1.2600	1.0549	0.2051
	8	0.0462	0.0504	0.0322	1.2300	1.0466	0.1834
	9	0.0601	0.0572	0.0406	1.2300	1.0526	0.1774
	10	0.0566	0.0611	0.0415	1.2600	1.0663	0.1937
Mean		0.0539	0.0561	0.0384	1.2530	1.0656	0.1874
StdDev		0.0054	0.0040	0.0034	0.0347	0.0183	0.0197
Min		0.0462	0.0498	0.0322	1.2000	1.0432	0.1568
Max		0.0601	0.0611	0.0434	1.3200	1.0932	0.2268
95% C.I. MOE (+/-)		0.0039	0.0029	0.0024	0.0248	0.0131	0.0141
95% C.I. Upper Limit		0.0577	0.0590	0.0409	1.2778	1.0787	0.2015
95% C.I. Lower Limit		0.0500	0.0532	0.0360	1.2282	1.0525	0.1733
95% P.I. MOE (+/-)		0.0128	0.0096	0.0080	0.0822	0.0435	0.0468
95% P.I. Upper Limit		0.0667	0.0657	0.0465	1.3352	1.1091	0.2342
95% P.I. Lower Limit		0.0411	0.0466	0.0304	1.1708	1.0221	0.1406

Table 55. NHTSA Test No. 7, 119.9 m to 60 m, Test Procedure Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 119.9 m to 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1456	0.1439	0.1493	1.3500	1.0932	0.2568
	2	0.1615	0.1468	0.1512	1.3500	1.0906	0.2594
	3	0.1550	0.1522	0.1667	1.3600	1.0633	0.2967
	4	0.1484	0.1491	0.1485	1.3500	1.0867	0.2633
	5	0.1674	0.1618	0.1798	1.3500	1.0588	0.2912
	6	0.1621	0.1526	0.1667	1.3100	1.0432	0.2668
	7	0.1596	0.1633	0.1581	1.3100	1.0549	0.2551
	8	0.1550	0.1473	0.1576	1.3200	1.0466	0.2734
	9	0.1518	0.1405	0.1598	1.3200	1.0526	0.2674
	10	0.1473	0.1367	0.1512	1.3300	1.0663	0.2637
Mean		0.1554	0.1494	0.1589	1.3350	1.0656	0.2694
StdDev		0.0072	0.0085	0.0099	0.0190	0.0183	0.0141
Min		0.1456	0.1367	0.1485	1.3100	1.0432	0.2551
Max		0.1674	0.1633	0.1798	1.3600	1.0932	0.2967
95% C.I. MOE (+/-)		0.0051	0.0061	0.0071	0.0136	0.0131	0.0101
95% C.I. Upper Limit		0.1605	0.1555	0.1660	1.3486	1.0787	0.2795
95% C.I. Lower Limit		0.1502	0.1433	0.1518	1.3214	1.0525	0.2593
95% P.I. MOE (+/-)		0.0171	0.0202	0.0235	0.0451	0.0435	0.0334
95% P.I. Upper Limit		0.1724	0.1696	0.1824	1.3801	1.1091	0.3028
95% P.I. Lower Limit		0.1383	0.1293	0.1354	1.2899	1.0221	0.2360

Table 56. NHTSA Test No. 7, 59.9 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.5930	0.5367	0.7088	1.2600	1.0932	0.1668
	2	0.6135	0.5933	0.7466	1.2700	1.0906	0.1794
	3	0.6427	0.5922	0.7782	1.2400	1.0633	0.1767
	4	0.5717	0.5551	0.7075	1.2500	1.0867	0.1633
	5	0.6879	0.6936	0.8962	1.2200	1.0588	0.1612
	6	0.6383	0.6229	0.7830	1.1900	1.0432	0.1468
	7	0.6211	0.6006	0.7576	1.2200	1.0549	0.1651
	8	0.5878	0.5697	0.7453	1.2100	1.0466	0.1634
	9	0.6253	0.5857	0.7533	1.2200	1.0526	0.1674
	10	0.5886	0.5682	0.7388	1.2300	1.0663	0.1637
Mean		0.6170	0.5918	0.7615	1.2310	1.0656	0.1654
StdDev		0.0342	0.0433	0.0534	0.0242	0.0183	0.0089
Min		0.5717	0.5367	0.7075	1.1900	1.0432	0.1468
Max		0.6879	0.6936	0.8962	1.2700	1.0932	0.1794
95% C.I. MOE (+/-)		0.0245	0.0310	0.0382	0.0173	0.0131	0.0063
95% C.I. Upper Limit		0.6415	0.6228	0.7997	1.2483	1.0787	0.1717
95% C.I. Lower Limit		0.5925	0.5608	0.7233	1.2137	1.0525	0.1591
95% P.I. MOE (+/-)		0.0812	0.1028	0.1266	0.0575	0.0435	0.0210
95% P.I. Upper Limit		0.6982	0.6946	0.8882	1.2885	1.1091	0.1864
95% P.I. Lower Limit		0.5358	0.4890	0.6349	1.1735	1.0221	0.1444

Table 57. NHTSA Test No. 7, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.9073	1.7389	1.4202	1.2500	1.0932	0.1568
	2	2.0295	1.8030	1.4931	1.2700	1.0906	0.1794
	3	2.0789	1.8382	1.5333	1.2400	1.0633	0.1767
	4	1.9111	1.7076	1.4210	1.2300	1.0867	0.1433
	5	2.1116	1.8807	1.5413	1.2100	1.0588	0.1512
	6	2.0792	1.8759	1.5337	1.1900	1.0432	0.1468
	7	2.0313	1.8123	1.4838	1.2200	1.0549	0.1651
	8	2.0495	1.8892	1.5091	1.2100	1.0466	0.1634
	9	2.0399	1.8307	1.4946	1.2100	1.0526	0.1574
	10	1.9813	1.7846	1.4639	1.2200	1.0663	0.1537
Mean		2.0220	1.8161	1.4894	1.2250	1.0656	0.1594
StdDev		0.0690	0.0603	0.0437	0.0232	0.0183	0.0119
Min		1.9073	1.7076	1.4202	1.1900	1.0432	0.1433
Max		2.1116	1.8892	1.5413	1.2700	1.0932	0.1794
95% C.I. MOE (+/-)		0.4289	0.3618	0.0062	0.0182	0.0150	0.0059
95% C.I. Upper Limit		2.0713	1.8592	1.5206	1.2416	1.0787	0.1679
95% C.I. Lower Limit		1.9726	1.7730	1.4582	1.2084	1.0525	0.1509
95% P.I. MOE (+/-)		0.1637	0.1430	0.1036	0.0551	0.0435	0.0283
95% P.I. Upper Limit		2.1857	1.9591	1.5930	1.2801	1.1091	0.1877
95% P.I. Lower Limit		1.8582	1.6731	1.3858	1.1699	1.0221	0.1311

Table 58. NHTSA Test No. 8, 70 m to 60 m, Test Procedure Repeatability

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 70 m to 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.8524	1.2526	0.2492	1.1700	1.0272	0.1428
	2	2.7304	1.1897	0.2440	1.1800	1.0505	0.1295
	3	2.5607	1.1064	0.2449	1.1600	1.0160	0.1440
	4	2.8525	1.3195	0.2530	1.1600	1.0299	0.1301
	5	3.5101	1.9525	0.2539	1.1400	1.0136	0.1264
	6	3.0750	1.4762	0.2519	1.1200	1.0029	0.1171
	7	4.2736	2.5720	0.2700	1.1000	0.9750	0.1250
	8	2.0115	0.7423	0.2434	1.1200	0.9939	0.1261
	9	3.2380	1.6783	0.2636	1.1600	1.0269	0.1331
	10	3.0930	1.5287	0.2571	1.1500	1.0152	0.1348
Mean		3.0197	1.4818	0.2531	1.1460	1.0151	0.1309
StdDev		0.5996	0.5058	0.0086	0.0255	0.0210	0.0082
Min		2.0115	0.7423	0.2434	1.1000	0.9750	0.1171
Max		4.2736	2.5720	0.2700	1.1800	1.0505	0.1440
95% C.I. MOE (+/-)		0.4235	0.1032	0.0315	0.0168	0.0150	0.0046
95% C.I. Upper Limit		3.4487	1.8437	0.2593	1.1642	1.0301	0.1367
95% C.I. Lower Limit		2.5908	1.1200	0.2469	1.1278	1.0001	0.1250
95% P.I. MOE (+/-)		1.4225	1.2001	0.0205	0.0604	0.0498	0.0194
95% P.I. Upper Limit		4.4422	2.6819	0.2736	1.2064	1.0649	0.1503
95% P.I. Lower Limit		1.5972	0.2818	0.2326	1.0856	0.9653	0.1115

Table 59. NHTSA Test No. 8, 59.9 m to 30 m, Test Procedure Repeatability

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 59.9 m to 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.7940	0.7025	1.1544	1.1600	1.0272	0.1328
	2	1.6848	0.6665	1.1150	1.1900	1.0505	0.1395
	3	1.4157	0.6851	1.1085	1.1400	1.0160	0.1240
	4	1.7730	0.6569	1.1281	1.1600	1.0299	0.1301
	5	2.3752	0.7205	1.1612	1.1500	1.0136	0.1364
	6	1.9198	0.6935	1.1669	1.1300	1.0029	0.1271
	7	3.2105	1.1425	1.2596	1.1100	0.9750	0.1350
	8	0.9706	0.6904	1.1124	1.1200	0.9939	0.1261
	9	2.0887	0.7004	1.1599	1.1600	1.0269	0.1331
	10	1.9974	0.6941	1.1605	1.1600	1.0152	0.1448
Mean		1.9230	0.7353	1.1527	1.1480	1.0151	0.1329
StdDev		0.5921	0.1442	0.0440	0.0235	0.0210	0.0064
Min		0.9706	0.6569	1.1085	1.1100	0.9750	0.1240
Max		3.2105	1.1425	1.2596	1.1900	1.0505	0.1448
95% C.I. MOE (+/-)		0.4235	0.1032	0.0315	0.0168	0.0150	0.0046
95% C.I. Upper Limit		2.3465	0.8384	1.1841	1.1648	1.0301	0.1375
95% C.I. Lower Limit		1.4994	0.6321	1.1212	1.1312	1.0001	0.1283
95% P.I. MOE (+/-)		1.4047	0.3422	0.1044	0.0557	0.0498	0.0152
95% P.I. Upper Limit		3.3277	1.0774	1.2570	1.2037	1.0649	0.1481
95% P.I. Lower Limit		0.5182	0.3931	1.0483	1.0923	0.9653	0.1177

Table 60. NHTSA Test No. 8, 29.9 m to 15 m, Test Procedure Repeatability

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 29.9 m to 15 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	2.1561	2.1633	1.5035	1.1100	1.0272	0.0828
	2	2.0612	2.0777	1.4743	1.1600	1.0505	0.1095
	3	2.0537	2.0503	1.4581	1.1100	1.0160	0.0940
	4	2.1102	2.1038	1.4917	1.1300	1.0299	0.1001
	5	2.1305	2.1038	1.5102	1.1100	1.0136	0.0964
	6	2.1478	2.1322	1.5099	1.1000	1.0029	0.0971
	7	2.2703	2.2007	1.5807	1.0800	0.9750	0.1050
	8	2.1255	2.1550	1.5199	1.1000	0.9939	0.1061
	9	2.1554	2.1266	1.5197	1.1200	1.0269	0.0931
	10	2.1568	2.1661	1.5304	1.1100	1.0152	0.0948
Mean		2.1368	2.1279	1.5098	1.1130	1.0151	0.0979
StdDev		0.0602	0.0453	0.0333	0.0211	0.0210	0.0077
Min		2.0537	2.0503	1.4581	1.0800	0.9750	0.0828
Max		2.2703	2.2007	1.5807	1.1600	1.0505	0.1095
95% C.I. MOE (+/-)		0.0430	0.0324	0.0238	0.0151	0.0150	0.0055
95% C.I. Upper Limit		2.1798	2.1603	1.5336	1.1281	1.0301	0.1034
95% C.I. Lower Limit		2.0937	2.0955	1.4860	1.0979	1.0001	0.0924
95% P.I. MOE (+/-)		0.1427	0.1075	0.0789	0.0501	0.0498	0.0183
95% P.I. Upper Limit		2.2795	2.2354	1.5887	1.1631	1.0649	0.1162
95% P.I. Lower Limit		1.9940	2.0204	1.4309	1.0629	0.9653	0.0796

3.3 NHTSA Test Procedure to Repeatability of Test Outcomes

An assessment of test outcome repeatability, meaning the consistency with which the test procedure produces the same pass or fail result, was conducted for the NHTSA test procedure. To do this, each repetition of the test procedure repeatability data was compared to the established glare limits. Tables 61 to 68 present test outcome repeatability results for each test repetition. A cell with a “P” indicates passing, meaning that all receptor head values had maximum illuminance values under the glare limit. A cell with an “E” indicated exceedance, meaning that at least one receptor head had a maximum illuminance value that exceeded the glare limit. NHTSA ADB test scenarios showed perfect test outcome repeatability for test scenario numbers 1 to 5 and 7. Glare limits were consistently met for all measurement distance sub-ranges for all test repetitions resulting in passing outcomes for each. For NHTSA test scenario numbers 6 and 8, both oncoming right curve scenarios, some or all repetitions showed glare limit exceedances for some measurement distance sub-ranges at the car driver eye point location. For NHTSA test scenario 6 measurement distance sub-range 50 m to 30 m, at least one receptor head exceeded glare limits for all 10 repetitions. For 9 repetitions, the car driver eye point receptor head had a glare exceedance. For one repetition, both the car driver eye point receptor head and motorcycle driver eye point receptor head had glare exceedances. For NHTSA test scenario 6 29.9 m to 15 m measurement distance sub-range, all 10 repetitions resulted in passing outcomes. For NHTSA test scenario 8 70 m to 60 m measurement distance sub-range, both the car driver eye point receptor head and the motorcycle driver eye point receptor head had values which exceeded the glare limits for all 10 repetitions. For NHTSA test scenario 8 59.9 m to 30 m measurement distance sub-range, the car driver eye point receptor head had values which exceeded the glare limit in 5 repetitions. For NHTSA test scenario 8 29.9 m to 15 m measurement distance sub-range, all 10 repetitions resulted in passing outcomes.

Table 61. NHTSA Test No. 1 Test Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
220 m - 120 m	P	P	P	P	P	P	P	P	P	P
119.9 m - 60 m	P	P	P	P	P	P	P	P	P	P
59.9 m - 30 m	P	P	P	P	P	P	P	P	P	P
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

Table 62. NHTSA Test No. 2 Test Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
100 m - 60 m	P	P	P	P	P	P	P	P	P	P
59.9 m - 30 m	P	P	P	P	P	P	P	P	P	P
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

Table 63. NHTSA Test No. 3 Test Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
59.9 m - 30 m	P	P	P	P	P	P	P	P	P	P
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

Table 64. NHTSA Test No. 4 Test Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
150 m - 120 m	P	P	P	P	P	P	P	P	P	P
119.9 m - 60 m	P	P	P	P	P	P	P	P	P	P
59.9 m - 30 m	P	P	P	P	P	P	P	P	P	P
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

Table 65. NHTSA Test No. 5 Test Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
100 m - 60 m	P	P	P	P	P	P	P	P	P	P
59.9 m - 30 m	P	P	P	P	P	P	P	P	P	P
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

Table 66. NHTSA Test No. 6 Test Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
50 m - 30 m	E*	E*	E*	E*	E*	E*	E**	E*	E*	E*
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

*Only Receptor Head 4 had a glare exceedance

** Both Receptor Head 4 and Receptor Head 1 had glare exceedances

Table 67. NHTSA Test No. 7 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
220 m - 120 m	P	P	P	P	P	P	P	P	P	P
119.9 m - 60 m	P	P	P	P	P	P	P	P	P	P
59.9 m - 30 m	P	P	P	P	P	P	P	P	P	P
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

Table 68. NHTSA Test No. 8 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance Sub-Range	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
70 m - 60 m	E**	E**	E**	E**	E**	E**	E**	E**	E**	E**
59.9 m - 30 m	P	P	P	P	E*	E*	E*	P	E*	E*
29.9 m - 15 m	P	P	P	P	P	P	P	P	P	P

*Only Receptor Head 4 had a glare exceedance

** Both Receptor Head 4 and Receptor Head 1 had glare exceedances

3.4 NHTSA Test Procedure - Ratio of Prediction Interval Margins of Error to Glare Limits

The prediction interval margins of error were taken as a proportion of the glare limit to give evidence that the test procedure is resulting in low measurement error, particularly when assessing in relation to the proportion of space under the glare limits. These results are shown in Tables 69 to 78. In general, prediction interval margins of error represent 7.9% or less of the glare limit. Exceptions to this were for test scenario numbers 6 and 8 for the Car Eye Point and Motorcycle Eye Point receptor heads. For scenario number 6, the ratio was above 50% for the 50 m to 30 m measurement distance sub-range for both the Car Eye Point receptor head and the Motorcycle Eye Point receptor head. For scenario number 8, the ratio was above 50% for the 70 m to 60 m measurement distance sub-range for both the Car Eye Point receptor head and the Motorcycle Eye Point receptor head. For scenario number 8, the ratio was also above 50% for the 59.9 m to 3 0m measurement distance sub-range for the Car Eye Point receptor head.

Table 69. NHTSA Test Procedure Car Eye Point Prediction Interval MOE Ratio to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Car Eye Point (values in lux and as a proportion of the glare limit)							
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 1**	**Scenario No. 3**	**Scenario No. 4**	**Scenario No. 6**	**Scenario No. 7**	**Scenario No. 8**
220 m - 120 m	0.3	0.0113 (3.8%)	-	-	-	0.0128 (4.3%)	-
150 m - 120 m	0.3	-	-	0.0145 (4.8%)	-	-	-
119.9 m - 60 m	0.6	0.0357 (6.0%)	-	0.0238 (4.0%)	-	0.0171 (2.9%)	-
70 m - 60 m	0.6	-	-	-	-	-	1.4225* (237%)
50 m - 30 m	1.8	-	-	-	2.2890* (127%)	-	-
59.9 m - 30 m	1.8	0.0741 (4.1%)	0.0690 (3.8%)	0.0933 (5.2%)	-	0.0812 (4.5%)	1.4047* (78%)
29.9 m - 15 m	3.1	0.1436 (4.6%)	0.1672 (5.4%)	0.1693 (5.5%)	0.1534 (4.9%)	0.1637 (5.3%)	0.1427 (4.6%)

Table 70. NHTSA Test Procedure Motorcycle Eye Point Prediction Interval MOE Ratio to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Motorcycle Eye Point (values in lux and as a proportion of the glare limit)							
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 1**	**Scenario No. 3**	**Scenario No. 4**	**Scenario No. 6**	**Scenario No. 7**	**Scenario No. 8**
220 m - 120 m	0.3	0.0181 (6.0%)	-	-	-	0.0096 (3.2%)	-
150 m - 120 m	0.3	-	-	0.0162 (5.4%)	-	-	-
119.9 m - 60 m	0.6	0.0369 (6.2%)	-	0.0175 (2.9%)	-	0.0202 (3.6%)	-
70 m - 60 m	0.6	-	-	-	-	-	1.200 * (200.0%)
50 m - 30 m	1.8	-	-	-	1.027* (57.0%)	-	-
59.9 m - 30 m	1.8	0.0650 (3.6%)	0.0664 (3.7%)	0.1045 (5.8%)	-	0.1028 (5.7%)	0.3422 * (19.0%)
29.9 m - 15 m	3.1	0.1452 (4.7%)	0.1058 (3.4%)	0.1137 (3.7%)	0.1544 (5.0%)	0.1430 (4.6%)	0.1075 (3.5%)

Table 71. NHTSA Test Procedure Truck Eye Point Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Truck Eye Point (values in lux and as a proportion of the glare limit)							
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 1**	**Scenario No. 3**	**Scenario No. 4**	**Scenario No. 6**	**Scenario No. 7**	**Scenario No. 8**
220 m - 120 m	0.3	0.0179 (6.0%)	-	0.0119 (4.0%)	-	0.0080 (2.7%)	-
150 m - 120 m	0.3	-	-	-	-	-	-
119.9 m - 60 m	0.6	0.0279 (4.7%)	-	0.0157 (2.6%)	-	0.0235 (3.9%)	-
70 m - 60 m	0.6	-	-	-	-	-	0.0205 (3.4%)
50 m - 30 m	1.8	-	-	-	-	-	-
59.9 m - 30 m	1.8	0.1029 (5.7%)	0.0843 (4.7%)	0.1421 (7.9%)	0.1298 (7.2%)	0.1266 (7.0%)	0.1044 (5.8%)
29.9 m - 15 m	3.1	0.1010 (3.3%)	0.1059 (3.4%)	0.1065 (3.4%)	0.0943 (3.0%)	0.1036 (3.3%)	0.0789 (2.6%)

Table 72. NHTSA Test Procedure Truck Driver Side Mirror Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Truck Driver Side Mirror (values in lux and as a proportion of the glare limit)			
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 2**	**Scenario No. 5**
100 m - 60 m	4	0.0351 (0.9%)	0.0199 (0.5%)
59.9 m - 30 m	18.9	0.1044 (0.6%)	0.0960 (0.5%)
29.9 m - 15 m	18.9	0.1027 (0.5%)	0.1041 (0.6%)

Table 73. NHTSA Test Procedure Car Passenger Side Mirror Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Car Passenger Side Mirror (values in lux and as a proportion of the glare limit)			
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 2**	**Scenario No. 5**
100 m - 60 m	4	0.0331 (0.8%)	0.0189 (0.5%)
59.9 m - 30 m	18.9	0.0963 (0.5%)	0.1121 (0.6%)
29.9 m - 15 m	18.9	0.2348 (1.2%)	0.3141 (1.7%)

Table 74. NHTSA Test Procedure Motorcycle Right Mirror Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Motorcycle Right Mirror (values in lux and as a proportion of the glare limit)			
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 2**	**Scenario No. 5**
100 m - 60 m	4	0.0288 (0.7%)	0.0116 (0.3%)
59.9 m - 30 m	18.9	0.0707 (0.4%)	0.0972 (0.5%)
29.9 m - 15 m	18.9	0.1305 (0.7%)	0.1451 (0.8%)

Table 75. NHTSA Test Procedure Motorcycle Left Mirror Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Motorcycle Left Mirror (values in lux and as a proportion of the glare limit)			
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 2**	**Scenario No. 5**
100 m – 60 m	4	0.0328 (0.8%)	0.0137 (0.3%)
59.9 m – 30 m	18.9	0.0620 (0.3%)	0.1025 (0.5%)
29.9 m – 15 m	18.9	0.1191 (0.6%)	0.1360 (0.7%)

Table 76. NHTSA Test Procedure Car Interior Mirror Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Car Interior Mirror (values in lux and as a proportion of the glare limit)			
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 2**	**Scenario No. 5**
100 m - 60 m	4	0.0337 (0.8%)	0.0201 (0.5%)
59.9 m - 30 m	18.9	0.0798 (0.4%)	0.0971 (0.5%)
29.9 m - 15 m	18.9	0.1118 (0.6%)	0.1250 (0.7%)

Table 77. NHTSA Test Procedure Truck Passenger Side Mirror Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Truck Passenger Side Mirror (values in lux and as a proportion of the glare limit)			
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 2**	**Scenario No. 5**
100 m - 60 m	4	0.0250 (0.6%)	0.0209 (0.5%)
59.9 m - 30 m	18.9	0.1171 (0.6%)	0.1065 (0.6%)
29.9 m - 15 m	18.9	0.2113 (1.1%)	0.2018 (1.1%)

Table 78. NHTSA Test Procedure Car Drive Side Mirror Prediction Interval MOE to Glare Limit

95th Percentile Prediction Interval Margin of Error NHTSA Test Procedure/Car Driver Side Mirror (values in lux and as a proportion of the glare limit)			
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Scenario No. 2**	**Scenario No. 5**
100 m - 60 m	4	0.0363 (0.9%)	0.0226 (0.6%)
59.9 m - 30 m	18.9	0.0738 (0.4%)	0.0845 (0.4%)
29.9 m - 15 m	18.9	0.1392 (0.7%)	0.1707 (0.9%)

3.5 SAE Test Procedure - Gauge (Measurement System) Repeatability Assessment

To assess how the measurement system used may have contributed to variability in the test results, an assessment of gauge (measurement system) repeatability was carried out for the SAE test procedure. Data from 10 repetitions of each test drive scenario performed within one night were used in this analysis. The same procedures described for the NHTSA gauge repeatability analysis were used to evaluate the gauge repeatability of the SAE measurement system. Standard deviations for SAE test drive 1 and SAE test drive 2 were 0.03 lux or less. More specifically, for the 155 m measurement distance, all standard deviations were 0.0142 lux or less. For the 120 m measurement distance, all standard deviations were 0.0146 lux or less. For the 60 m measurement distance, all standard deviations were 0.0171 lux or less. For the 30 m measurement distance, all standard deviations were 0.0216 lux or less.

SAE Test 3 had higher standard deviations. More specifically, for the 155 m measurement distance, all standard deviations were 0.0851 lux or less. For the 120 m measurement distance, all standard deviations were 0.0878 lux or less. For the 60 m measurement distance, all standard deviations were 0.0787 lux or less. For the 30 m measurement distance, all standard deviations were 0.0180 lux or less.

For SAE test drives 10 and 11 at the 155 m measurement distance, all standard deviations were 0.0209 lux or less. More specifically, for the 155 m measurement distance, all standard deviations were 0.0209 lux or less. For the 120 m measurement distance, all standard deviations were 0.0259 lux or less. For the 60 m measurement distance, all standard deviations were 0.0254 lux or less. For the 30 m measurement distance, all standard deviations were 0.0218 lux or less.

SAE test drive 12 had higher standard deviations than test drives 10 and 11. More specifically, for the 155 m measurement distance, all standard deviations were 0.0887 lux or less. For the 120 m measurement distance, all standard deviations were 0.1186 lux or less. For the 60 m measurement distance, all standard deviations were 0.0973 lux or less. For the 30 m measurement distance, all standard deviations were 0.1230 lux or less.

Prediction interval margins of error for SAE test drive 1 and SAE test drive 2 were +/- 0.0513 lux or less. More specifically, for the 155 m measurement distance, all prediction interval margins of

error were +/- 0.0338 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.0346 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.0406 lux or less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.0513 lux or less.

SAE Test 3 had higher prediction interval margins of error. More specifically, for the 155 m measurement distance, all prediction interval margins of error were +/- 0.2019 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.2083 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.1868 lux or less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.0426 lux or less.

For SAE test drives 10 and 11 at the 155 m measurement distance, all prediction interval margins of error were +/- 0.0615 lux or less. More specifically, for the 155 m measurement distance, all prediction interval margins of error were +/- 0.0395 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.0615 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.0602 lux or less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.0518 lux or less.

SAE test drive 12 had higher prediction interval margins of error than test drives 10 and 11. More specifically, for the 155 m measurement distance, all prediction interval margins of error were +/- 0.2105 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.2814 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.2308 lux or less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.2917 lux or less.

In order to further investigate the repeatability of the measurement system for the SAE test procedure, the repeatability of the pitch measured during the test procedure was assessed. The maximum pitch values for all test scenarios did not vary from the mean by more than 0.033 degrees for any test scenario. The average difference value for all test scenarios was 0.14 degrees or less and did not vary from the mean by more than 0.034 degrees. Pitch information is presented here for the SAE test procedure; however, it is important to note the SAE test procedure does not have test specifications to control pitch. See Section 2.5 for information on the test surface requirements, and Section 2.9 for information on the vehicle pitch controls of the NHTSA test procedure that were used in execution of both the NHTSA and SAE test procedures.

Tables 79 to 102 provide the results of examining the gauge repeatability of the SAE measurement system.

Table 79. SAE Test Drive 1, 155 m, Gauge (Measurement System) Repeatability

SAE Test Drive 1, Oncoming Path 1, 155 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0433	0.0134	0.0314	1.3800	1.2379	0.1421
	2	0.0325	0.0203	0.0318	1.3400	1.2212	0.1188
	3	0.0425	0.0374	0.0330	1.3400	1.2345	0.1055
	4	0.0236	0.0390	0.0230	1.4100	1.2393	0.1707
	5	0.0351	0.0416	0.0287	1.3500	1.2326	0.1174
	6	0.0270	0.0422	0.0244	1.3300	1.2089	0.1211
	7	0.0349	0.0272	0.0230	1.3700	1.2184	0.1516
	8	0.0333	0.0362	0.0337	1.3400	1.2132	0.1268
	9	0.0202	0.0168	0.0352	1.3500	1.2260	0.1240
	10	0.0433	0.0241	0.0267	1.3600	1.2261	0.1339
Mean		0.0336	0.0298	0.0291	1.3570	1.2258	0.1312
StdDev		0.0081	0.0108	0.0046	0.0241	0.0104	0.0191
Min		0.0202	0.0134	0.0230	1.3300	1.2089	0.1055
Max		0.0433	0.0422	0.0352	1.4100	1.2393	0.1707
95% C.I. MOE (+/-)		0.0033	0.0058	0.0077	0.0172	0.0074	0.0137
95% C.I. Upper Limit		0.0394	0.0375	0.0324	1.3742	1.2332	0.1449
95% C.I. Lower Limit		0.0278	0.0221	0.0258	1.3398	1.2184	0.1175
95% P.I. MOE (+/-)		0.0193	0.0256	0.0109	0.0571	0.0247	0.0453
95% P.I. Upper Limit		0.0529	0.0554	0.0400	1.4141	1.2505	0.1765
95% P.I. Lower Limit		0.0143	0.0043	0.0182	1.2999	1.2011	0.0859

Table 80. SAE Test Drive 1, 120 m, Gauge (Measurement System) Repeatability

SAE Test Drive 1, Oncoming Path 1, 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0460	0.0464	0.0404	1.2800	1.2379	0.0421
	2	0.0541	0.0434	0.0473	1.2700	1.2212	0.0488
	3	0.0353	0.0429	0.0445	1.2700	1.2345	0.0355
	4	0.0699	0.0404	0.0474	1.3100	1.2393	0.0707
	5	0.0513	0.0624	0.0446	1.2800	1.2326	0.0474
	6	0.0467	0.0361	0.0470	1.2800	1.2089	0.0711
	7	0.0479	0.0570	0.0387	1.2600	1.2184	0.0416
	8	0.0551	0.0384	0.0403	1.2600	1.2132	0.0468
	9	0.0630	0.0450	0.0485	1.2700	1.2260	0.0440
	10	0.0462	0.0510	0.0400	1.2700	1.2261	0.0439
Mean		0.0516	0.0463	0.0439	1.2750	1.2258	0.0492
StdDev		0.0097	0.0083	0.0037	0.0143	0.0104	0.0120
Min		0.0353	0.0361	0.0387	1.2600	1.2089	0.0355
Max		0.0699	0.0624	0.0485	1.3100	1.2393	0.0711
95% C.I. MOE (+/-)		0.0026	0.0069	0.0059	0.0103	0.0074	0.0086
95% C.I. Upper Limit		0.0585	0.0522	0.0465	1.2853	1.2332	0.0578
95% C.I. Lower Limit		0.0446	0.0404	0.0412	1.2647	1.2184	0.0406
95% P.I. MOE (+/-)		0.0230	0.0197	0.0087	0.0340	0.0247	0.0286
95% P.I. Upper Limit		0.0746	0.0660	0.0526	1.3090	1.2505	0.0777
95% P.I. Lower Limit		0.0285	0.0266	0.0351	1.2410	1.2011	0.0206

Table 81. SAE Test Drive 1, 60 m, Gauge (Measurement System) Repeatability

SAE Test Drive 1, Oncoming Path 1, 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1724	0.1483	0.1716	1.3100	1.2379	0.0721
	2	0.1596	0.1461	0.1686	1.2800	1.2212	0.0588
	3	0.1672	0.1466	0.1725	1.3000	1.2345	0.0655
	4	0.1654	0.1473	0.1683	1.2800	1.2393	0.0407
	5	0.1625	0.1572	0.1728	1.2900	1.2326	0.0574
	6	0.1735	0.1470	0.1755	1.2800	1.2089	0.0711
	7	0.1640	0.1323	0.1788	1.2700	1.2184	0.0516
	8	0.1791	0.1500	0.1697	1.3100	1.2132	0.0968
	9	0.1559	0.1387	0.1803	1.2700	1.2260	0.0440
	10	0.1524	0.1436	0.1696	1.2800	1.2261	0.0539
Mean		0.1652	0.1457	0.1728	1.2870	1.2258	0.0612
StdDev		0.0082	0.0066	0.0042	0.0149	0.0104	0.0163
Min		0.1524	0.1323	0.1683	1.2700	1.2089	0.0407
Max		0.1791	0.1572	0.1803	1.3100	1.2393	0.0968
95% C.I. MOE (+/-)		0.0030	0.0059	0.0048	0.0107	0.0074	0.0116
95% C.I. Upper Limit		0.1711	0.1505	0.1758	1.2977	1.2332	0.0728
95% C.I. Lower Limit		0.1593	0.1410	0.1698	1.2763	1.2184	0.0496
95% P.I. MOE (+/-)		0.0196	0.0158	0.0100	0.0355	0.0247	0.0386
95% P.I. Upper Limit		0.1848	0.1615	0.1827	1.3225	1.2505	0.0998
95% P.I. Lower Limit		0.1457	0.1299	0.1628	1.2515	1.2011	0.0226

Table 82. SAE Test Drive 1, 30 m, Gauge (Measurement System) Repeatability

SAE Test Drive 1, Oncoming Path 1, 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4867	0.4407	0.4505	1.3000	1.2379	0.0621
	2	0.4630	0.4416	0.4451	1.2800	1.2212	0.0588
	3	0.4987	0.4350	0.4467	1.3000	1.2345	0.0655
	4	0.4565	0.4509	0.4584	1.2700	1.2393	0.0307
	5	0.4618	0.4273	0.4472	1.2900	1.2326	0.0574
	6	0.4822	0.4128	0.4586	1.2700	1.2089	0.0611
	7	0.4849	0.4476	0.4545	1.2800	1.2184	0.0616
	8	0.4805	0.4438	0.4471	1.3100	1.2132	0.0968
	9	0.4782	0.4402	0.4536	1.2900	1.2260	0.0640
	10	0.4679	0.4355	0.4630	1.2900	1.2261	0.0639
Mean		0.4760	0.4375	0.4525	1.2880	1.2258	0.0622
StdDev		0.0133	0.0110	0.0061	0.0132	0.0104	0.0158
Min		0.4565	0.4128	0.4451	1.2700	1.2089	0.0307
Max		0.4987	0.4509	0.4630	1.3100	1.2393	0.0968
95% C.I. MOE (+/-)		0.0044	0.0095	0.0078	0.0094	0.0074	0.0113
95% C.I. Upper Limit		0.4856	0.4454	0.4568	1.2974	1.2332	0.0735
95% C.I. Lower Limit		0.4665	0.4297	0.4481	1.2786	1.2184	0.0509
95% P.I. MOE (+/-)		0.0315	0.0260	0.0145	0.0312	0.0247	0.0374
95% P.I. Upper Limit		0.5076	0.4635	0.4670	1.3192	1.2505	0.0996
95% P.I. Lower Limit		0.4445	0.4116	0.4379	1.2568	1.2011	0.0248

Table 83. SAE Test Drive 2, 155 m, Gauge (Measurement System) Repeatability

SAE Test Drive 2, Oncoming Path 2, 155 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0369	0.0219	0.0301	1.3300	1.2357	0.0943
	2	0.0385	0.0317	0.0246	1.2900	1.2180	0.0720
	3	0.0229	0.0360	0.0245	1.3500	1.2137	0.1363
	4	0.0494	0.0230	0.0306	1.2700	1.2049	0.0651
	5	0.0394	0.0083	0.0466	1.3200	1.2175	0.1025
	6	0.0212	0.0488	0.0217	1.2800	1.2242	0.0558
	7	0.0501	0.0336	0.0295	1.3200	1.2186	0.1014
	8	0.0319	0.0125	0.0333	1.3600	1.2150	0.1450
	9	0.0290	0.0440	0.0290	1.3600	1.2123	0.1477
	10	0.0277	0.0484	0.0279	1.3200	1.1954	0.1246
Mean		0.0347	0.0308	0.0298	1.3200	1.2155	0.1045
StdDev		0.0100	0.0142	0.0068	0.0320	0.0107	0.0334
Min		0.0212	0.0083	0.0217	1.2700	1.1954	0.0558
Max		0.0501	0.0488	0.0466	1.3600	1.2357	0.1477
95% C.I. MOE (+/-)		0.0049	0.0072	0.0102	0.0229	0.0077	0.0239
95% C.I. Upper Limit		0.0419	0.0410	0.0347	1.3429	1.2232	0.1283
95% C.I. Lower Limit		0.0275	0.0206	0.0249	1.2971	1.2079	0.0806
95% P.I. MOE (+/-)		0.0238	0.0338	0.0162	0.0759	0.0254	0.0791
95% P.I. Upper Limit		0.0585	0.0646	0.0460	1.3959	1.2409	0.1836
95% P.I. Lower Limit		0.0109	-0.0030	0.0136	1.2441	1.1901	0.0253

Table 84. SAE Test Drive 2, 120 m, Gauge (Measurement System) Repeatability

SAE Test Drive 2, Oncoming Path 2, 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0580	0.0619	0.0435	1.3200	1.2357	0.0843
	2	0.0449	0.0585	0.0442	1.3500	1.2180	0.1320
	3	0.0730	0.0515	0.0390	1.3500	1.2137	0.1363
	4	0.0605	0.0768	0.0474	1.3400	1.2049	0.1351
	5	0.0435	0.0503	0.0487	1.3500	1.2175	0.1325
	6	0.0633	0.0508	0.0459	1.3400	1.2242	0.1158
	7	0.0469	0.0680	0.0480	1.3300	1.2186	0.1114
	8	0.0660	0.0691	0.0538	1.3700	1.2150	0.1550
	9	0.0316	0.0541	0.0462	1.3600	1.2123	0.1477
	10	0.0782	0.0853	0.0564	1.3200	1.1954	0.1246
Mean		0.0566	0.0626	0.0473	1.3430	1.2155	0.1275
StdDev		0.0146	0.0120	0.0050	0.0164	0.0107	0.0200
Min		0.0316	0.0503	0.0390	1.3200	1.1954	0.0843
Max		0.0782	0.0853	0.0564	1.3700	1.2357	0.1550
95% C.I. MOE (+/-)		0.0036	0.0104	0.0086	0.0117	0.0077	0.0143
95% C.I. Upper Limit		0.0670	0.0712	0.0509	1.3547	1.2232	0.1418
95% C.I. Lower Limit		0.0462	0.0541	0.0438	1.3313	1.2079	0.1131
95% P.I. MOE (+/-)		0.0346	0.0284	0.0118	0.0388	0.0254	0.0475
95% P.I. Upper Limit		0.0912	0.0910	0.0592	1.3818	1.2409	0.1750
95% P.I. Lower Limit		0.0220	0.0342	0.0355	1.3042	1.1901	0.0799

Table 85. SAE Test Drive 2, 60 m, Gauge (Measurement System) Repeatability

SAE Test Drive 2, Oncoming Path 2, 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1761	0.1876	0.1829	1.3000	1.2357	0.0643
	2	0.1909	0.1999	0.1797	1.2800	1.2180	0.0620
	3	0.1968	0.1946	0.1857	1.2800	1.2137	0.0663
	4	0.1890	0.1776	0.1835	1.2700	1.2049	0.0651
	5	0.1696	0.1635	0.1876	1.2700	1.2175	0.0525
	6	0.2081	0.1650	0.2061	1.2900	1.2242	0.0658
	7	0.1857	0.1484	0.1918	1.3000	1.2186	0.0814
	8	0.2105	0.1919	0.1891	1.2700	1.2150	0.0550
	9	0.1950	0.1774	0.1873	1.2700	1.2123	0.0577
	10	0.1957	0.1590	0.1915	1.2500	1.1954	0.0546
Mean		0.1917	0.1765	0.1885	1.2780	1.2155	0.0625
StdDev		0.0127	0.0171	0.0072	0.0155	0.0107	0.0084
Min		0.1696	0.1484	0.1797	1.2500	1.1954	0.0525
Max		0.2105	0.1999	0.2061	1.3000	1.2357	0.0814
95% C.I. MOE (+/-)		0.0052	0.0091	0.0122	0.0111	0.0077	0.0060
95% C.I. Upper Limit		0.2008	0.1887	0.1937	1.2891	1.2232	0.0685
95% C.I. Lower Limit		0.1827	0.1643	0.1833	1.2669	1.2079	0.0565
95% P.I. MOE (+/-)		0.0301	0.0406	0.0172	0.0368	0.0254	0.0199
95% P.I. Upper Limit		0.2218	0.2171	0.2057	1.3148	1.2409	0.0824
95% P.I. Lower Limit		0.1617	0.1359	0.1713	1.2412	1.1901	0.0425

Table 86. SAE Test Drive 2, 30 m, Gauge (Measurement System) Repeatability

SAE Test Drive 2, Oncoming Path 2, 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.5959	0.6258	0.8375	1.2900	1.2357	0.0543
	2	0.6426	0.6113	0.8494	1.2800	1.2180	0.0620
	3	0.6177	0.6221	0.8529	1.2600	1.2137	0.0463
	4	0.6293	0.6156	0.8634	1.2600	1.2049	0.0551
	5	0.6488	0.6122	0.8586	1.2600	1.2175	0.0425
	6	0.6323	0.6266	0.8686	1.3100	1.2242	0.0858
	7	0.6735	0.6098	0.8575	1.3100	1.2186	0.0914
	8	0.6364	0.6076	0.8663	1.2700	1.2150	0.0550
	9	0.6516	0.6262	0.8693	1.2700	1.2123	0.0577
	10	0.6565	0.6172	0.8805	1.2400	1.1954	0.0446
Mean		0.6385	0.6174	0.8604	1.2750	1.2155	0.0595
StdDev		0.0216	0.0073	0.0121	0.0227	0.0107	0.0166
Min		0.5959	0.6076	0.8375	1.2400	1.1954	0.0425
Max		0.6735	0.6266	0.8805	1.3100	1.2357	0.0914
95% C.I. MOE (+/-)		0.0086	0.0155	0.0052	0.0163	0.0077	0.0118
95% C.I. Upper Limit		0.6539	0.6227	0.8690	1.2913	1.2232	0.0713
95% C.I. Lower Limit		0.6230	0.6122	0.8518	1.2587	1.2079	0.0476
95% P.I. MOE (+/-)		0.0513	0.0173	0.0286	0.0539	0.0254	0.0393
95% P.I. Upper Limit		0.6898	0.6347	0.8890	1.3289	1.2409	0.0988
95% P.I. Lower Limit		0.5871	0.6002	0.8318	1.2211	1.1901	0.0202

Table 87. SAE Test Drive 3, 155 m, Gauge (Measurement System) Repeatability

SAE Test Drive 3, Oncoming Path 3, 155 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.7590	0.6155	0.1129	1.3100	1.1733	0.1367
	2	0.6147	0.4455	0.0719	1.3100	1.2026	0.1074
	3	0.7102	0.5612	0.1062	1.2600	1.1892	0.0708
	4	0.6972	0.5234	0.0824	1.2700	1.2067	0.0633
	5	0.5121	0.3659	0.0664	1.3100	1.1822	0.1278
	6	0.6560	0.5171	0.0785	1.3300	1.2014	0.1286
	7	0.5243	0.3936	0.0653	1.3100	1.1933	0.1167
	8	0.6628	0.5140	0.0840	1.3000	1.2109	0.0891
	9	0.6922	0.5252	0.0973	1.2900	1.2011	0.0889
	10	0.7502	0.5627	0.1103	1.3100	1.2073	0.1027
Mean		0.6579	0.5024	0.0875	1.3000	1.1968	0.1032
StdDev		0.0851	0.0781	0.0180	0.0211	0.0121	0.0250
Min		0.5121	0.3659	0.0653	1.2600	1.1733	0.0633
Max		0.7590	0.6155	0.1129	1.3300	1.2109	0.1367
95% C.I. MOE (+/-)		0.0129	0.0609	0.0559	0.0151	0.0086	0.0179
95% C.I. Upper Limit		0.7188	0.5583	0.1004	1.3151	1.2055	0.1210
95% C.I. Lower Limit		0.5970	0.4465	0.0747	1.2849	1.1882	0.0853
95% P.I. MOE (+/-)		0.2019	0.1853	0.0427	0.0500	0.0287	0.0593
95% P.I. Upper Limit		0.8598	0.6877	0.1302	1.3500	1.2255	0.1624
95% P.I. Lower Limit		0.4560	0.3171	0.0448	1.2500	1.1681	0.0439

Table 88. SAE Test Drive 3, 120 m, Gauge (Measurement System) Repeatability

SAE Test Drive 3, Oncoming Path 3, 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4575	0.2729	0.0684	1.2800	1.1733	0.1067
	2	0.4881	0.2811	0.0642	1.3200	1.2026	0.1174
	3	0.5421	0.3294	0.0707	1.2900	1.1892	0.1008
	4	0.6426	0.4442	0.0722	1.3100	1.2067	0.1033
	5	0.5128	0.3328	0.0714	1.2600	1.1822	0.0778
	6	0.4776	0.3174	0.0584	1.3000	1.2014	0.0986
	7	0.3150	0.1697	0.0596	1.3100	1.1933	0.1167
	8	0.5100	0.3095	0.0655	1.3000	1.2109	0.0891
	9	0.5934	0.3961	0.0640	1.3000	1.2011	0.0989
	10	0.5483	0.3369	0.0770	1.3200	1.2073	0.1127
Mean		0.5087	0.3190	0.0671	1.2990	1.1968	0.1022
StdDev		0.0878	0.0732	0.0059	0.0185	0.0121	0.0123
Min		0.3150	0.1697	0.0584	1.2600	1.1733	0.0778
Max		0.6426	0.4442	0.0770	1.3200	1.2109	0.1174
95% C.I. MOE (+/-)		0.0042	0.0628	0.0523	0.0133	0.0086	0.0088
95% C.I. Upper Limit		0.5715	0.3713	0.0713	1.3123	1.2055	0.1110
95% C.I. Lower Limit		0.4460	0.2667	0.0629	1.2857	1.1882	0.0934
95% P.I. MOE (+/-)		0.2083	0.1736	0.0139	0.0440	0.0287	0.0292
95% P.I. Upper Limit		0.7170	0.4926	0.0811	1.3430	1.2255	0.1314
95% P.I. Lower Limit		0.3005	0.1454	0.0532	1.2550	1.1681	0.0729

Table 89. SAE Test Drive 3, 60 m, Gauge (Measurement System) Repeatability

SAE Test Drive 3, Oncoming Path 3, 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	1.2617	0.7329	0.1712	1.2000	1.1733	0.0267
	2	1.2312	0.6835	0.1613	1.2500	1.2026	0.0474
	3	1.3786	0.8089	0.1685	1.2300	1.1892	0.0408
	4	1.3941	0.8263	0.1658	1.2400	1.2067	0.0333
	5	1.3037	0.7705	0.1643	1.2300	1.1822	0.0478
	6	1.2564	0.6605	0.1717	1.2400	1.2014	0.0386
	7	1.2187	0.6526	0.1766	1.2400	1.1933	0.0467
	8	1.1491	0.6251	0.1710	1.2400	1.2109	0.0291
	9	1.1766	0.6527	0.1701	1.2100	1.2011	0.0089
	10	1.2504	0.6919	0.1625	1.2400	1.2073	0.0327
Mean		1.2621	0.7105	0.1683	1.2320	1.1968	0.0352
StdDev		0.0787	0.0705	0.0048	0.0155	0.0121	0.0120
Min		1.1491	0.6251	0.1613	1.2000	1.1733	0.0089
Max		1.3941	0.8263	0.1766	1.2500	1.2109	0.0478
95% C.I. MOE (+/-)		0.0034	0.0563	0.0504	0.0111	0.0086	0.0086
95% C.I. Upper Limit		1.3184	0.7609	0.1717	1.2431	1.2055	0.0437
95% C.I. Lower Limit		1.2057	0.6601	0.1649	1.2209	1.1882	0.0266
95% P.I. MOE (+/-)		0.1868	0.1673	0.0113	0.0368	0.0287	0.0284
95% P.I. Upper Limit		1.4488	0.8778	0.1796	1.2688	1.2255	0.0636
95% P.I. Lower Limit		1.0753	0.5432	0.1570	1.1952	1.1681	0.0067

Table 90. SAE Test Drive 3, 30 m, Gauge (Measurement System) Repeatability

SAE Test Drive 3, Oncoming Path 3, 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4814	0.4346	0.4715	1.2200	1.1733	0.0467
	2	0.4539	0.4264	0.4612	1.2500	1.2026	0.0474
	3	0.4756	0.4212	0.4665	1.2500	1.1892	0.0608
	4	0.4790	0.4194	0.4692	1.2600	1.2067	0.0533
	5	0.4727	0.4167	0.4683	1.2400	1.1822	0.0578
	6	0.4744	0.4014	0.4681	1.2600	1.2014	0.0586
	7	0.4283	0.4258	0.4586	1.2500	1.1933	0.0567
	8	0.4587	0.4233	0.4590	1.2800	1.2109	0.0691
	9	0.4754	0.4374	0.4741	1.2600	1.2011	0.0589
	10	0.4921	0.4431	0.4757	1.2500	1.2073	0.0427
Mean		0.4692	0.4249	0.4672	1.2520	1.1968	0.0552
StdDev		0.0180	0.0118	0.0060	0.0155	0.0121	0.0078
Min		0.4283	0.4014	0.4586	1.2200	1.1733	0.0427
Max		0.4921	0.4431	0.4757	1.2800	1.2109	0.0691
95% C.I. MOE (+/-)		0.0043	0.0128	0.0084	0.0111	0.0086	0.0056
95% C.I. Upper Limit		0.4820	0.4334	0.4715	1.2631	1.2055	0.0608
95% C.I. Lower Limit		0.4563	0.4165	0.4630	1.2409	1.1882	0.0496
95% P.I. MOE (+/-)		0.0426	0.0280	0.0142	0.0368	0.0287	0.0186
95% P.I. Upper Limit		0.5117	0.4529	0.4814	1.2888	1.2255	0.0737
95% P.I. Lower Limit		0.4266	0.3970	0.4531	1.2152	1.1681	0.0366

Table 91. SAE Test Drive 10, 155 m, Gauge (Measurement System) Repeatability

SAE Test Drive 10, Preceding Path 1, 155 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0137	0.0349	0.0271	0.0295	0.0418	0.0228	0.0330	1.3800	1.2379	0.1421
	2	0.0471	0.0360	0.0415	0.0258	0.0184	0.0336	0.0385	1.3400	1.2212	0.1188
	3	0.0464	0.0328	0.0323	0.0483	0.0421	0.0319	0.0281	1.3400	1.2345	0.1055
	4	0.0384	0.0273	0.0319	0.0145	0.0371	0.0307	0.0332	1.4100	1.2393	0.1707
	5	0.0248	0.0300	0.0229	0.0279	0.0241	0.0225	0.0283	1.3500	1.2326	0.1174
	6	-0.0058	0.0236	0.0347	0.0385	0.0380	0.0343	0.0263	1.3300	1.2089	0.1211
	7	0.0131	0.0270	0.0264	0.0172	0.0433	0.0360	0.0406	1.3700	1.2184	0.1516
	8	0.0381	0.0274	0.0318	0.0191	0.0313	0.0269	0.0326	1.3400	1.2132	0.1268
	9	0.0254	0.0180	0.0323	0.0156	0.0278	0.0233	0.0462	1.3500	1.2260	0.1240
	10	0.0233	0.0136	0.0327	0.0290	0.0468	0.0167	0.0344	1.3600	1.2261	0.1339
Mean		0.0264	0.0271	0.0314	0.0266	0.0351	0.0279	0.0341	1.3570	1.2258	0.1312
StdDev		0.0167	0.0071	0.0051	0.0108	0.0093	0.0064	0.0062	0.0241	0.0104	0.0191
Min		-0.0058	0.0136	0.0229	0.0145	0.0184	0.0167	0.0263	1.3300	1.2089	0.1055
Max		0.0471	0.0360	0.0415	0.0483	0.0468	0.0360	0.0462	1.4100	1.2393	0.1707
95% C.I. MOE (+/-)		0.0119	0.0051	0.0036	0.0077	0.0067	0.0046	0.0044	0.0172	0.0074	0.0137
95% C.I. Upper Limit		0.0384	0.0322	0.0350	0.0343	0.0417	0.0324	0.0385	1.3742	1.2332	0.1449
95% C.I. Lower Limit		0.0145	0.0220	0.0277	0.0189	0.0284	0.0233	0.0297	1.3398	1.2184	0.1175
95% P.I. MOE (+/-)		0.0395	0.0169	0.0121	0.0255	0.0221	0.0151	0.0146	0.0571	0.0247	0.0453
95% P.I. Upper Limit		0.0660	0.0440	0.0434	0.0521	0.0571	0.0430	0.0487	1.4141	1.2505	0.1765
95% P.I. Lower Limit		-0.0131	0.0101	0.0193	0.0010	0.0130	0.0127	0.0195	1.2999	1.2011	0.0859

Table 92. SAE Test Drive 10, 120 m, Gauge (Measurement System) Repeatability

SAE Test Drive 10, Preceding Path 1, 120 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0168	0.0532	0.0482	0.0468	0.0521	0.0500	0.0500	1.2800	1.2379	0.0421
	2	0.0696	0.0582	0.0610	0.0278	0.0457	0.0542	0.0467	1.2700	1.2212	0.0488
	3	0.0476	0.0405	0.0472	0.0734	0.0541	0.0503	0.0294	1.2700	1.2345	0.0355
	4	0.0614	0.0618	0.0483	0.0235	0.0556	0.0446	0.0441	1.3100	1.2393	0.0707
	5	0.0550	0.0532	0.0579	0.0500	0.0414	0.0483	0.0562	1.2800	1.2326	0.0474
	6	0.0687	0.0604	0.0489	0.0557	0.0618	0.0503	0.0468	1.2800	1.2089	0.0711
	7	0.0386	0.0598	0.0460	0.0492	0.0455	0.0442	0.0507	1.2600	1.2184	0.0416
	8	0.0518	0.0478	0.0464	0.0386	0.0538	0.0448	0.0686	1.2600	1.2132	0.0468
	9	0.0397	0.0501	0.0528	0.0332	0.0596	0.0529	0.0515	1.2700	1.2260	0.0440
	10	0.0501	0.0500	0.0517	0.0529	0.0591	0.0483	0.0502	1.2700	1.2261	0.0439
Mean		0.0499	0.0535	0.0508	0.0451	0.0529	0.0488	0.0494	1.2750	1.2258	0.0492
StdDev		0.0158	0.0067	0.0051	0.0148	0.0068	0.0035	0.0098	0.0143	0.0104	0.0120
Min		0.0168	0.0405	0.0460	0.0235	0.0414	0.0442	0.0294	1.2600	1.2089	0.0355
Max		0.0696	0.0618	0.0610	0.0734	0.0618	0.0542	0.0686	1.3100	1.2393	0.0711
95% C.I. MOE (+/-)		0.0113	0.0048	0.0036	0.0106	0.0048	0.0025	0.0070	0.0103	0.0074	0.0086
95% C.I. Upper Limit		0.0612	0.0583	0.0545	0.0557	0.0577	0.0513	0.0564	1.2853	1.2332	0.0578
95% C.I. Lower Limit		0.0387	0.0487	0.0472	0.0345	0.0480	0.0463	0.0424	1.2647	1.2184	0.0406
95% P.I. MOE (+/-)		0.0374	0.0159	0.0120	0.0351	0.0160	0.0082	0.0232	0.0340	0.0247	0.0286
95% P.I. Upper Limit		0.0873	0.0694	0.0629	0.0802	0.0689	0.0570	0.0727	1.3090	1.2505	0.0777
95% P.I. Lower Limit		0.0126	0.0376	0.0388	0.0100	0.0369	0.0406	0.0262	1.2410	1.2011	0.0206

Table 93. SAE Test Drive 10, 60 m, Gauge (Measurement System) Repeatability

SAE Test Drive 10, Preceding Path 1, 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1277	0.1862	0.1601	0.1409	0.1550	0.1535	0.1413	1.3100	1.2379	0.0721
	2	0.1367	0.1967	0.1643	0.1431	0.1237	0.1465	0.1628	1.2800	1.2212	0.0588
	3	0.1242	0.1805	0.1617	0.1482	0.1578	0.1492	0.1836	1.3000	1.2345	0.0655
	4	0.1533	0.1810	0.1579	0.1399	0.1633	0.1440	0.1535	1.2800	1.2393	0.0407
	5	0.1331	0.1748	0.1585	0.1554	0.1607	0.1498	0.1399	1.2900	1.2326	0.0574
	6	0.1665	0.1707	0.1451	0.1422	0.1595	0.1445	0.1557	1.2800	1.2089	0.0711
	7	0.1421	0.1778	0.1545	0.1414	0.1530	0.1486	0.1512	1.2700	1.2184	0.0516
	8	0.1514	0.1821	0.1600	0.1374	0.1657	0.1535	0.1620	1.3100	1.2132	0.0968
	9	0.1447	0.1839	0.1630	0.1495	0.1498	0.1462	0.1662	1.2700	1.2260	0.0440
	10	0.1467	0.1785	0.1520	0.1639	0.1383	0.1591	0.1491	1.2800	1.2261	0.0539
Mean		0.1427	0.1812	0.1577	0.1462	0.1527	0.1495	0.1565	1.2870	1.2258	0.0612
StdDev		0.0128	0.0070	0.0058	0.0082	0.0128	0.0047	0.0129	0.0149	0.0104	0.0163
Min		0.1242	0.1707	0.1451	0.1374	0.1237	0.1440	0.1399	1.2700	1.2089	0.0407
Max		0.1665	0.1967	0.1643	0.1639	0.1657	0.1591	0.1836	1.3100	1.2393	0.0968
95% C.I. MOE (+/-)		0.0091	0.0050	0.0041	0.0059	0.0092	0.0034	0.0092	0.0107	0.0074	0.0116
95% C.I. Upper Limit		0.1518	0.1863	0.1619	0.1521	0.1618	0.1529	0.1658	1.2977	1.2332	0.0728
95% C.I. Lower Limit		0.1335	0.1762	0.1536	0.1403	0.1435	0.1461	0.1473	1.2763	1.2184	0.0496
95% P.I. MOE (+/-)		0.0303	0.0167	0.0137	0.0195	0.0304	0.0112	0.0306	0.0355	0.0247	0.0386
95% P.I. Upper Limit		0.1730	0.1979	0.1714	0.1657	0.1831	0.1607	0.1871	1.3225	1.2505	0.0998
95% P.I. Lower Limit		0.1123	0.1646	0.1440	0.1267	0.1223	0.1383	0.1259	1.2515	1.2011	0.0226

Table 94. SAE Test Drive 10, 30 m, Gauge (Measurement System) Repeatability

SAE Test Drive 10, Preceding Path 1, 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4159	0.6059	0.4722	0.4416	0.4316	0.4865	0.5113	1.3000	1.2379	0.0621
	2	0.3532	0.5826	0.4640	0.4328	0.4554	0.4765	0.4914	1.2800	1.2212	0.0588
	3	0.3820	0.5915	0.4724	0.4477	0.4490	0.4896	0.4905	1.3000	1.2345	0.0655
	4	0.3833	0.5830	0.4674	0.4216	0.4469	0.4885	0.4902	1.2700	1.2393	0.0307
	5	0.4023	0.5862	0.4605	0.4236	0.4499	0.4770	0.4924	1.2900	1.2326	0.0574
	6	0.4054	0.5927	0.4662	0.4467	0.4500	0.4820	0.4824	1.2700	1.2089	0.0611
	7	0.3926	0.5899	0.4768	0.4340	0.4436	0.4875	0.5183	1.2800	1.2184	0.0616
	8	0.3703	0.5924	0.4771	0.4447	0.4621	0.4769	0.5232	1.3100	1.2132	0.0968
	9	0.3675	0.5891	0.4664	0.4222	0.4517	0.4910	0.4947	1.2900	1.2260	0.0640
	10	0.3521	0.5890	0.4662	0.4165	0.4187	0.4833	0.4772	1.2900	1.2261	0.0639
Mean		0.3825	0.5902	0.4689	0.4332	0.4459	0.4839	0.4972	1.2880	1.2258	0.0622
StdDev		0.0218	0.0066	0.0055	0.0117	0.0124	0.0056	0.0153	0.0132	0.0104	0.0158
Min		0.3521	0.5826	0.4605	0.4165	0.4187	0.4765	0.4772	1.2700	1.2089	0.0307
Max		0.4159	0.6059	0.4771	0.4477	0.4621	0.4910	0.5232	1.3100	1.2393	0.0968
95% C.I. MOE (+/-)		0.0156	0.0047	0.0039	0.0083	0.0089	0.0040	0.0109	0.0094	0.0074	0.0113
95% C.I. Upper Limit		0.3981	0.5949	0.4728	0.4415	0.4548	0.4879	0.5081	1.2974	1.2332	0.0735
95% C.I. Lower Limit		0.3668	0.5855	0.4650	0.4248	0.4370	0.4799	0.4862	1.2786	1.2184	0.0509
95% P.I. MOE (+/-)		0.0518	0.0156	0.0130	0.0277	0.0294	0.0132	0.0362	0.0312	0.0247	0.0374
95% P.I. Upper Limit		0.4342	0.6058	0.4819	0.4608	0.4753	0.4971	0.5334	1.3192	1.2505	0.0996
95% P.I. Lower Limit		0.3307	0.5747	0.4559	0.4055	0.4165	0.4707	0.4609	1.2568	1.2011	0.0248

Table 95. SAE Test Drive 11, 155 m, Gauge (Measurement System) Repeatability

SAE Test Drive 11, Preceding Path 2, 155 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	-0.0078	0.0351	0.0318	0.0250	0.0369	0.0443	0.0335	1.3300	1.2357	0.0943
	2	0.0485	0.0487	0.0325	0.0307	0.0576	0.0335	0.0364	1.2900	1.2180	0.0720
	3	0.0190	0.0225	0.0358	0.0199	0.0324	0.0314	0.0346	1.3500	1.2137	0.1363
	4	0.0220	0.0576	0.0358	0.0419	0.0397	0.0489	0.0278	1.2700	1.2049	0.0651
	5	0.0123	0.0502	0.0291	0.0148	0.0226	0.0523	0.0405	1.3200	1.2175	0.1025
	6	0.0512	0.0099	0.0313	0.0288	0.0442	0.0470	0.0350	1.2800	1.2242	0.0558
	7	0.0474	0.0254	0.0368	0.0387	0.0391	0.0341	0.0406	1.3200	1.2186	0.1014
	8	0.0128	0.0275	0.0358	0.0319	0.0320	0.0343	0.0372	1.3600	1.2150	0.1450
	9	0.0190	0.0373	0.0367	0.0318	0.0479	0.0374	0.0304	1.3600	1.2123	0.1477
	10	0.0533	0.0194	0.0343	0.0554	0.0314	0.0398	0.0375	1.3200	1.1954	0.1246
Mean		0.0278	0.0334	0.0340	0.0319	0.0384	0.0403	0.0353	1.3200	1.2155	0.1045
StdDev		0.0209	0.0152	0.0026	0.0115	0.0098	0.0074	0.0041	0.0320	0.0107	0.0334
Min		-0.0078	0.0099	0.0291	0.0148	0.0226	0.0314	0.0278	1.2700	1.1954	0.0558
Max		0.0533	0.0576	0.0368	0.0554	0.0576	0.0523	0.0406	1.3600	1.2357	0.1477
95% C.I. MOE (+/-)		0.0149	0.0109	0.0019	0.0082	0.0070	0.0053	0.0029	0.0229	0.0077	0.0239
95% C.I. Upper Limit		0.0427	0.0442	0.0359	0.0401	0.0454	0.0456	0.0382	1.3429	1.2232	0.1283
95% C.I. Lower Limit		0.0128	0.0225	0.0321	0.0237	0.0313	0.0350	0.0324	1.2971	1.2079	0.0806
95% P.I. MOE (+/-)		0.0496	0.0361	0.0063	0.0273	0.0234	0.0174	0.0096	0.0759	0.0254	0.0791
95% P.I. Upper Limit		0.0773	0.0695	0.0403	0.0592	0.0617	0.0577	0.0450	1.3959	1.2409	0.1836
95% P.I. Lower Limit		-0.0218	-0.0028	0.0277	0.0046	0.0150	0.0229	0.0257	1.2441	1.1901	0.0253

Table 96. SAE Test Drive 11, 120 m, Gauge (Measurement System) Repeatability

SAE Test Drive 11, Preceding Path 2, 120 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0019	0.0472	0.0576	0.0547	0.0521	0.0516	0.0297	1.3200	1.2357	0.0843
	2	0.0142	0.0580	0.0592	0.0481	0.0446	0.0492	0.0385	1.3500	1.2180	0.1320
	3	0.0430	0.0485	0.0508	0.0601	0.0720	0.0448	0.0418	1.3500	1.2137	0.1363
	4	0.0804	0.0717	0.0619	0.0395	0.0655	0.0590	0.0689	1.3400	1.2049	0.1351
	5	0.0499	0.0602	0.0575	0.0493	0.0449	0.0433	0.0750	1.3500	1.2175	0.1325
	6	0.0576	0.0546	0.0431	0.0468	0.0431	0.0545	0.0574	1.3400	1.2242	0.1158
	7	0.0461	0.0644	0.0604	0.0473	0.0464	0.0560	0.0744	1.3300	1.2186	0.1114
	8	0.0737	0.0631	0.0604	0.0508	0.0657	0.0567	0.0706	1.3700	1.2150	0.1550
	9	0.0295	0.0659	0.0590	0.0421	0.0353	0.0519	0.0485	1.3600	1.2123	0.1477
	10	0.0730	0.0690	0.0506	0.0793	0.0645	0.0569	0.0911	1.3200	1.1954	0.1246
Mean		0.0469	0.0603	0.0561	0.0518	0.0534	0.0524	0.0596	1.3430	1.2155	0.1275
StdDev		0.0259	0.0082	0.0060	0.0113	0.0125	0.0053	0.0195	0.0164	0.0107	0.0200
Min		0.0019	0.0472	0.0431	0.0395	0.0353	0.0433	0.0297	1.3200	1.1954	0.0843
Max		0.0804	0.0717	0.0619	0.0793	0.0720	0.0590	0.0911	1.3700	1.2357	0.1550
95% C.I. MOE (+/-)		0.0186	0.0059	0.0043	0.0081	0.0089	0.0038	0.0140	0.0117	0.0077	0.0143
95% C.I. Upper Limit		0.0655	0.0662	0.0603	0.0599	0.0623	0.0562	0.0736	1.3547	1.2232	0.1418
95% C.I. Lower Limit		0.0284	0.0544	0.0518	0.0437	0.0445	0.0486	0.0456	1.3313	1.2079	0.1131
95% P.I. MOE (+/-)		0.0615	0.0195	0.0142	0.0268	0.0296	0.0125	0.0463	0.0388	0.0254	0.0475
95% P.I. Upper Limit		0.1085	0.0798	0.0702	0.0786	0.0830	0.0649	0.1059	1.3818	1.2409	0.1750
95% P.I. Lower Limit		-0.0146	0.0407	0.0419	0.0250	0.0238	0.0399	0.0133	1.3042	1.1901	0.0799

Table 97. SAE Test Drive 11, 60 m, Gauge (Measurement System) Repeatability

SAE Test Drive 11, Preceding Path 2, 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1490	0.2310	0.1927	0.1710	0.1710	0.1731	0.1860	1.3000	1.2357	0.0643
	2	0.1468	0.2303	0.1899	0.1867	0.1716	0.1967	0.2184	1.2800	1.2180	0.0620
	3	0.1194	0.2238	0.1918	0.1780	0.1933	0.1889	0.2050	1.2800	1.2137	0.0663
	4	0.1634	0.2205	0.1926	0.1812	0.2045	0.1840	0.2329	1.2700	1.2049	0.0651
	5	0.1678	0.2310	0.1922	0.1804	0.1771	0.1719	0.2070	1.2700	1.2175	0.0525
	6	0.1308	0.2300	0.2044	0.1720	0.2020	0.1733	0.2002	1.2900	1.2242	0.0658
	7	0.1205	0.2337	0.1889	0.1859	0.1881	0.1806	0.1536	1.3000	1.2186	0.0814
	8	0.1709	0.2295	0.1973	0.1899	0.2115	0.1925	0.2360	1.2700	1.2150	0.0550
	9	0.1648	0.2432	0.1848	0.1976	0.1731	0.1677	0.2243	1.2700	1.2123	0.0577
	10	0.1123	0.2480	0.1949	0.1654	0.1671	0.1792	0.1831	1.2500	1.1954	0.0546
Mean		0.1446	0.2321	0.1929	0.1808	0.1859	0.1808	0.2046	1.2780	1.2155	0.0625
StdDev		0.0223	0.0081	0.0053	0.0097	0.0161	0.0096	0.0254	0.0155	0.0107	0.0084
Min		0.1123	0.2205	0.1848	0.1654	0.1671	0.1677	0.1536	1.2500	1.1954	0.0525
Max		0.1709	0.2480	0.2044	0.1976	0.2115	0.1967	0.2360	1.3000	1.2357	0.0814
95% C.I. MOE (+/-)		0.0159	0.0058	0.0038	0.0069	0.0115	0.0069	0.0182	0.0111	0.0077	0.0060
95% C.I. Upper Limit		0.1605	0.2379	0.1967	0.1877	0.1974	0.1877	0.2228	1.2891	1.2232	0.0685
95% C.I. Lower Limit		0.1286	0.2263	0.1892	0.1739	0.1744	0.1739	0.1865	1.2669	1.2079	0.0565
95% P.I. MOE (+/-)		0.0528	0.0193	0.0125	0.0230	0.0382	0.0228	0.0602	0.0368	0.0254	0.0199
95% P.I. Upper Limit		0.1974	0.2514	0.2054	0.2038	0.2242	0.2036	0.2649	1.3148	1.2409	0.0824
95% P.I. Lower Limit		0.0917	0.2128	0.1804	0.1578	0.1477	0.1580	0.1444	1.2412	1.1901	0.0425

Table 98. SAE Test Drive 11, 30 m, Gauge (Measurement System) Repeatability

SAE Test Drive 11, Preceding Path 2, 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.6531	0.8138	0.6301	0.5813	0.5773	0.9659	0.6208	1.2900	1.2357	0.0543
	2	0.6431	0.8226	0.6313	0.5963	0.6241	0.9775	0.6217	1.2800	1.2180	0.0620
	3	0.6456	0.8221	0.6346	0.5967	0.5916	0.9722	0.6448	1.2600	1.2137	0.0463
	4	0.6688	0.8182	0.6307	0.6047	0.6201	0.9899	0.6298	1.2600	1.2049	0.0551
	5	0.6204	0.8348	0.6333	0.6066	0.6036	0.9874	0.6336	1.2600	1.2175	0.0425
	6	0.6506	0.8410	0.6459	0.6019	0.6114	1.0057	0.6222	1.3100	1.2242	0.0858
	7	0.6398	0.8614	0.6465	0.6020	0.6380	0.9843	0.6381	1.3100	1.2186	0.0914
	8	0.6362	0.8393	0.6473	0.5696	0.6028	0.9885	0.6342	1.2700	1.2150	0.0550
	9	0.6463	0.8375	0.6543	0.6083	0.6037	0.9959	0.6175	1.2700	1.2123	0.0577
	10	0.6396	0.8553	0.6488	0.5900	0.6412	0.9962	0.6513	1.2400	1.1954	0.0446
Mean		0.6443	0.8346	0.6403	0.5957	0.6114	0.9864	0.6314	1.2750	1.2155	0.0595
StdDev		0.0125	0.0157	0.0091	0.0123	0.0199	0.0119	0.0111	0.0227	0.0107	0.0166
Min		0.6204	0.8138	0.6301	0.5696	0.5773	0.9659	0.6175	1.2400	1.1954	0.0425
Max		0.6688	0.8614	0.6543	0.6083	0.6412	1.0057	0.6513	1.3100	1.2357	0.0914
95% C.I. MOE (+/-)		0.0089	0.0112	0.0065	0.0088	0.0143	0.0085	0.0080	0.0163	0.0077	0.0118
95% C.I. Upper Limit		0.6533	0.8458	0.6468	0.6045	0.6257	0.9949	0.6394	1.2913	1.2232	0.0713
95% C.I. Lower Limit		0.6354	0.8234	0.6337	0.5870	0.5971	0.9778	0.6234	1.2587	1.2079	0.0476
95% P.I. MOE (+/-)		0.0296	0.0373	0.0217	0.0291	0.0473	0.0283	0.0264	0.0539	0.0254	0.0393
95% P.I. Upper Limit		0.6740	0.8719	0.6619	0.6249	0.6587	1.0147	0.6578	1.3289	1.2409	0.0988
95% P.I. Lower Limit		0.6147	0.7973	0.6186	0.5666	0.5641	0.9581	0.6049	1.2211	1.1901	0.0202

Table 99. SAE Test Drive 12, 155 m, Gauge (Measurement System) Repeatability

SAE Test Drive 12, Preceding Path 3, 155 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.2772	0.7274	0.6791	0.7060	0.9139	0.2764	0.8128	1.3100	1.1733	0.1367
	2	0.1307	0.5318	0.5207	0.5413	0.7670	0.1494	0.6721	1.3100	1.2026	0.1074
	3	0.2157	0.6437	0.6571	0.5873	0.8893	0.2400	0.7925	1.2600	1.1892	0.0708
	4	0.1847	0.5904	0.5419	0.5524	0.8375	0.2019	0.6929	1.2700	1.2067	0.0633
	5	0.1297	0.4664	0.4227	0.4477	0.6771	0.1165	0.5979	1.3100	1.1822	0.1278
	6	0.1913	0.5687	0.5809	0.5941	0.8484	0.1927	0.7016	1.3300	1.2014	0.1286
	7	0.1461	0.4646	0.4600	0.4540	0.6985	0.1357	0.5953	1.3100	1.1933	0.1167
	8	0.1980	0.5797	0.5778	0.5780	0.8707	0.1911	0.7321	1.3000	1.2109	0.0891
	9	0.2159	0.6259	0.6059	0.6311	0.8879	0.2142	0.7690	1.2900	1.2011	0.0889
	10	0.2469	0.6820	0.6684	0.6732	0.9315	0.2418	0.8042	1.3100	1.2073	0.1027
Mean		0.1936	0.5881	0.5714	0.5765	0.8322	0.1960	0.7171	1.3000	1.1968	0.1032
StdDev		0.0486	0.0859	0.0867	0.0836	0.0887	0.0506	0.0798	0.0211	0.0121	0.0250
Min		0.1297	0.4646	0.4227	0.4477	0.6771	0.1165	0.5953	1.2600	1.1733	0.0633
Max		0.2772	0.7274	0.6791	0.7060	0.9315	0.2764	0.8128	1.3300	1.2109	0.1367
95% C.I. MOE (+/-)		0.0347	0.0615	0.0620	0.0598	0.0635	0.0362	0.0571	0.0151	0.0086	0.0179
95% C.I. Upper Limit		0.2283	0.6495	0.6335	0.6363	0.8956	0.2321	0.7741	1.3151	1.2055	0.1210
95% C.I. Lower Limit		0.1589	0.5266	0.5094	0.5167	0.7687	0.1598	0.6600	1.2849	1.1882	0.0853
95% P.I. MOE (+/-)		0.1152	0.2038	0.2057	0.1984	0.2105	0.1200	0.1892	0.0500	0.0287	0.0593
95% P.I. Upper Limit		0.3088	0.7919	0.7771	0.7749	1.0427	0.3160	0.9063	1.3500	1.2255	0.1624
95% P.I. Lower Limit		0.0784	0.3842	0.3658	0.3781	0.6217	0.0760	0.5278	1.2500	1.1681	0.0439

Table 100. SAE Test Drive 12, 120 m, Gauge (Measurement System) Repeatability

SAE Test Drive 12, Preceding Path 3, 120 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0959	0.5920	0.3554	0.3837	0.3889	0.0734	0.7648	1.2800	1.1733	0.1067
	2	0.0952	0.6446	0.3841	0.3995	0.3848	0.0744	0.8250	1.3200	1.2026	0.1174
	3	0.0731	0.6421	0.4292	0.4228	0.4608	0.0835	0.8132	1.2900	1.1892	0.1008
	4	0.1107	0.7406	0.5495	0.5484	0.5698	0.1069	0.9917	1.3100	1.2067	0.1033
	5	0.0881	0.6627	0.4278	0.4188	0.4184	0.0755	0.8294	1.2600	1.1822	0.0778
	6	0.1283	0.5929	0.3668	0.3832	0.3829	0.0706	0.7792	1.3000	1.2014	0.0986
	7	0.0970	0.4746	0.2279	0.2234	0.2228	0.0613	0.5396	1.3100	1.1933	0.1167
	8	0.0911	0.6346	0.4231	0.4160	0.3946	0.0932	0.8052	1.3000	1.2109	0.0891
	9	0.1336	0.7150	0.5063	0.5160	0.4807	0.0931	0.9348	1.3000	1.2011	0.0989
	10	0.0974	0.6732	0.4443	0.4677	0.4486	0.0960	0.8471	1.3200	1.2073	0.1127
Mean		0.1010	0.6372	0.4114	0.4179	0.4152	0.0828	0.8130	1.2990	1.1968	0.1022
StdDev		0.0184	0.0740	0.0878	0.0880	0.0891	0.0141	0.1186	0.0185	0.0121	0.0123
Min		0.0731	0.4746	0.2279	0.2234	0.2228	0.0613	0.5396	1.2600	1.1733	0.0778
Max		0.1336	0.7406	0.5495	0.5484	0.5698	0.1069	0.9917	1.3200	1.2109	0.1174
95% C.I. MOE (+/-)		0.0131	0.0529	0.0628	0.0629	0.0638	0.0101	0.0849	0.0133	0.0086	0.0088
95% C.I. Upper Limit		0.1142	0.6902	0.4743	0.4809	0.4790	0.0929	0.8979	1.3123	1.2055	0.1110
95% C.I. Lower Limit		0.0879	0.5843	0.3486	0.3550	0.3515	0.0727	0.7281	1.2857	1.1882	0.0934
95% P.I. MOE (+/-)		0.0436	0.1755	0.2083	0.2088	0.2115	0.0335	0.2814	0.0440	0.0287	0.0292
95% P.I. Upper Limit		0.1446	0.8127	0.6198	0.6267	0.6267	0.1163	1.0944	1.3430	1.2255	0.1314
95% P.I. Lower Limit		0.0575	0.4618	0.2031	0.2092	0.2038	0.0493	0.5316	1.2550	1.1681	0.0729

Table 101. SAE Test Drive 12, 60 m, Gauge (Measurement System) Repeatability

SAE Test Drive 12, Preceding Path 3, 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.2215	1.6299	0.9960	1.0211	1.0220	0.1474	2.2330	1.2000	1.1733	0.0267
	2	0.2247	1.5804	0.9235	0.9701	0.9690	0.1481	2.1447	1.2500	1.2026	0.0474
	3	0.2011	1.6702	1.0589	1.1221	1.1344	0.1555	2.3260	1.2300	1.1892	0.0408
	4	0.2105	1.7179	1.0803	1.1358	1.1101	0.1487	2.3649	1.2400	1.2067	0.0333
	5	0.2005	1.6501	1.0346	1.0856	1.0554	0.1492	2.2469	1.2300	1.1822	0.0478
	6	0.1994	1.6021	0.9580	0.9913	0.9484	0.1444	2.1143	1.2400	1.2014	0.0386
	7	0.1891	1.5814	0.9347	0.9687	0.9905	0.1435	2.1511	1.2400	1.1933	0.0467
	8	0.1763	1.5325	0.8972	0.9061	0.9172	0.1515	2.0752	1.2400	1.2109	0.0291
	9	0.1906	1.5392	0.8945	0.9403	0.9355	0.1503	2.0988	1.2100	1.2011	0.0089
	10	0.2187	1.6111	0.9750	1.0275	1.0034	0.1509	2.2170	1.2400	1.2073	0.0327
Mean		0.2032	1.6115	0.9753	1.0169	1.0086	0.1490	2.1972	1.2320	1.1968	0.0352
StdDev		0.0156	0.0577	0.0660	0.0770	0.0728	0.0035	0.0973	0.0155	0.0121	0.0120
Min		0.1763	1.5325	0.8945	0.9061	0.9172	0.1435	2.0752	1.2000	1.1733	0.0089
Max		0.2247	1.7179	1.0803	1.1358	1.1344	0.1555	2.3649	1.2500	1.2109	0.0478
95% C.I. MOE (+/-)		0.0112	0.0413	0.0472	0.0551	0.0521	0.0025	0.0696	0.0111	0.0086	0.0086
95% C.I. Upper Limit		0.2144	1.6528	1.0225	1.0720	1.0607	0.1514	2.2668	1.2431	1.2055	0.0437
95% C.I. Lower Limit		0.1921	1.5702	0.9281	0.9618	0.9565	0.1465	2.1276	1.2209	1.1882	0.0266
95% P.I. MOE (+/-)		0.0370	0.1370	0.1566	0.1827	0.1728	0.0082	0.2308	0.0368	0.0287	0.0284
95% P.I. Upper Limit		0.2403	1.7485	1.1319	1.1996	1.1813	0.1572	2.4279	1.2688	1.2255	0.0636
95% P.I. Lower Limit		0.1662	1.4745	0.8187	0.8342	0.8358	0.1407	1.9664	1.1952	1.1681	0.0067

Table 102. SAE Test Drive 12, 30 m, Gauge (Measurement System) Repeatability

SAE Test Drive 12, Preceding Path 3, 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.6045	0.6175	0.4124	0.4583	0.4342	0.3911	1.8716	1.2200	1.1733	0.0467
	2	0.5508	0.5775	0.4161	0.4548	0.4399	0.3977	1.6811	1.2500	1.2026	0.0474
	3	0.5453	0.6194	0.4197	0.4518	0.4390	0.3955	1.8817	1.2500	1.1892	0.0608
	4	0.5245	0.6249	0.4245	0.4354	0.4343	0.3856	1.9156	1.2600	1.2067	0.0533
	5	0.5718	0.5999	0.4280	0.4214	0.4419	0.3930	1.8046	1.2400	1.1822	0.0578
	6	0.5799	0.6097	0.4220	0.4334	0.4263	0.3962	1.8287	1.2600	1.2014	0.0586
	7	0.6012	0.5398	0.4166	0.4151	0.4301	0.3980	1.5046	1.2500	1.1933	0.0567
	8	0.5698	0.5926	0.4192	0.4540	0.4418	0.4011	1.7965	1.2800	1.2109	0.0691
	9	0.5750	0.6035	0.4237	0.4567	0.4566	0.4037	1.8343	1.2600	1.2011	0.0589
	10	0.6085	0.6052	0.4251	0.4838	0.4528	0.3911	1.8864	1.2500	1.2073	0.0427
Mean		0.5731	0.5990	0.4207	0.4465	0.4397	0.3953	1.8005	1.2520	1.1968	0.0552
StdDev		0.0273	0.0250	0.0048	0.0203	0.0094	0.0053	0.1230	0.0155	0.0121	0.0078
Min		0.5245	0.5398	0.4124	0.4151	0.4263	0.3856	1.5046	1.2200	1.1733	0.0427
Max		0.6085	0.6249	0.4280	0.4838	0.4566	0.4037	1.9156	1.2800	1.2109	0.0691
95% C.I. MOE (+/-)		0.0196	0.0179	0.0034	0.0145	0.0067	0.0038	0.0880	0.0111	0.0086	0.0056
95% C.I. Upper Limit		0.5927	0.6169	0.4241	0.4610	0.4465	0.3991	1.8885	1.2631	1.2055	0.0608
95% C.I. Lower Limit		0.5536	0.5811	0.4173	0.4320	0.4330	0.3915	1.7126	1.2409	1.1882	0.0496
95% P.I. MOE (+/-)		0.0648	0.0592	0.0113	0.0481	0.0223	0.0125	0.2917	0.0368	0.0287	0.0186
95% P.I. Upper Limit		0.6380	0.6582	0.4321	0.4946	0.4621	0.4078	2.0923	1.2888	1.2255	0.0737
95% P.I. Lower Limit		0.5083	0.5398	0.4094	0.3984	0.4174	0.3828	1.5088	1.2152	1.1681	0.0366

3.6 SAE Test Procedure - Repeatability of Test Results

To assess the repeatability of results for the SAE test procedure, the full test procedure was run once each night for 10 nights. The same procedures described for the NHTSA test procedure were used to evaluate the repeatability of the SAE test procedure. The repeatability results of the test procedure generally replicated the SAE gauge repeatability results. Standard deviations for SAE test drives 1 and 2 were 0.0380 lux or less. More specifically, for the 155 m measurement distance, all standard deviations were 0.0141 lux or less. For the 120 m measurement distance, all standard deviations were 0.0132 lux or less. For the 60 m measurement distance, all standard deviations were 0.0219 lux or less. For the 30 m measurement distance, all standard deviations were 0.0380 lux or less.

Standard deviations were higher for SAE test drive 3. More specifically, for the 155 m measurement distance, all standard deviations were 0.1234 lux or less. For the 120 m measurement distance, all standard deviations were 0.1489 lux or less. For the 60 m measurement distance, all standard deviations were 0.2464 lux or less. For the 30 m measurement distance, all standard deviations were 0.0413 lux or less.

For SAE test drives 10 and 11 at the 155 m measurement distance, all standard deviations were 0.0338 lux or less. More specifically, for the 155 m measurement distance, all standard deviations were 0.0228 lux or less. For the 120 m measurement distance, all standard deviations were 0.0231 lux or less. For the 60 m measurement distance, all standard deviations were 0.0226 lux or less. For the 30 m measurement distance, all standard deviations were 0.0338 lux or less.

Standard deviations were higher for SAE test drive 12. More specifically, for the 155 m measurement distance, all standard deviations were 0.1436 lux or less. For the 120 m measurement distance, all standard deviations were 0.1909 lux or less. For the 60 m measurement distance, all standard deviations were 0.3020 lux or less. For the 30 m measurement distance, all standard deviations were 0.3503 lux or less.

Prediction interval margins of error for SAE test drive 1 and SAE test drive 2 were +/- 0.0902 lux or less. More specifically, for the 155 m measurement distance, all prediction interval margins of error were +/- 0.0336 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.0314 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.0519 lux or less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.0902 lux or less.

SAE Test 3 had higher prediction interval margins of error. More specifically, for the 155 m measurement distance, all prediction interval margins of error were +/- 0.2928 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.3532 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.5845 lux or less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.0981 lux or less.

For SAE test drives 10 and 11 at the 155 m measurement distance, all prediction interval margins of error were +/- 0.0809 lux or less. More specifically, for the 155 m measurement distance, all prediction interval margins of error were +/- 0.0542 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.0549 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.0535 lux or

less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.0809 lux or less.

SAE test drive 12 had higher prediction interval margins of error than test drives 10 and 11. More specifically, for the 155 m measurement distance, all prediction interval margins of error were +/- 0.3407 lux or less. For the 120 m measurement distance, all prediction interval margins of error were +/- 0.4529 lux or less. For the 60 m measurement distance, all prediction interval margins of error were +/- 0.7164 lux or less. For the 30 m measurement distance, all prediction interval margins of error were +/- 0.8310 lux or less.

In order to further investigate the repeatability of the SAE test procedure, the repeatability of the maximum pitch measured during the test procedure was assessed. Pitch standard deviations were low for all test scenarios. The maximum pitch values for all test scenarios did not vary from the mean by more than 0.054 degrees. The difference values between the maximum pitch and average pitch did not vary from the mean by more than 0.041 degrees.

Tables 103 to 126 provide the results of from testing of the SAE J3069 test procedure.

Table 103. SAE Test Drive 1, 155 m, Test Procedure Repeatability

SAE Test Drive 1, Oncoming Path 1, 155 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0173	0.0598	0.0281	1.2800	1.1989	0.0811
	2	0.0354	0.0213	0.0297	1.3400	1.2327	0.1073
	3	0.0334	0.0211	0.0240	1.3400	1.1975	0.1425
	4	0.0376	0.0285	0.0351	1.3700	1.2511	0.1189
	5	0.0324	0.0297	0.0286	1.2900	1.1905	0.0995
	6	0.0410	0.0301	0.0409	1.2600	1.1783	0.0817
	7	0.0390	0.0227	0.0316	1.2900	1.1812	0.1088
	8	0.0248	0.0538	0.0267	1.3500	1.2089	0.1411
	9	0.0300	0.0190	0.0319	1.3000	1.1880	0.1120
	10	0.0320	0.0384	0.0238	1.2900	1.1985	0.0915
Mean		0.0323	0.0324	0.0300	1.3110	1.2026	0.1084
StdDev		0.0070	0.0141	0.0052	0.0360	0.0230	0.0215
Min		0.0173	0.0190	0.0238	1.2600	1.1783	0.0811
Max		0.0410	0.0598	0.0409	1.3700	1.2511	0.1425
95% C.I. MOE (+/-)		0.0037	0.0050	0.0101	0.0258	0.0165	0.0154
95% C.I. Upper Limit		0.0373	0.0426	0.0337	1.3368	1.2190	0.1238
95% C.I. Lower Limit		0.0272	0.0223	0.0263	1.2852	1.1861	0.0930
95% P.I. MOE (+/-)		0.0167	0.0336	0.0123	0.0855	0.0546	0.0511
95% P.I. Upper Limit		0.0490	0.0660	0.0424	1.3965	1.2572	0.1596
95% P.I. Lower Limit		0.0156	-0.0011	0.0177	1.2255	1.1480	0.0573

Table 104. SAE Test Drive 1, 120 m, Test Procedure Repeatability

SAE Test Drive 1, Oncoming Path 1, 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0438	0.0309	0.0332	1.2500	1.1989	0.0511
	2	0.0604	0.0313	0.0430	1.2800	1.2327	0.0473
	3	0.0567	0.0428	0.0339	1.2300	1.1975	0.0325
	4	0.0344	0.0484	0.0462	1.3000	1.2511	0.0489
	5	0.0447	0.0661	0.0502	1.2400	1.1905	0.0495
	6	0.0531	0.0610	0.0429	1.2400	1.1783	0.0617
	7	0.0378	0.0517	0.0389	1.2100	1.1812	0.0288
	8	0.0642	0.0460	0.0435	1.2700	1.2089	0.0611
	9	0.0513	0.0673	0.0361	1.2600	1.1880	0.0720
	10	0.0390	0.0387	0.0531	1.2700	1.1985	0.0715
Mean		0.0485	0.0484	0.0421	1.2550	1.2026	0.0524
StdDev		0.0101	0.0132	0.0067	0.0264	0.0230	0.0146
Min		0.0344	0.0309	0.0332	1.2100	1.1783	0.0288
Max		0.0642	0.0673	0.0531	1.3000	1.2511	0.0720
95% C.I. MOE (+/-)		0.0048	0.0073	0.0095	0.0189	0.0165	0.0104
95% C.I. Upper Limit		0.0558	0.0579	0.0469	1.2739	1.2190	0.0629
95% C.I. Lower Limit		0.0413	0.0390	0.0373	1.2362	1.1861	0.0420
95% P.I. MOE (+/-)		0.0241	0.0314	0.0158	0.0625	0.0546	0.0346
95% P.I. Upper Limit		0.0726	0.0798	0.0579	1.3175	1.2572	0.0870
95% P.I. Lower Limit		0.0245	0.0170	0.0263	1.1925	1.1480	0.0178

Table 105. SAE Test Drive 1, 60 m, Test Procedure Repeatability

SAE Test Drive 1, Oncoming Path 1, 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1557	0.1386	0.1592	1.2500	1.1989	0.0511
	2	0.1552	0.1397	0.1662	1.3000	1.2327	0.0673
	3	0.1581	0.1399	0.1749	1.2500	1.1975	0.0525
	4	0.1601	0.1092	0.1596	1.3100	1.2511	0.0589
	5	0.1902	0.1541	0.2023	1.2700	1.1905	0.0795
	6	0.1748	0.1524	0.1824	1.2600	1.1783	0.0817
	7	0.1728	0.1312	0.1775	1.2400	1.1812	0.0588
	8	0.1449	0.1395	0.1640	1.2500	1.2089	0.0411
	9	0.1404	0.1459	0.1720	1.2700	1.1880	0.0820
	10	0.1652	0.1398	0.1645	1.2600	1.1985	0.0615
Mean		0.1617	0.1390	0.1723	1.2660	1.2026	0.0634
StdDev		0.0147	0.0125	0.0131	0.0227	0.0230	0.0140
Min		0.1404	0.1092	0.1592	1.2400	1.1783	0.0411
Max		0.1902	0.1541	0.2023	1.3100	1.2511	0.0820
95% C.I. MOE (+/-)		0.0093	0.0105	0.0089	0.0162	0.0165	0.0100
95% C.I. Upper Limit		0.1723	0.1480	0.1816	1.2822	1.2190	0.0735
95% C.I. Lower Limit		0.1512	0.1301	0.1629	1.2498	1.1861	0.0534
95% P.I. MOE (+/-)		0.0349	0.0297	0.0310	0.0539	0.0546	0.0333
95% P.I. Upper Limit		0.1966	0.1687	0.2033	1.3199	1.2572	0.0967
95% P.I. Lower Limit		0.1268	0.1094	0.1413	1.2121	1.1480	0.0301

Table 106. SAE Test Drive 1, 30 m, Test Procedure Repeatability

SAE Test Drive 1, Oncoming Path 1, 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.4562	0.4150	0.4294	1.2500	1.1989	0.0511
	2	0.4556	0.3965	0.4356	1.3000	1.2327	0.0673
	3	0.4839	0.4372	0.4500	1.2600	1.1975	0.0625
	4	0.4567	0.3995	0.4177	1.3100	1.2511	0.0589
	5	0.4973	0.4403	0.4605	1.2800	1.1905	0.0895
	6	0.4888	0.4114	0.4638	1.2600	1.1783	0.0817
	7	0.4706	0.4478	0.4426	1.2400	1.1812	0.0588
	8	0.4671	0.4408	0.4406	1.2500	1.2089	0.0411
	9	0.4940	0.4350	0.4548	1.2700	1.1880	0.0820
	10	0.4390	0.4337	0.4438	1.2700	1.1985	0.0715
Mean		0.4709	0.4257	0.4439	1.2690	1.2026	0.0664
StdDev		0.0195	0.0185	0.0142	0.0223	0.0230	0.0151
Min		0.4390	0.3965	0.4177	1.2400	1.1783	0.0411
Max		0.4973	0.4478	0.4638	1.3100	1.2511	0.0895
95% C.I. MOE (+/-)		0.0101	0.0139	0.0132	0.0160	0.0165	0.0108
95% C.I. Upper Limit		0.4849	0.4389	0.4540	1.2850	1.2190	0.0772
95% C.I. Lower Limit		0.4570	0.4125	0.4337	1.2530	1.1861	0.0556
95% P.I. MOE (+/-)		0.0461	0.0438	0.0336	0.0530	0.0546	0.0358
95% P.I. Upper Limit		0.5171	0.4696	0.4775	1.3220	1.2572	0.1022
95% P.I. Lower Limit		0.4248	0.3819	0.4103	1.2160	1.1480	0.0307

Table 107. SAE Test Drive 2, 155 m, Test Procedure Repeatability

SAE Test Drive 2, Oncoming Path 2, 155 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0239	0.0301	0.0375	1.3100	1.2245	0.0855
	2	0.0150	0.0315	0.0362	1.3900	1.2030	0.1870
	3	0.0429	0.0430	0.0345	1.3200	1.2119	0.1081
	4	0.0412	0.0037	0.0288	1.4100	1.2447	0.1653
	5	0.0454	0.0466	0.0301	1.2900	1.1704	0.1196
	6	0.0289	0.0506	0.0282	1.2700	1.1751	0.0949
	7	0.0366	0.0269	0.0241	1.3300	1.1815	0.1485
	8	0.0438	0.0246	0.0305	1.2400	1.1820	0.0580
	9	0.0245	0.0359	0.0219	1.2700	1.1939	0.0761
	10	0.0322	0.0452	0.0303	1.3100	1.1995	0.1105
Mean		0.0334	0.0338	0.0302	1.3140	1.1986	0.1154
StdDev		0.0102	0.0138	0.0049	0.0530	0.0234	0.0408
Min		0.0150	0.0037	0.0219	1.2400	1.1704	0.0580
Max		0.0454	0.0506	0.0375	1.4100	1.2447	0.1870
95% C.I. MOE (+/-)		0.0035	0.0073	0.0099	0.0379	0.0167	0.0292
95% C.I. Upper Limit		0.0408	0.0437	0.0337	1.3519	1.2154	0.1445
95% C.I. Lower Limit		0.0261	0.0239	0.0267	1.2761	1.1819	0.0862
95% P.I. MOE (+/-)		0.0243	0.0329	0.0117	0.1256	0.0555	0.0967
95% P.I. Upper Limit		0.0577	0.0667	0.0419	1.4396	1.2542	0.2121
95% P.I. Lower Limit		0.0092	0.0010	0.0185	1.1884	1.1431	0.0186

Table 108. SAE Test Drive 2, 120 m, Test Procedure Repeatability

SAE Test Drive 2, Oncoming Path 2, 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0411	0.0499	0.0372	1.3800	1.2245	0.1555
	2	0.0556	0.0487	0.0448	1.3300	1.2030	0.1270
	3	0.0725	0.0441	0.0445	1.3500	1.2119	0.1381
	4	0.0570	0.0362	0.0494	1.3900	1.2447	0.1453
	5	0.0640	0.0663	0.0549	1.2800	1.1704	0.1096
	6	0.0516	0.0598	0.0504	1.2900	1.1751	0.1149
	7	0.0768	0.0567	0.0533	1.2900	1.1815	0.1085
	8	0.0562	0.0550	0.0463	1.3300	1.1820	0.1480
	9	0.0865	0.0541	0.0454	1.3400	1.1939	0.1461
	10	0.0619	0.0550	0.0472	1.3400	1.1995	0.1405
Mean		0.0623	0.0526	0.0473	1.3320	1.1986	0.1334
StdDev		0.0132	0.0084	0.0050	0.0371	0.0234	0.0172
Min		0.0411	0.0362	0.0372	1.2800	1.1704	0.1085
Max		0.0865	0.0663	0.0549	1.3900	1.2447	0.1555
95% C.I. MOE (+/-)		0.0036	0.0095	0.0060	0.0265	0.0167	0.0123
95% C.I. Upper Limit		0.0718	0.0586	0.0509	1.3585	1.2154	0.1456
95% C.I. Lower Limit		0.0529	0.0466	0.0437	1.3055	1.1819	0.1211
95% P.I. MOE (+/-)		0.0314	0.0199	0.0119	0.0879	0.0555	0.0407
95% P.I. Upper Limit		0.0937	0.0725	0.0593	1.4199	1.2542	0.1740
95% P.I. Lower Limit		0.0309	0.0326	0.0354	1.2441	1.1431	0.0927

Table 109. SAE Test Drive 2, 60 m, Test Procedure Repeatability

SAE Test Drive 2, Oncoming Path 2, 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1627	0.1930	0.1861	1.2800	1.2245	0.0555
	2	0.2088	0.2053	0.1882	1.2600	1.2030	0.0570
	3	0.2156	0.1914	0.1987	1.2600	1.2119	0.0481
	4	0.1807	0.1990	0.1843	1.3000	1.2447	0.0553
	5	0.2230	0.2118	0.2200	1.2500	1.1704	0.0796
	6	0.2210	0.1968	0.1944	1.2400	1.1751	0.0649
	7	0.2038	0.1766	0.2017	1.2200	1.1815	0.0385
	8	0.1868	0.1939	0.1944	1.2400	1.1820	0.0580
	9	0.2278	0.1957	0.1912	1.2400	1.1939	0.0461
	10	0.1824	0.1843	0.1959	1.2600	1.1995	0.0605
Mean		0.2013	0.1948	0.1955	1.2550	1.1986	0.0564
StdDev		0.0219	0.0099	0.0102	0.0227	0.0234	0.0112
Min		0.1627	0.1766	0.1843	1.2200	1.1704	0.0385
Max		0.2278	0.2118	0.2200	1.3000	1.2447	0.0796
95% C.I. MOE (+/-)		0.0073	0.0156	0.0071	0.0163	0.0167	0.0080
95% C.I. Upper Limit		0.2169	0.2019	0.2028	1.2713	1.2154	0.0644
95% C.I. Lower Limit		0.1856	0.1877	0.1882	1.2387	1.1819	0.0483
95% P.I. MOE (+/-)		0.0519	0.0234	0.0242	0.0539	0.0555	0.0266
95% P.I. Upper Limit		0.2532	0.2182	0.2197	1.3089	1.2542	0.0829
95% P.I. Lower Limit		0.1493	0.1713	0.1713	1.2011	1.1431	0.0298

Table 110. SAE Test Drive 2, 30 m, Test Procedure Repeatability

SAE Test Drive 2, Oncoming Path 2, 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.5981	0.6070	0.8317	1.2900	1.2245	0.0655
	2	0.6668	0.6330	0.8521	1.2500	1.2030	0.0470
	3	0.6875	0.6237	0.9036	1.3000	1.2119	0.0881
	4	0.6302	0.6025	0.8295	1.3100	1.2447	0.0653
	5	0.7033	0.6813	0.9442	1.2500	1.1704	0.0796
	6	0.6898	0.6628	0.9163	1.2600	1.1751	0.0849
	7	0.6463	0.6285	0.8714	1.2400	1.1815	0.0585
	8	0.6432	0.6060	0.8470	1.2500	1.1820	0.0680
	9	0.6647	0.6438	0.8853	1.2200	1.1939	0.0261
	10	0.6438	0.6260	0.8562	1.2800	1.1995	0.0805
Mean		0.6574	0.6315	0.8737	1.2650	1.1986	0.0664
StdDev		0.0316	0.0254	0.0380	0.0288	0.0234	0.0190
Min		0.5981	0.6025	0.8295	1.2200	1.1704	0.0261
Max		0.7033	0.6813	0.9442	1.3100	1.2447	0.0881
95% C.I. MOE (+/-)		0.0272	0.0226	0.0182	0.0206	0.0167	0.0136
95% C.I. Upper Limit		0.6800	0.6496	0.9010	1.2856	1.2154	0.0800
95% C.I. Lower Limit		0.6348	0.6133	0.8465	1.2444	1.1819	0.0528
95% P.I. MOE (+/-)		0.0749	0.0602	0.0902	0.0683	0.0555	0.0451
95% P.I. Upper Limit		0.7322	0.6917	0.9640	1.3333	1.2542	0.1115
95% P.I. Lower Limit		0.5825	0.5712	0.7835	1.1967	1.1431	0.0213

Table 111. SAE Test Drive 3, 155 m, Test Procedure Repeatability

SAE Test Drive 3, Oncoming Path 3, 155 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0412	0.3309	0.2191	1.2800	1.2055	0.0745
	2	0.0407	0.3455	0.2333	1.2800	1.2157	0.0643
	3	0.0678	0.5953	0.4623	1.2800	1.1954	0.0846
	4	0.0669	0.5193	0.4101	1.2800	1.2080	0.0720
	5	0.0705	0.5620	0.3820	1.2700	1.1664	0.1036
	6	0.0707	0.5617	0.4313	1.2100	1.1695	0.0405
	7	0.1083	0.7057	0.5501	1.2600	1.1593	0.1007
	8	0.0539	0.4485	0.2905	1.2600	1.1772	0.0828
	9	0.0905	0.6698	0.5202	1.2400	1.1748	0.0652
	10	0.0654	0.5224	0.4428	1.2600	1.1784	0.0816
Mean		0.0676	0.5261	0.3942	1.2620	1.1850	0.0770
StdDev		0.0206	0.1234	0.1137	0.0225	0.0196	0.0184
Min		0.0407	0.3309	0.2191	1.2100	1.1593	0.0405
Max		0.1083	0.7057	0.5501	1.2800	1.2157	0.1036
95% C.I. MOE (+/-)		0.0147	0.0883	0.0813	0.0161	0.0140	0.0132
95% C.I. Upper Limit		0.0823	0.6144	0.4755	1.2781	1.1990	0.0901
95% C.I. Lower Limit		0.0529	0.4378	0.3129	1.2459	1.1710	0.0638
95% P.I. MOE (+/-)		0.0488	0.2928	0.2696	0.0534	0.0465	0.0436
95% P.I. Upper Limit		0.1164	0.8189	0.6638	1.3154	1.2315	0.1206
95% P.I. Lower Limit		0.0188	0.2334	0.1245	1.2086	1.1385	0.0333

Table 112. SAE Test Drive 3, 120 m, Test Procedure Repeatability

SAE Test Drive 3, Oncoming Path 3, 120 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0476	0.3071	0.1532	1.3500	1.2055	0.1445
	2	0.0548	0.2669	0.1411	1.3100	1.2157	0.0943
	3	0.0691	0.5507	0.3522	1.3200	1.1954	0.1246
	4	0.0546	0.3276	0.1789	1.3100	1.2080	0.1020
	5	0.1092	0.7286	0.5617	1.2700	1.1664	0.1036
	6	0.0646	0.5492	0.3820	1.2700	1.1695	0.1005
	7	0.0701	0.4482	0.2693	1.2500	1.1593	0.0907
	8	0.0572	0.3472	0.2059	1.3000	1.1772	0.1228
	9	0.0633	0.5995	0.4296	1.2600	1.1748	0.0852
	10	0.0571	0.4844	0.2882	1.2700	1.1784	0.0916
Mean		0.0648	0.4609	0.2962	1.2910	1.1850	0.1060
StdDev		0.0171	0.1489	0.1358	0.0318	0.0196	0.0188
Min		0.0476	0.2669	0.1411	1.2500	1.1593	0.0852
Max		0.1092	0.7286	0.5617	1.3500	1.2157	0.1445
95% C.I. MOE (+/-)		0.0122	0.1065	0.0971	0.0227	0.0140	0.0134
95% C.I. Upper Limit		0.0770	0.5674	0.3934	1.3137	1.1990	0.1194
95% C.I. Lower Limit		0.0525	0.3544	0.1991	1.2683	1.1710	0.0925
95% P.I. MOE (+/-)		0.0406	0.3532	0.3222	0.0754	0.0465	0.0446
95% P.I. Upper Limit		0.1054	0.8141	0.6184	1.3664	1.2315	0.1505
95% P.I. Lower Limit		0.0241	0.1077	-0.0260	1.2156	1.1385	0.0614

Table 113. SAE Test Drive 3, 60 m, Test Procedure Repeatability

SAE Test Drive 3, Oncoming Path 3, 60 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.6735	0.2757	0.1554	1.2000	1.2055	0.0055
	2	0.9789	0.4667	0.1680	1.2600	1.2157	0.0443
	3	1.0401	0.5219	0.1709	1.2100	1.1954	0.0146
	4	1.0717	0.5591	0.1615	1.2700	1.2080	0.0620
	5	1.4695	0.9063	0.1775	1.2100	1.1664	0.0436
	6	1.3068	0.7631	0.1690	1.2200	1.1695	0.0505
	7	1.1854	0.6156	0.1590	1.1900	1.1593	0.0307
	8	0.8337	0.3381	0.1626	1.2000	1.1772	0.0228
	9	1.3728	0.8290	0.1865	1.2200	1.1748	0.0452
	10	0.9810	0.4907	0.1571	1.1900	1.1784	0.0116
Mean		1.0913	0.5766	0.1668	1.2170	1.1850	0.0331
StdDev		0.2464	0.2052	0.0098	0.0275	0.0196	0.0189
Min		0.6735	0.2757	0.1554	1.1900	1.1593	0.0055
Max		1.4695	0.9063	0.1865	1.2700	1.2157	0.0620
95% C.I. MOE (+/-)		0.0070	0.1762	0.1468	0.0197	0.0140	0.0135
95% C.I. Upper Limit		1.2676	0.7234	0.1737	1.2367	1.1990	0.0466
95% C.I. Lower Limit		0.9151	0.4298	0.1598	1.1973	1.1710	0.0196
95% P.I. MOE (+/-)		0.5845	0.4868	0.0231	0.0653	0.0465	0.0447
95% P.I. Upper Limit		1.6758	1.0635	0.1899	1.2823	1.2315	0.0778
95% P.I. Lower Limit		0.5069	0.0898	0.1436	1.1517	1.1385	-0.0117

Table 114. SAE Test Drive 3, 30 m, Test Procedure Repeatability

SAE Test Drive 3, Oncoming Path 3, 30 m							
Descriptive Statistic	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.3998	0.3915	0.4358	1.2700	1.2055	0.0645
	2	0.4148	0.4180	0.4460	1.2900	1.2157	0.0743
	3	0.4872	0.4295	0.4607	1.2400	1.1954	0.0446
	4	0.4317	0.3731	0.4487	1.2800	1.2080	0.0720
	5	0.5402	0.4788	0.5433	1.2100	1.1664	0.0436
	6	0.4730	0.4407	0.4668	1.2400	1.1695	0.0705
	7	0.4556	0.4137	0.4563	1.2400	1.1593	0.0807
	8	0.4232	0.3973	0.4459	1.2200	1.1772	0.0428
	9	0.4730	0.4272	0.4665	1.2200	1.1748	0.0452
	10	0.4393	0.4035	0.4462	1.2400	1.1784	0.0616
Mean		0.4538	0.4173	0.4616	1.2450	1.1850	0.0600
StdDev		0.0413	0.0295	0.0304	0.0268	0.0196	0.0146
Min		0.3998	0.3731	0.4358	1.2100	1.1593	0.0428
Max		0.5402	0.4788	0.5433	1.2900	1.2157	0.0807
95% C.I. MOE (+/-)		0.0217	0.0296	0.0211	0.0191	0.0140	0.0105
95% C.I. Upper Limit		0.4834	0.4384	0.4833	1.2641	1.1990	0.0704
95% C.I. Lower Limit		0.4242	0.3963	0.4399	1.2259	1.1710	0.0495
95% P.I. MOE (+/-)		0.0981	0.0699	0.0721	0.0635	0.0465	0.0347
95% P.I. Upper Limit		0.5519	0.4872	0.5337	1.3085	1.2315	0.0947
95% P.I. Lower Limit		0.3557	0.3474	0.3896	1.1815	1.1385	0.0252

Table 115. SAE Test Drive 10, 155 m, Test Procedure Repeatability

SAE Test Drive 10, Preceding Path 1, 155 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0456	0.0402	0.0274	0.0129	0.0448	0.0231	0.0352	1.2800	1.1989	0.0811
	2	0.0153	0.0455	0.0232	0.0380	0.0217	0.0171	0.0257	1.3400	1.2327	0.1073
	3	0.0456	0.0324	0.0353	0.0440	0.0424	0.0378	0.0303	1.3400	1.1975	0.1425
	4	0.0433	0.0380	0.0278	0.0458	0.0282	0.0310	0.0283	1.3700	1.2511	0.1189
	5	0.0214	0.0288	0.0368	0.0587	0.0344	0.0385	0.0394	1.2900	1.1905	0.0995
	6	0.0386	0.0342	0.0357	0.0367	0.0475	0.0282	0.0348	1.2600	1.1783	0.0817
	7	0.0406	0.0363	0.0353	0.0303	0.0240	0.0285	0.0343	1.2900	1.1812	0.1088
	8	0.0088	0.0177	0.0280	0.0253	0.0229	0.0325	0.0372	1.3500	1.2089	0.1411
	9	0.0424	0.0244	0.0315	0.0457	0.0389	0.0277	0.0351	1.3000	1.1880	0.1120
	10	0.0485	0.0376	0.0244	0.0486	0.0479	0.0297	0.0286	1.2900	1.1985	0.0915
Mean		0.0350	0.0335	0.0305	0.0386	0.0353	0.0294	0.0329	1.3110	1.2026	0.1084
StdDev		0.0143	0.0081	0.0050	0.0131	0.0104	0.0063	0.0044	0.0360	0.0230	0.0215
Min		0.0088	0.0177	0.0232	0.0129	0.0217	0.0171	0.0257	1.2600	1.1783	0.0811
Max		0.0485	0.0455	0.0368	0.0587	0.0479	0.0385	0.0394	1.3700	1.2511	0.1425
95% C.I. MOE (+/-)		0.0102	0.0058	0.0036	0.0094	0.0074	0.0045	0.0032	0.0258	0.0165	0.0154
95% C.I. Upper Limit		0.0452	0.0393	0.0341	0.0480	0.0427	0.0339	0.0361	1.3368	1.2190	0.1238
95% C.I. Lower Limit		0.0248	0.0277	0.0270	0.0292	0.0278	0.0249	0.0297	1.2852	1.1861	0.0930
95% P.I. MOE (+/-)		0.0338	0.0193	0.0119	0.0311	0.0247	0.0150	0.0105	0.0855	0.0546	0.0511
95% P.I. Upper Limit		0.0689	0.0528	0.0424	0.0697	0.0600	0.0444	0.0434	1.3965	1.2572	0.1596
95% P.I. Lower Limit		0.0012	0.0142	0.0186	0.0075	0.0106	0.0144	0.0224	1.2255	1.1480	0.0573

Table 116. SAE Test Drive 10, 120 m, Test Procedure Repeatability

SAE Test Drive 10, Preceding Path 1, 120 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0310	0.0460	0.0507	0.0312	0.0489	0.0419	0.0634	1.2500	1.1989	0.0511
	2	0.0682	0.0445	0.0565	0.0349	0.0702	0.0428	0.0391	1.2800	1.2327	0.0473
	3	0.0277	0.0519	0.0455	0.0546	0.0644	0.0443	0.0377	1.2300	1.1975	0.0325
	4	0.0520	0.0546	0.0531	0.0501	0.0506	0.0443	0.0569	1.3000	1.2511	0.0489
	5	0.0690	0.0531	0.0543	0.0482	0.0573	0.0490	0.0223	1.2400	1.1905	0.0495
	6	0.0562	0.0645	0.0515	0.0376	0.0487	0.0469	0.0571	1.2400	1.1783	0.0617
	7	0.0197	0.0551	0.0464	0.0420	0.0374	0.0433	0.0421	1.2100	1.1812	0.0288
	8	0.0221	0.0548	0.0530	0.0276	0.0433	0.0456	0.0551	1.2700	1.2089	0.0611
	9	0.0831	0.0597	0.0490	0.0733	0.0490	0.0370	0.0629	1.2600	1.1880	0.0720
	10	0.0244	0.0528	0.0441	0.0379	0.0493	0.0414	0.0386	1.2700	1.1985	0.0715
Mean		0.0453	0.0537	0.0504	0.0437	0.0519	0.0436	0.0475	1.2550	1.2026	0.0524
StdDev		0.0231	0.0058	0.0041	0.0134	0.0097	0.0033	0.0135	0.0264	0.0230	0.0146
Min		0.0197	0.0445	0.0441	0.0276	0.0374	0.0370	0.0223	1.2100	1.1783	0.0288
Max		0.0831	0.0645	0.0565	0.0733	0.0702	0.0490	0.0634	1.3000	1.2511	0.0720
95% C.I. MOE (+/-)		0.0166	0.0042	0.0029	0.0096	0.0069	0.0023	0.0096	0.0189	0.0165	0.0104
95% C.I. Upper Limit		0.0619	0.0579	0.0533	0.0534	0.0588	0.0460	0.0572	1.2739	1.2190	0.0629
95% C.I. Lower Limit		0.0288	0.0495	0.0475	0.0341	0.0450	0.0413	0.0379	1.2362	1.1861	0.0420
95% P.I. MOE (+/-)		0.0549	0.0138	0.0096	0.0319	0.0230	0.0078	0.0320	0.0625	0.0546	0.0346
95% P.I. Upper Limit		0.1002	0.0675	0.0600	0.0756	0.0749	0.0514	0.0795	1.3175	1.2572	0.0870
95% P.I. Lower Limit		-0.0096	0.0399	0.0408	0.0119	0.0290	0.0359	0.0155	1.1925	1.1480	0.0178

Table 117. SAE Test Drive 10, 60 m, Test Procedure Repeatability

SAE Test Drive 10, Preceding Path 1, 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1402	0.1691	0.1604	0.1598	0.1625	0.1472	0.1575	1.2500	1.1989	0.0511
	2	0.1580	0.1728	0.1503	0.1510	0.1461	0.1495	0.1505	1.3000	1.2327	0.0673
	3	0.1612	0.1826	0.1614	0.1636	0.1584	0.1422	0.1796	1.2500	1.1975	0.0525
	4	0.1446	0.1745	0.1535	0.1359	0.1572	0.1444	0.1681	1.3100	1.2511	0.0589
	5	0.1724	0.1949	0.1735	0.1949	0.1785	0.1698	0.1817	1.2700	1.1905	0.0795
	6	0.1496	0.1878	0.1608	0.1545	0.1607	0.1584	0.1697	1.2600	1.1783	0.0817
	7	0.1421	0.1750	0.1530	0.1447	0.1484	0.1453	0.1602	1.2400	1.1812	0.0588
	8	0.1433	0.1685	0.1491	0.1600	0.1413	0.1464	0.1558	1.2500	1.2089	0.0411
	9	0.1366	0.1912	0.1694	0.1407	0.1050	0.1451	0.1441	1.2700	1.1880	0.0820
	10	0.1193	0.1694	0.1465	0.1209	0.1606	0.1554	0.1562	1.2600	1.1985	0.0615
Mean		0.1467	0.1786	0.1578	0.1526	0.1519	0.1504	0.1623	1.2660	1.2026	0.0634
StdDev		0.0147	0.0098	0.0089	0.0198	0.0194	0.0085	0.0122	0.0227	0.0230	0.0140
Min		0.1193	0.1685	0.1465	0.1209	0.1050	0.1422	0.1441	1.2400	1.1783	0.0411
Max		0.1724	0.1949	0.1735	0.1949	0.1785	0.1698	0.1817	1.3100	1.2511	0.0820
95% C.I. MOE (+/-)		0.0105	0.0070	0.0064	0.0141	0.0139	0.0061	0.0087	0.0162	0.0165	0.0100
95% C.I. Upper Limit		0.1572	0.1856	0.1641	0.1667	0.1658	0.1564	0.1711	1.2822	1.2190	0.0735
95% C.I. Lower Limit		0.1362	0.1716	0.1514	0.1385	0.1380	0.1443	0.1536	1.2498	1.1861	0.0534
95% P.I. MOE (+/-)		0.0348	0.0232	0.0211	0.0469	0.0461	0.0201	0.0290	0.0539	0.0546	0.0333
95% P.I. Upper Limit		0.1816	0.2018	0.1789	0.1995	0.1980	0.1705	0.1913	1.3199	1.2572	0.0967
95% P.I. Lower Limit		0.1119	0.1553	0.1367	0.1057	0.1058	0.1302	0.1334	1.2121	1.1480	0.0301

Table 118. SAE Test Drive 10, 30 m, Test Procedure Repeatability

SAE Test Drive 10, Preceding Path 1, 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.3670	0.5446	0.4417	0.4002	0.4262	0.4645	0.4490	1.2500	1.1989	0.0511
	2	0.3499	0.5635	0.4417	0.4204	0.3982	0.4561	0.4838	1.3000	1.2327	0.0673
	3	0.3652	0.5979	0.4634	0.4315	0.4516	0.4949	0.4952	1.2600	1.1975	0.0625
	4	0.3671	0.5424	0.4397	0.4339	0.4210	0.4566	0.4846	1.3100	1.2511	0.0589
	5	0.4025	0.6020	0.4697	0.4489	0.4613	0.4863	0.5088	1.2800	1.1905	0.0895
	6	0.3947	0.6137	0.4730	0.4318	0.4427	0.4766	0.4840	1.2600	1.1783	0.0817
	7	0.3733	0.5744	0.4612	0.4507	0.4336	0.4794	0.4923	1.2400	1.1812	0.0588
	8	0.3789	0.5549	0.4610	0.4449	0.4384	0.4908	0.4713	1.2500	1.2089	0.0411
	9	0.3529	0.5806	0.4560	0.4332	0.4510	0.4848	0.4624	1.2700	1.1880	0.0820
	10	0.3707	0.5609	0.4534	0.4160	0.4325	0.4558	0.5066	1.2700	1.1985	0.0715
Mean		0.3722	0.5735	0.4561	0.4311	0.4357	0.4746	0.4838	1.2690	1.2026	0.0664
StdDev		0.0165	0.0247	0.0119	0.0156	0.0180	0.0151	0.0188	0.0223	0.0230	0.0151
Min		0.3499	0.5424	0.4397	0.4002	0.3982	0.4558	0.4490	1.2400	1.1783	0.0411
Max		0.4025	0.6137	0.4730	0.4507	0.4613	0.4949	0.5088	1.3100	1.2511	0.0895
95% C.I. MOE (+/-)		0.0118	0.0177	0.0085	0.0112	0.0129	0.0108	0.0134	0.0160	0.0165	0.0108
95% C.I. Upper Limit		0.3840	0.5912	0.4646	0.4423	0.4486	0.4854	0.4972	1.2850	1.2190	0.0772
95% C.I. Lower Limit		0.3604	0.5558	0.4476	0.4200	0.4228	0.4637	0.4703	1.2530	1.1861	0.0556
95% P.I. MOE (+/-)		0.0391	0.0586	0.0281	0.0371	0.0428	0.0359	0.0446	0.0530	0.0546	0.0358
95% P.I. Upper Limit		0.4113	0.6321	0.4842	0.4682	0.4784	0.5105	0.5283	1.3220	1.2572	0.1022
95% P.I. Lower Limit		0.3331	0.5149	0.4280	0.3940	0.3929	0.4387	0.4392	1.2160	1.1480	0.0307

Table 119. SAE Test Drive 11, 155 m, Test Procedure Repeatability

SAE Test Drive 11, Preceding Path 2,155 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0468	0.0325	0.0285	0.0264	0.0339	0.0306	0.0401	1.3100	1.2245	0.0855
	2	0.0452	0.0398	0.0494	0.0350	0.0513	0.0359	0.0348	1.3900	1.2030	0.1870
	3	0.0681	0.0452	0.0440	0.0403	0.0571	0.0294	0.0268	1.3200	1.2119	0.1081
	4	0.0299	0.0408	0.0252	0.0355	0.0422	0.0260	0.0241	1.4100	1.2447	0.1653
	5	0.0299	0.0462	0.0363	0.0609	0.0384	0.0335	0.0407	1.2900	1.1704	0.1196
	6	0.0632	0.0319	0.0344	0.0335	0.0335	0.0342	0.0439	1.2700	1.1751	0.0949
	7	0.0103	0.0233	0.0326	0.0255	0.0439	0.0308	0.0390	1.3300	1.1815	0.1485
	8	0.0334	0.0259	0.0323	0.0358	0.0434	0.0371	0.0411	1.2400	1.1820	0.0580
	9	-0.0080	0.0256	0.0278	0.0188	0.0175	0.0343	0.0366	1.2700	1.1939	0.0761
	10	0.0279	0.0237	0.0441	0.0289	0.0307	0.0463	0.0416	1.3100	1.1995	0.1105
Mean		0.0347	0.0335	0.0355	0.0341	0.0392	0.0338	0.0369	1.3140	1.1986	0.1154
StdDev		0.0228	0.0089	0.0080	0.0113	0.0112	0.0055	0.0066	0.0530	0.0234	0.0408
Min		-0.0080	0.0233	0.0252	0.0188	0.0175	0.0260	0.0241	1.2400	1.1704	0.0580
Max		0.0681	0.0462	0.0494	0.0609	0.0571	0.0463	0.0439	1.4100	1.2447	0.1870
95% C.I. MOE (+/-)		0.0163	0.0064	0.0057	0.0081	0.0080	0.0039	0.0047	0.0379	0.0167	0.0292
95% C.I. Upper Limit		0.0510	0.0398	0.0412	0.0422	0.0472	0.0377	0.0416	1.3519	1.2154	0.1445
95% C.I. Lower Limit		0.0184	0.0271	0.0298	0.0260	0.0312	0.0299	0.0322	1.2761	1.1819	0.0862
95% P.I. MOE (+/-)		0.0542	0.0211	0.0189	0.0269	0.0265	0.0130	0.0156	0.1256	0.0555	0.0967
95% P.I. Upper Limit		0.0888	0.0546	0.0544	0.0609	0.0657	0.0468	0.0525	1.4396	1.2542	0.2121
95% P.I. Lower Limit		-0.0195	0.0124	0.0165	0.0072	0.0127	0.0208	0.0213	1.1884	1.1431	0.0186

Table 120. SAE Test Drive 11, 120 m, Test Procedure Repeatability

SAE Test Drive 11, Preceding Path 2, 120 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0283	0.0525	0.0574	0.0450	0.0461	0.0407	0.0477	1.3800	1.2245	0.1555
	2	0.0551	0.0629	0.0520	0.0604	0.0618	0.0486	0.0595	1.3300	1.2030	0.1270
	3	0.0400	0.0599	0.0535	0.0618	0.0763	0.0551	0.0618	1.3500	1.2119	0.1381
	4	0.0572	0.0579	0.0558	0.0441	0.0541	0.0580	0.0419	1.3900	1.2447	0.1453
	5	0.0543	0.0592	0.0537	0.0452	0.0648	0.0617	0.0711	1.2800	1.1704	0.1096
	6	0.0661	0.0596	0.0642	0.0548	0.0616	0.0477	0.0606	1.2900	1.1751	0.1149
	7	0.0312	0.0560	0.0554	0.0445	0.0740	0.0541	0.0619	1.2900	1.1815	0.1085
	8	0.0580	0.0621	0.0509	0.0607	0.0496	0.0495	0.0492	1.3300	1.1820	0.1480
	9	0.0861	0.0670	0.0605	0.0402	0.0668	0.0529	0.0467	1.3400	1.1939	0.1461
	10	0.0486	0.0523	0.0496	0.0383	0.0676	0.0396	0.0440	1.3400	1.1995	0.1405
Mean		0.0525	0.0589	0.0553	0.0495	0.0623	0.0508	0.0544	1.3320	1.1986	0.1334
StdDev		0.0170	0.0046	0.0045	0.0090	0.0099	0.0071	0.0097	0.0371	0.0234	0.0172
Min		0.0283	0.0523	0.0496	0.0383	0.0461	0.0396	0.0419	1.2800	1.1704	0.1085
Max		0.0861	0.0670	0.0642	0.0618	0.0763	0.0617	0.0711	1.3900	1.2447	0.1555
95% C.I. MOE (+/-)		0.0121	0.0033	0.0032	0.0064	0.0071	0.0051	0.0069	0.0265	0.0167	0.0123
95% C.I. Upper Limit		0.0646	0.0622	0.0585	0.0559	0.0693	0.0558	0.0614	1.3585	1.2154	0.1456
95% C.I. Lower Limit		0.0404	0.0557	0.0521	0.0431	0.0552	0.0457	0.0475	1.3055	1.1819	0.1211
95% P.I. MOE (+/-)		0.0403	0.0108	0.0106	0.0213	0.0234	0.0168	0.0230	0.0879	0.0555	0.0407
95% P.I. Upper Limit		0.0928	0.0698	0.0659	0.0708	0.0857	0.0676	0.0775	1.4199	1.2542	0.1740
95% P.I. Lower Limit		0.0122	0.0481	0.0447	0.0281	0.0388	0.0340	0.0314	1.2441	1.1431	0.0927

Table 121. SAE Test Drive 11, 60 m, Test Procedure Repeatability

SAE Test Drive 11, Preceding Path 2, 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1604	0.2151	0.1899	0.1681	0.1797	0.1802	0.1913	1.2800	1.2245	0.0555
	2	0.1927	0.2262	0.2009	0.2155	0.2101	0.1885	0.2212	1.2600	1.2030	0.0570
	3	0.1686	0.2374	0.1985	0.1942	0.2150	0.1958	0.2097	1.2600	1.2119	0.0481
	4	0.1336	0.2110	0.1821	0.1812	0.1931	0.1679	0.1939	1.3000	1.2447	0.0553
	5	0.1547	0.2553	0.2197	0.2354	0.2156	0.1965	0.2085	1.2500	1.1704	0.0796
	6	0.1586	0.2385	0.2015	0.2086	0.2117	0.1984	0.2051	1.2400	1.1751	0.0649
	7	0.1548	0.2309	0.1899	0.1653	0.1868	0.1760	0.1673	1.2200	1.1815	0.0385
	8	0.1615	0.2274	0.1827	0.1797	0.1787	0.1828	0.2030	1.2400	1.1820	0.0580
	9	0.1718	0.2383	0.2028	0.2110	0.2054	0.1854	0.2075	1.2400	1.1939	0.0461
	10	0.2079	0.2144	0.1842	0.1878	0.2008	0.1822	0.2091	1.2600	1.1995	0.0605
Mean		0.1665	0.2294	0.1952	0.1947	0.1997	0.1853	0.2017	1.2550	1.1986	0.0564
StdDev		0.0208	0.0137	0.0118	0.0226	0.0142	0.0097	0.0147	0.0227	0.0234	0.0112
Min		0.1336	0.2110	0.1821	0.1653	0.1787	0.1679	0.1673	1.2200	1.1704	0.0385
Max		0.2079	0.2553	0.2197	0.2354	0.2156	0.1984	0.2212	1.3000	1.2447	0.0796
95% C.I. MOE (+/-)		0.0149	0.0098	0.0084	0.0161	0.0102	0.0069	0.0105	0.0163	0.0167	0.0080
95% C.I. Upper Limit		0.1814	0.2392	0.2036	0.2108	0.2099	0.1923	0.2122	1.2713	1.2154	0.0644
95% C.I. Lower Limit		0.1516	0.2197	0.1868	0.1785	0.1895	0.1784	0.1911	1.2387	1.1819	0.0483
95% P.I. MOE (+/-)		0.0495	0.0324	0.0280	0.0535	0.0338	0.0230	0.0349	0.0539	0.0555	0.0266
95% P.I. Upper Limit		0.2159	0.2619	0.2232	0.2482	0.2335	0.2084	0.2365	1.3089	1.2542	0.0829
95% P.I. Lower Limit		0.1170	0.1970	0.1673	0.1412	0.1659	0.1623	0.1668	1.2011	1.1431	0.0298

Table 122. SAE Test Drive 11, 30 m, Test Procedure Repeatability

SAE Test Drive 11, Preceding Path 2, 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.6472	0.8071	0.6291	0.5592	0.5959	0.9616	0.6133	1.2900	1.2245	0.0655
	2	0.6704	0.8328	0.6312	0.5980	0.6416	0.9889	0.6513	1.2500	1.2030	0.0470
	3	0.6642	0.8802	0.6524	0.6417	0.6380	1.0358	0.6636	1.3000	1.2119	0.0881
	4	0.6641	0.8108	0.6198	0.5910	0.6053	0.9575	0.6242	1.3100	1.2447	0.0653
	5	0.7148	0.9018	0.6996	0.6456	0.6765	1.0640	0.6935	1.2500	1.1704	0.0796
	6	0.6836	0.8916	0.6802	0.6462	0.6485	1.0299	0.6660	1.2600	1.1751	0.0849
	7	0.6305	0.8493	0.6494	0.6241	0.6398	0.9900	0.6582	1.2400	1.1815	0.0585
	8	0.6611	0.8239	0.6453	0.5921	0.6216	0.9977	0.6347	1.2500	1.1820	0.0680
	9	0.6793	0.8386	0.6560	0.6165	0.6293	1.0238	0.6349	1.2200	1.1939	0.0261
	10	0.6638	0.8244	0.6398	0.6097	0.6221	0.9848	0.6437	1.2800	1.1995	0.0805
Mean		0.6679	0.8460	0.6503	0.6124	0.6319	1.0034	0.6483	1.2650	1.1986	0.0664
StdDev		0.0224	0.0338	0.0241	0.0282	0.0228	0.0341	0.0233	0.0288	0.0234	0.0190
Min		0.6305	0.8071	0.6198	0.5592	0.5959	0.9575	0.6133	1.2200	1.1704	0.0261
Max		0.7148	0.9018	0.6996	0.6462	0.6765	1.0640	0.6935	1.3100	1.2447	0.0881
95% C.I. MOE (+/-)		0.0160	0.0242	0.0173	0.0202	0.0163	0.0244	0.0167	0.0206	0.0167	0.0136
95% C.I. Upper Limit		0.6839	0.8703	0.6675	0.6326	0.6482	1.0278	0.6650	1.2856	1.2154	0.0800
95% C.I. Lower Limit		0.6519	0.8218	0.6330	0.5922	0.6156	0.9790	0.6317	1.2444	1.1819	0.0528
95% P.I. MOE (+/-)		0.0530	0.0803	0.0572	0.0670	0.0540	0.0809	0.0553	0.0683	0.0555	0.0451
95% P.I. Upper Limit		0.7209	0.9263	0.7075	0.6794	0.6859	1.0843	0.7036	1.3333	1.2542	0.1115
95% P.I. Lower Limit		0.6149	0.7657	0.5930	0.5454	0.5779	0.9225	0.5931	1.1967	1.1431	0.0213

Table 123. SAE Test Drive 12, 155 m, Test Procedure Repeatability

SAE Test Drive 12, Preceding Path 3, 155 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0530	0.2584	0.2754	0.2667	0.4959	0.0743	0.4361	1.2800	1.2055	0.0745
	2	0.0784	0.2658	0.2669	0.2767	0.5036	0.0753	0.4338	1.2800	1.2157	0.0643
	3	0.1484	0.5128	0.5123	0.5220	0.6993	0.1640	0.6596	1.2800	1.1954	0.0846
	4	0.1347	0.4996	0.4881	0.4888	0.7750	0.1428	0.6508	1.2800	1.2080	0.0720
	5	0.2477	0.6364	0.6705	0.6384	0.8839	0.2386	0.7420	1.2700	1.1664	0.1036
	6	0.1334	0.4963	0.4860	0.4824	0.7392	0.1456	0.6687	1.2100	1.1695	0.0405
	7	0.2245	0.6212	0.6330	0.6371	0.8850	0.2256	0.7510	1.2600	1.1593	0.1007
	8	0.0812	0.3472	0.3679	0.3834	0.6359	0.0945	0.5138	1.2600	1.1772	0.0828
	9	0.1996	0.6443	0.5807	0.6012	0.8261	0.1988	0.7433	1.2400	1.1748	0.0652
	10	0.1382	0.4759	0.4889	0.4744	0.7430	0.1454	0.6385	1.2600	1.1784	0.0816
Mean		0.1439	0.4758	0.4770	0.4771	0.7187	0.1505	0.6238	1.2620	1.1850	0.0770
StdDev		0.0642	0.1436	0.1378	0.1343	0.1390	0.0583	0.1212	0.0225	0.0196	0.0184
Min		0.0530	0.2584	0.2669	0.2667	0.4959	0.0743	0.4338	1.2100	1.1593	0.0405
Max		0.2477	0.6443	0.6705	0.6384	0.8850	0.2386	0.7510	1.2800	1.2157	0.1036
95% C.I. MOE (+/-)		0.0459	0.1027	0.0985	0.0961	0.0994	0.0417	0.0867	0.0161	0.0140	0.0132
95% C.I. Upper Limit		0.1899	0.5785	0.5755	0.5732	0.8181	0.1922	0.7104	1.2781	1.1990	0.0901
95% C.I. Lower Limit		0.0980	0.3731	0.3784	0.3810	0.6193	0.1088	0.5371	1.2459	1.1710	0.0638
95% P.I. MOE (+/-)		0.1523	0.3407	0.3268	0.3187	0.3297	0.1384	0.2875	0.0534	0.0465	0.0436
95% P.I. Upper Limit		0.2963	0.8164	0.8038	0.7958	1.0484	0.2889	0.9112	1.3154	1.2315	0.1206
95% P.I. Lower Limit		-0.0084	0.1351	0.1501	0.1584	0.3890	0.0121	0.3363	1.2086	1.1385	0.0333

Table 124. SAE Test Drive 12, 120 m, Test Procedure Repeatability

SAE Test Drive 12, Preceding Path 3, 120 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.0337	0.4563	0.2338	0.2484	0.2249	0.0639	0.5362	1.3500	1.2055	0.1445
	2	0.0406	0.4053	0.1950	0.2022	0.1864	0.0636	0.4494	1.3100	1.2157	0.0943
	3	0.1165	0.6855	0.4410	0.4669	0.4716	0.0961	0.9156	1.3200	1.1954	0.1246
	4	0.1046	0.4764	0.2490	0.2417	0.2537	0.0648	0.5431	1.3100	1.2080	0.1020
	5	0.1120	0.7075	0.4797	0.5093	0.4815	0.1020	0.9108	1.2700	1.1664	0.1036
	6	0.1008	0.6748	0.4729	0.4731	0.4776	0.0887	0.8908	1.2700	1.1695	0.1005
	7	0.0691	0.5822	0.3780	0.3434	0.3590	0.0728	0.7326	1.2500	1.1593	0.0907
	8	0.0653	0.4730	0.2557	0.2369	0.2671	0.0622	0.5855	1.3000	1.1772	0.1228
	9	0.0756	0.7134	0.5261	0.5082	0.5334	0.1253	0.9799	1.2600	1.1748	0.0852
	10	0.0813	0.5707	0.3842	0.3824	0.3857	0.0786	0.7499	1.2700	1.1784	0.0916
Mean		0.0800	0.5745	0.3615	0.3613	0.3641	0.0818	0.7294	1.2910	1.1850	0.1060
StdDev		0.0288	0.1164	0.1195	0.1228	0.1247	0.0210	0.1909	0.0318	0.0196	0.0188
Min		0.0337	0.4053	0.1950	0.2022	0.1864	0.0622	0.4494	1.2500	1.1593	0.0852
Max		0.1165	0.7134	0.5261	0.5093	0.5334	0.1253	0.9799	1.3500	1.2157	0.1445
95% C.I. MOE (+/-)		0.0206	0.0833	0.0855	0.0878	0.0892	0.0150	0.1365	0.0227	0.0140	0.0134
95% C.I. Upper Limit		0.1005	0.6578	0.4470	0.4491	0.4533	0.0968	0.8659	1.3137	1.1990	0.1194
95% C.I. Lower Limit		0.0594	0.4912	0.2761	0.2734	0.2749	0.0668	0.5928	1.2683	1.1710	0.0925
95% P.I. MOE (+/-)		0.0682	0.2761	0.2834	0.2914	0.2958	0.0498	0.4529	0.0754	0.0465	0.0446
95% P.I. Upper Limit		0.1482	0.8507	0.6450	0.6526	0.6599	0.1316	1.1822	1.3664	1.2315	0.1505
95% P.I. Lower Limit		0.0117	0.2984	0.0781	0.0699	0.0683	0.0320	0.2765	1.2156	1.1385	0.0614

Table 125. SAE Test Drive 12, 60 m, Test Procedure Repeatability

SAE Test Drive 12, Preceding Path 3, 60 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.1638	1.0780	0.4413	0.4295	0.4356	0.1220	1.4379	1.2000	1.2055	0.0055
	2	0.1637	1.3728	0.6963	0.7151	0.7161	0.1382	1.8459	1.2600	1.2157	0.0443
	3	0.1484	1.4450	0.7803	0.7942	0.7896	0.1447	1.9712	1.2100	1.1954	0.0146
	4	0.1958	1.4119	0.7979	0.8457	0.8202	0.1366	1.9214	1.2700	1.2080	0.0620
	5	0.1943	1.7923	1.1640	1.2381	1.1996	0.1510	2.4367	1.2100	1.1664	0.0436
	6	0.2023	1.6545	1.0219	1.0487	1.0508	0.1418	2.2327	1.2200	1.1695	0.0505
	7	0.1974	1.5243	0.9004	0.9332	0.9169	0.1517	2.0599	1.1900	1.1593	0.0307
	8	0.1958	1.2219	0.5737	0.5943	0.5631	0.1377	1.6367	1.2000	1.1772	0.0228
	9	0.1900	1.6897	1.0937	1.1274	1.1122	0.1734	2.2800	1.2200	1.1748	0.0452
	10	0.1854	1.3667	0.7254	0.7599	0.7305	0.1409	1.8364	1.1900	1.1784	0.0116
Mean		0.1837	1.4557	0.8195	0.8486	0.8335	0.1438	1.9659	1.2170	1.1850	0.0331
StdDev		0.0183	0.2177	0.2287	0.2462	0.2413	0.0133	0.3020	0.0275	0.0196	0.0189
Min		0.1484	1.0780	0.4413	0.4295	0.4356	0.1220	1.4379	1.1900	1.1593	0.0055
Max		0.2023	1.7923	1.1640	1.2381	1.1996	0.1734	2.4367	1.2700	1.2157	0.0620
95% C.I. MOE (+/-)		0.0131	0.1557	0.1636	0.1761	0.1726	0.0095	0.2160	0.0197	0.0140	0.0135
95% C.I. Upper Limit		0.1968	1.6114	0.9831	1.0247	1.0060	0.1533	2.1819	1.2367	1.1990	0.0466
95% C.I. Lower Limit		0.1706	1.3000	0.6559	0.6725	0.6609	0.1343	1.7499	1.1973	1.1710	0.0196
95% P.I. MOE (+/-)		0.0435	0.5164	0.5427	0.5841	0.5723	0.0316	0.7164	0.0653	0.0465	0.0447
95% P.I. Upper Limit		0.2272	1.9721	1.3621	1.4327	1.4058	0.1754	2.6823	1.2823	1.2315	0.0778
95% P.I. Lower Limit		0.1402	0.9393	0.2768	0.2645	0.2611	0.1122	1.2495	1.1517	1.1385	-0.0117

Table 126. SAE Test Drive 12, 30 m, Test Procedure Repeatability

SAE Test Drive 12, Preceding Path 3, 30 m											
Descriptive Statistic	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	1	0.5551	0.4465	0.3968	0.4274	0.4172	0.3840	1.0917	1.2700	1.2055	0.0645
	2	0.5715	0.4859	0.4017	0.4198	0.4225	0.3750	1.2984	1.2900	1.2157	0.0743
	3	0.5814	0.6094	0.4329	0.4668	0.4716	0.3930	1.8518	1.2400	1.1954	0.0446
	4	0.5698	0.5129	0.4070	0.4242	0.4068	0.3728	1.3546	1.2800	1.2080	0.0720
	5	0.6588	0.6818	0.4698	0.5229	0.4719	0.4494	2.1070	1.2100	1.1664	0.0436
	6	0.6009	0.6005	0.4249	0.4524	0.4308	0.4056	1.8138	1.2400	1.1695	0.0705
	7	0.5696	0.5652	0.4130	0.4418	0.4411	0.3931	1.7215	1.2400	1.1593	0.0807
	8	0.6061	0.4621	0.4091	0.4271	0.4137	0.3933	1.1531	1.2200	1.1772	0.0428
	9	0.5839	0.6156	0.4338	0.4395	0.4404	0.3931	1.8666	1.2200	1.1748	0.0452
	10	0.6043	0.4894	0.4101	0.4305	0.4290	0.3764	1.3602	1.2400	1.1784	0.0616
Mean		0.5901	0.5469	0.4199	0.4452	0.4345	0.3936	1.5619	1.2450	1.1850	0.0600
StdDev		0.0295	0.0785	0.0215	0.0308	0.0225	0.0222	0.3503	0.0268	0.0196	0.0146
Min		0.5551	0.4465	0.3968	0.4198	0.4068	0.3728	1.0917	1.2100	1.1593	0.0428
Max		0.6588	0.6818	0.4698	0.5229	0.4719	0.4494	2.1070	1.2900	1.2157	0.0807
95% C.I. MOE (+/-)		0.0211	0.0562	0.0154	0.0220	0.0161	0.0159	0.2506	0.0191	0.0140	0.0105
95% C.I. Upper Limit		0.6112	0.6031	0.4353	0.4673	0.4506	0.4094	1.8124	1.2641	1.1990	0.0704
95% C.I. Lower Limit		0.5691	0.4908	0.4045	0.4232	0.4184	0.3777	1.3113	1.2259	1.1710	0.0495
95% P.I. MOE (+/-)		0.0699	0.1862	0.0510	0.0731	0.0533	0.0526	0.8310	0.0635	0.0465	0.0347
95% P.I. Upper Limit		0.6600	0.7332	0.4710	0.5183	0.4878	0.4462	2.3929	1.3085	1.2315	0.0947
95% P.I. Lower Limit		0.5202	0.3607	0.3689	0.3721	0.3812	0.3410	0.7309	1.1815	1.1385	0.0252

3.7 SAE Test Procedure - Repeatability of Test Outcomes

To assess SAE J3069 test procedure outcome repeatability, each repetition of the test procedure repeatability data was compared to the established glare limits. Tables 127 to 132 present outcome results for each SAE test procedure repetition. A cell with a “P” indicates that all receptor heads had maximum illuminance values under the glare limit. A cell with an “E” indicates that at least one receptor head had a maximum illuminance value which exceeded the glare limit. SAE test drives showed perfect test outcome repeatability for test drives 1, 2, and 10 to 12. Glare limits were consistently met for all measurement distances for all test repetitions resulting in passing outcomes for each. For SAE test drive 3 155 m measurement distance all 10 repetitions had values which exceeded the glare limit. In three repetitions only the car driver eye point receptor head had a value which exceeded the glare limit. For seven repetitions, both the car driver eye point and motorcycle eye point receptor heads had values which exceeded the glare limit. For SAE test drive 3 120 m measurement distance, one repetition had a passing outcome. For 5 repetitions, only the car driver eye point receptor head had values which exceeded the glare limit. For four repetitions, both the car driver eye point and motorcycle driver eye point receptor heads had values which exceeded the glare limit. For SAE test drive 3 60 m measurement distance, one repetition had passing outcomes. For six repetitions, only the car driver eye point receptor head had values which exceeded the glare limit. For three repetitions, both the car driver eye point and motorcycle eye point receptor heads had values which exceeded the glare limit. For SAE test drive 3 30 m measurement distance, all 10 repetitions had passing outcomes.

Table 127. SAE Test Drive 1 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
155 m	P	P	P	P	P	P	P	P	P	P
120 m	P	P	P	P	P	P	P	P	P	P
60 m	P	P	P	P	P	P	P	P	P	P
30 m	P	P	P	P	P	P	P	P	P	P

Table 128. SAE Test Drive 2 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
155 m	P	P	P	P	P	P	P	P	P	P
120 m	P	P	P	P	P	P	P	P	P	P
60 m	P	P	P	P	P	P	P	P	P	P
30 m	P	P	P	P	P	P	P	P	P	P

Table 129. SAE Test Drive 3 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
155 m	E*	E*	E**	E**	E**	E**	E**	E*	E**	E**
120 m	E*	P	E**	E*	E**	E**	E*	E*	E**	E*
60 m	P	E*	E*	E*	E**	E**	E*	E*	E**	E*
30 m	P	P	P	P	P	P	P	P	P	P

*Only Receptor Head 4 had a glare exceedance
**Both Receptor Head 4 and Receptor Head 1 had a glare exceedance

Table 130. SAE Test Drive 10 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
155 m	P	P	P	P	P	P	P	P	P	P
120 m	P	P	P	P	P	P	P	P	P	P
60 m	P	P	P	P	P	P	P	P	P	P
30 m	P	P	P	P	P	P	P	P	P	P

Table 131. SAE Test Drive 11 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
155 m	P	P	P	P	P	P	P	P	P	P
120 m	P	P	P	P	P	P	P	P	P	P
60 m	P	P	P	P	P	P	P	P	P	P
30 m	P	P	P	P	P	P	P	P	P	P

Table 132. SAE Test Drive 12 Test Procedure Outcomes by Test Repetition

	Repetition									
Measurement Distance	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
155 m	P	P	P	P	P	P	P	P	P	P
120 m	P	P	P	P	P	P	P	P	P	P
60 m	P	P	P	P	P	P	P	P	P	P
30 m	P	P	P	P	P	P	P	P	P	P

3.8 SAE Test Procedure - Ratio of Prediction Interval Margins of Error to Glare Limits

Like with the NHTSA test procedure, the prediction interval margins of error were taken as a proportion of the glare limit to give evidence that the SAE test procedure is resulting in low measurement error, particularly when assessing in relation to the proportion of space under the glare limits. These results are shown in Tables 133 to 142. In general, prediction interval margins of error represent 12% or less of the glare limit. Exceptions to this were for test drive 3, particularly for the Car Eye Point and Cycle Eye Point receptor heads. For test drive 3, the ratio was above 50% for the 155 m measurement distance sub-range, 120 m measurement distance

sub-range, and 60 m measurement distance sub-range for the Car Eye Point receptor head. The ratio was also above 50% for the 155 m measurement distance sub-range and the 120 m measurement distance sub-range for the Motorcycle Eye Point.

Table 133. SAE Test Procedure Car Eye Point Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Car Eye Point (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 1**	**Test Drive 2**	**Test Drive 3**
155 m	0.3	0.0167 (5.6%)	0.0243 (8.1%)	0.2928* (97.6%)
120 m	0.3	0.0241 (8.0%)	0.0314 (10.5%)	0.3532* (117.7%)
60 m	0.7	0.0349 (5.0%)	0.0519 (7.4%)	0.5845* (83.5%)
30 m	1.8	0.0461 (2.6%)	0.0749 (4.2%)	0.0981 (5.4%)

Table 134. SAE Test Procedure Cycle Eye Point Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Motorcycle Eye Point (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 1**	**Test Drive 2**	**Test Drive 3**
155 m	0.3	0.0336 (11.2%)	0.0329 (11.0%)	0.2696* (89.9%)
120 m	0.3	0.0314 (10.5%)	0.0199 (6.6%)	0.3222* (107.4%)
60 m	0.7	0.0297 (4.2%)	0.0234 (3.3%)	0.4868* (69.5%)
30 m	1.8	0.0438 (2.4%)	0.0602 (3.3%)	0.0699 (3.9%)

Table 135. SAE Test Procedure Truck Eye Point Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Truck Eye Point (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 1**	**Test Drive 2**	**Test Drive 3**
155 m	0.3	0.0123 (4.1%)	0.0117 (3.9%)	0.0488 (16.3%)
120 m	0.3	0.0158 (5.3%)	0.0119 (4.0%)	0.0406 (13.5%)
60 m	0.7	0.031 (4.4%)	0.0242 (3.5%)	0.0231 (3.3%)
30 m	1.8	0.0336 (1.9%)	0.0902 (4.0%)	0.0721 (4.0%)

Table 136. SAE Test Procedure Truck Driver Side Mirror Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Truck Driver Side Mirror (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
155 m	4.0	0.0338 (0.8%)	0.0542 (1.4%)	0.1523 (3.8%)
120 m	4.0	0.0549 (1.4%)	0.0403 (1.0%)	0.0682 (1.7%)
60 m	8.9	0.0348 (0.4%)	0.0495 (0.6%)	0.0435 (0.5%)
30 m	18.9	0.0391 (0.2%)	0.0530 (0.3%)	0.0699 (0.4%)

Table 137. SAE Test Procedure Passenger Side Mirror Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Car Passenger Side Mirror (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
155 m	4.0	0.0193 (0.5%)	0.0211 (0.5%)	0.3407 (8.5%)
120 m	4.0	0.0138 (0.3%)	0.0108 (0.3%)	0.2761 (6.9%)
60 m	8.9	0.0232 (0.3%)	0.0324 (0.4%)	0.5164 (5.8%)
30 m	18.9	0.0586 (0.35%)	0.0803 (0.4%)	0.1862 (1.0%)

Table 138. SAE Test Procedure Cycle Right Mirror Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Cycle Right Mirror (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
155 m	4.0	0.0119 (0.3%)	0.0189 (0.5%)	0.3268 (8.2%)
120 m	4.0	0.0096 (0.2%)	0.0106 (0.3%)	0.2834 (7.1%)
60 m	8.9	0.0211 (0.2%)	0.028 (0.3%)	0.5427 (6.1%)
30 m	18.9	0.0281 (0.1%)	0.0572 (0.3%)	0.051 (0.3%)

Table 139. SAE Test Procedure Cycle Left Mirror Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Cycle Left Mirror (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
155 m	4.0	0.0311 (0.8%)	0.0269 (0.7%)	0.3187 (8.0%)
120 m	4.0	0.0319 (0.8%)	0.0213 (0.5%)	0.2914 (7.3%)
60 m	8.9	0.0469 (0.5%)	0.0535 (0.6%)	0.5841 (6.6%)
30 m	18.9	0.0371 (0.2%)	0.067 (0.4%)	0.0731 (0.4%)

Table 140. SAE Test Procedure Car Interior Mirror Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Car Interior Mirror (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
155 m	4.0	0.0247 (0.6%)	0.0265 (0.7%)	0.3297 (8.2%)
120 m	4.0	0.023 (0.6%)	0.0234 (0.6%)	0.2958 (7.4%)
60 m	8.9	0.0461 (0.5%)	0.0338 (0.4%)	0.5723 (6.4%)
30 m	18.9	0.0428 (0.2%)	0.054 (0.3%)	0.0533 (0.3%)

Table 141. SAE Test Procedure Truck Passenger Side Mirror Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Truck Passenger Side Mirror (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
155 m	4.0	0.015 (0.4%)	0.013 (0.3%)	0.1384 (3.5%)
120 m	4.0	0.0078 (0.2%)	0.0168 (0.4%)	0.0498 (1.2%)
60 m	8.9	0.0201 (0.2%)	0.023 (0.3%)	0.0316 (0.4%)
30 m	18.9	0.036 (0.2%)	0.0809 (0.4%)	0.0526 (0.3%)

Table 142. SAE Test Procedure Car Driver Side Mirror Prediction Interval MOE Ratio to Glare Limits

95th Percentile Prediction Interval Margin of Error SAE Test Procedure/Car Driver Side Mirror (Values in lux and as a proportion of the glare limit)				
Measurement Distance Sub-Range	**Glare Limit (lux)**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
155 m	4.0	0.0105 (0.3%)	0.0156 (0.4%)	0.2875 (7.2%)
120 m	4.0	0.032 (0.6%)	0.023 (0.6%)	0.4529 (11.3%)
60 m	8.9	0.029 (0.3%)	0.0349 (0.4%)	0.7164 (8.0%)
30 m	18.9	0.0446 (0.2%)	0.0553 (0.3%)	0.831 (4.4%)

3.9 NHTSA ADB Test Procedure - Limited Assessment of Test Reproducibility

A limited analysis of test reproducibility was conducted that involved examination of the effects on the test results of different operators performing headlamp aiming prior to running a test set. All other aspects of these tests, including test equipment and test setup, remained the same such that the headlamp aiming process could be examined to determine if different operators following a headlight aiming procedure would impact test results. This analysis was not conducted for the SAE J3069 test procedure.

For each reproducibility test repetition, the test vehicle's headlamps were mis-aimed by one individual, then aimed per the SAE J599 aiming procedure by another individual. Final aiming status was documented with pictures showing the aim of the headlamps on a screen. Following the completion of the aiming procedure, the NHTSA test procedure was performed.

The intent was to have three individuals ("operators") perform headlamp aiming for each of two repetitions of the NHTSA test procedure. However, due to an issue that occurred between the first and second test repetitions, which was not identified until all 6 repetitions were completed, repetitions 2 to 6 involved the headlamps being aimed with the headlamp aiming screen's height marker positioned at the incorrect height. As a result, the test vehicle's headlamps in repetitions 2 to 6 were aimed somewhat more downward than they should have been. Despite the use of an incorrect lamp height in the aiming procedure, the test results for reproducibility repetitions 2 to 6 could still be analyzed to see if the measurements were effectively the same across these 5 repetitions. As such, illuminance and vehicle dynamics measures (e.g., speed, pitch, accelerations) were analyzed to assess the consistency of values across all reproducibility repetitions. Summary statistics were calculated to characterize the test reproducibility.

Tables 143 to 167 contain measurements and analysis results for each of the three individual aimers, labeled as aimers A, B and C. The results presented include two test sets for Aimers B and C, but only one set of test results for Aimer A due to an error in carrying out the aiming procedure for one of the test sets. Table rows 2-6 contain the measurement results for each aimer's test sets. Below the individual aimer results are the mean and standard deviation values of the aimers' results combined.

The NHTSA test procedure with different headlamp aimers demonstrated standard deviations of 0.13 lux or less for all NHTSA test scenarios. More specifically, for the oncoming scenarios, test scenarios 1, 3, 4, 6, 7, and 8, for 220 m to 120 m measurement distance sub-range, all standard deviations were 0.0056 lux or less. For the 150 m to 120 m measurement distance sub-range, all standard deviations were 0.0068 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all standard deviations were 0.0122 lux or less. For the 70 m to 60 m measurement distance sub-range, all standard deviations were 0.0121 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0365 lux or less. For the 50 m to 30 m measurement distance sub-range, all standard deviations were 0.0354 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0932 lux or less.

For the same-direction NHTSA test scenarios 2 and 5, for the 100 m to 60 m measurement distance sub-range, all standard deviations were 0.0153 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0521 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.1264 lux or less.

When interpreting the results from Tables 143 to 167, it should be noted that the values in these tables were affected by the inadvertent use of an incorrect headlamp height value that was somewhat different from the test vehicle's actual headlamp height. However, since this incorrect height was used by all aimers consistently, the collected data still permit a valid assessment of the effects on test results of using different individuals to aim the headlamps. This contrasts with the tables above in which the headlamps were aimed to the height of the Volvo XC90. Because of this, the reproducibility assessment results in Tables 143 to 167 were only compared within each other to assess whether there were any differences in illuminance due to different aimers.

Table 143. NHTSA Test No. 1, 220 m to 120 m, Reproducibility

NHTSA Test No. 1, Oncoming Straight, 220 m to 120 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.0545	0.0599	0.0578	1.3000	1.1677	0.1323
	B	1	0.0673	0.0672	0.0581	1.3200	1.1678	0.1522
	B	2	0.0658	0.0662	0.0556	1.2800	1.1823	0.0977
	C	1	0.0632	0.0631	0.0545	1.2800	1.1817	0.0983
	C	2	0.0676	0.0663	0.0540	1.3500	1.1951	0.1549
Mean			0.0637	0.0645	0.0560	1.3060	1.1789	0.1271
StdDev			0.0054	0.0030	0.0019	0.0297	0.0115	0.0280
95% P.I. MOE (+/-)			0.0134	0.0075	0.0047	0.0735	0.0286	0.0693
95% P.I. Upper Limit			0.0771	0.0720	0.0606	1.3795	1.2075	0.1963
95% P.I. Lower Limit			0.0503	0.0571	0.0513	1.2325	1.1504	0.0578

Table 144. NHTSA Test No. 1, 119.9 m to 60 m, Reproducibility

NHTSA Test No 1, Oncoming Straight, 119.9 m to 60 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.1601	0.1708	0.2351	1.2800	1.1677	0.1123
	B	1	0.1723	0.1754	0.2308	1.2800	1.1678	0.1122
	B	2	0.1804	0.1775	0.2530	1.3200	1.1823	0.1377
	C	1	0.1637	0.1711	0.2509	1.2800	1.1817	0.0983
	C	2	0.1828	0.1761	0.2295	1.2900	1.1951	0.0949
Mean			0.1718	0.1742	0.2399	1.2900	1.1789	0.1111
StdDev			0.0100	0.0031	0.0112	0.0173	0.0115	0.0169
95% P.I. MOE (+/-)			0.0247	0.0076	0.0279	0.0429	0.0286	0.0418
95% P.I. Upper Limit			0.1966	0.1817	0.2677	1.3329	1.2075	0.1529
95% P.I. Lower Limit			0.1471	0.1666	0.2120	1.2471	1.1504	0.0693

Table 145. NHTSA Test No. 1, 59.9 m to 30 m, Reproducibility

NHTSA Test No. 1, Oncoming Straight, 59.9 m to 30 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.5775	0.5857	0.7474	1.2500	1.1677	0.0823
	B	1	0.6220	0.6298	0.7831	1.2400	1.1678	0.0722
	B	2	0.6371	0.6393	0.8245	1.2600	1.1823	0.0777
	C	1	0.5619	0.5943	0.7299	1.2300	1.1817	0.0483
	C	2	0.6042	0.6248	0.7800	1.2700	1.1951	0.0749
Mean			0.6006	0.6148	0.7730	1.2500	1.1789	0.0711
StdDev			0.0310	0.0234	0.0365	0.0158	0.0115	0.0133
95% P.I. MOE (+/-)			0.0767	0.0580	0.0904	0.0392	0.0286	0.0329
95% P.I. Upper Limit			0.6773	0.6728	0.8634	1.2892	1.2075	0.1040
95% P.I. Lower Limit			0.5238	0.5568	0.6826	1.2108	1.1504	0.0381

Table 146. NHTSA Test No. 1, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 1, Oncoming Straight, 29.9 m to 15 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	2.0575	2.1289	1.5558	1.2700	1.1677	0.1023
	B	1	2.2471	2.2474	1.6038	1.2500	1.1678	0.0822
	B	2	2.2030	2.2729	1.6604	1.2600	1.1823	0.0777
	C	1	2.0991	2.1802	1.5704	1.2600	1.1817	0.0783
	C	2	2.2356	2.2699	1.5914	1.2500	1.1951	0.0549
Mean			2.1685	2.2198	1.5964	1.2580	1.1789	0.0791
StdDev			0.0852	0.0631	0.0403	0.0084	0.0115	0.0169
95% P.I. MOE (+/-)			0.2111	0.1563	0.0999	0.0207	0.0286	0.0418
95% P.I. Upper Limit			2.3795	2.3762	1.6963	1.2787	1.2075	0.1209
95% P.I. Lower Limit			1.9574	2.0635	1.4964	1.2373	1.1504	0.0373

Table 147. NHTSA Test No. 2, 100 m to 60 m, Reproducibility

NHTSA Test No. 2, Same Direction Straight, 100 m to 60 m												
Descriptive Statistic	**Aimer**	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	16	0.1766	0.1887	0.1750	0.1627	0.1680	0.2084	0.1764	1.2800	1.1641	0.1159
	B	14	0.1985	0.1810	0.1589	0.1668	0.1688	0.2188	0.1657	1.2800	1.1731	0.1069
	B	17	0.1720	0.1797	0.1610	0.1629	0.1731	0.2133	0.1764	1.2800	1.1788	0.1012
	C	15	0.2027	0.1971	0.1742	0.1688	0.1851	0.2251	0.1915	1.3200	1.1852	0.1348
	C	18	0.1725	0.1920	0.1736	0.1755	0.1671	0.1970	0.1817	1.2900	1.1865	0.1035
Mean			0.1845	0.1877	0.1685	0.1674	0.1724	0.2125	0.1784	1.2900	1.1775	0.1125
StdDev			0.0149	0.0074	0.0079	0.0052	0.0074	0.0107	0.0094	0.0173	0.0092	0.0137
95% P.I. MOE (+/-)			0.0370	0.0183	0.0195	0.0130	0.0184	0.0265	0.0232	0.0429	0.0229	0.0339
95% P.I. Upper Limit			0.2095	0.2103	0.1932	0.1885	0.1856	0.2235	0.2049	1.3329	1.2093	0.1374
95% P.I. Lower Limit			0.1354	0.1738	0.1541	0.1625	0.1487	0.1705	0.1584	1.2471	1.1636	0.0697

Table 148. NHTSA Test No. 2, 59.9 m to 30 m, Reproducibility

NHTSA Test No. 2, Oncoming Straight, 59.9 m to 30 m												
Descriptive Statistic	**Aimer**	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	16	0.7585	0.7580	0.6184	0.5924	0.6108	1.0321	0.6387	1.2400	1.1641	0.0759
	B	14	0.7291	0.6901	0.5697	0.5555	0.5648	0.9395	0.5481	1.2300	1.1731	0.0569
	B	17	0.7172	0.7045	0.5768	0.5539	0.5705	0.9453	0.5683	1.2500	1.1788	0.0712
	C	15	0.7826	0.7588	0.6386	0.5943	0.6344	1.0574	0.6103	1.2600	1.1852	0.0748
	C	18	0.7324	0.7438	0.6140	0.5904	0.6155	0.9872	0.5977	1.2700	1.1865	0.0835
Mean			0.7439	0.7310	0.6035	0.5773	0.5992	0.9923	0.5926	1.2500	1.1775	0.0725
StdDev			0.0263	0.0318	0.0293	0.0207	0.0302	0.0521	0.0355	0.0158	0.0092	0.0098
95% P.I. MOE (+/-)			0.0652	0.0787	0.0725	0.0513	0.0748	0.1290	0.0879	0.0392	0.0229	0.0243
95% P.I. Upper Limit			0.7977	0.8225	0.6865	0.6417	0.6902	1.1162	0.6857	1.3092	1.2093	0.1078
95% P.I. Lower Limit			0.6672	0.6650	0.5415	0.5391	0.5407	0.8582	0.5098	1.2308	1.1636	0.0593

Table 149. NHTSA Test No. 2, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 2, Oncoming Straight, 29.9 m –-15 m												
Descriptive Statistic	**Aimer**	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	16	1.4494	2.8389	2.3978	2.1798	2.2605	2.2789	1.8861	1.2500	1.1641	0.0859
	B	14	1.3962	2.5904	2.2899	2.0854	2.1931	2.2397	1.6758	1.2600	1.1731	0.0869
	B	17	1.3536	2.6064	2.2537	2.0378	2.1224	2.1874	1.6391	1.2700	1.1788	0.0912
	C	15	1.4459	2.8460	2.3931	2.1744	2.2733	2.4034	1.7604	1.2600	1.1852	0.0748
	C	18	1.4564	2.7929	2.3945	2.1946	2.2826	2.2741	1.8661	1.2500	1.1865	0.0635
Mean			1.4203	2.7349	2.3458	2.1344	2.2264	2.2767	1.7655	1.2580	1.1775	0.0805
StdDev			0.0443	0.1264	0.0688	0.0689	0.0679	0.0797	0.1104	0.0084	0.0092	0.0112
95% P.I. MOE (+/-)			0.1097	0.3133	0.1705	0.1708	0.1682	0.1975	0.2735	0.0207	0.0229	0.0279
95% P.I. Upper Limit			1.5661	3.1062	2.5650	2.3654	2.4508	2.4717	2.1396	1.2707	1.2093	0.0914
95% P.I. Lower Limit			1.3468	2.4797	2.2240	2.0238	2.1143	2.0766	1.5926	1.2293	1.1636	0.0357

Table 150. NHTSA Test No. 3, 59.9 m to 30 m, Reproducibility

NHTSA Test No. 3, Oncoming Left Curve 85 m Radius, 59.9 m to 30 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.3485	0.3378	0.3383	1.1100	1.0240	0.0860
	B	1	0.3695	0.3637	0.3415	1.1100	0.9976	0.1124
	B	2	0.3940	0.3810	0.3588	1.1000	0.9965	0.1035
	C	1	0.3656	0.3577	0.3439	1.1300	1.0212	0.1088
	C	2	0.3639	0.3446	0.3316	1.1000	1.0054	0.0946
Mean			0.3683	0.3570	0.3428	1.1100	1.0089	0.1011
StdDev			0.0164	0.0169	0.0101	0.0122	0.0130	0.0107
95% P.I. MOE (+/-)			0.0407	0.0419	0.0249	0.0303	0.0322	0.0266
95% P.I. Upper Limit			0.4089	0.3988	0.3677	1.1403	1.0411	0.1277
95% P.I. Lower Limit			0.3276	0.3151	0.3179	1.0797	0.9767	0.0745

Table 151. NHTSA Test No. 3, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 3, Oncoming Left Curve 85 m Radius, 29.9 m to 15 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	1.4803	1.4557	1.2007	1.1900	1.0240	0.1660
	B	1	1.4788	1.4765	1.2213	1.1800	0.9976	0.1824
	B	2	1.5963	1.5849	1.3113	1.1500	0.9965	0.1535
	C	1	1.5039	1.4885	1.2231	1.2000	1.0212	0.1788
	C	2	1.4612	1.4769	1.2040	1.1900	1.0054	0.1846
Mean			1.5041	1.4965	1.2321	1.1820	1.0089	0.1731
StdDev			0.0537	0.0508	0.0454	0.0192	0.0130	0.0131
95% P.I. MOE (+/-)			0.1331	0.1258	0.1125	0.0477	0.0322	0.0324
95% P.I. Upper Limit			1.6372	1.6223	1.3445	1.2297	1.0411	0.2055
95% P.I. Lower Limit			1.3710	1.3706	1.1196	1.1343	0.9767	0.1406

Table 152. NHTSA Test No. 4, 150 m to 120 m, Reproducibility

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 150 m to 120 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.0476	0.0461	0.0308	1.0000	1.0410	0.0410
	B	1	0.0413	0.0576	0.0292	1.0000	1.0282	0.0282
	B	2	0.0567	0.0531	0.0443	1.0500	1.0305	0.0195
	C	1	0.0443	0.0503	0.0352	0.9800	1.0169	0.0369
	C	2	0.0443	0.0430	0.0273	1.0100	1.0227	0.0127
Mean			0.0468	0.0500	0.0333	1.0080	1.0278	0.0277
StdDev			0.0060	0.0057	0.0068	0.0259	0.0090	0.0118
95% P.I. MOE (+/-)			0.0148	0.0142	0.0168	0.0641	0.0224	0.0291
95% P.I. Upper Limit			0.0616	0.0642	0.0501	1.0721	1.0502	0.0568
95% P.I. Lower Limit			0.0321	0.0358	0.0166	0.9439	1.0055	-0.0015

Table 153. NHTSA Test No. 4, 119.9 m to 60 m, Reproducibility

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 119.9 m to 60 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.1253	0.1209	0.1161	1.3500	1.0410	0.3090
	B	1	0.1226	0.1319	0.1119	1.3300	1.0282	0.3018
	B	2	0.1484	0.1451	0.1294	1.3400	1.0305	0.3095
	C	1	0.1216	0.1300	0.1183	1.3300	1.0169	0.3131
	C	2	0.1179	0.1266	0.1174	1.3200	1.0227	0.2973
Mean			0.1271	0.1309	0.1186	1.3340	1.0278	0.3062
StdDev			0.0122	0.0090	0.0065	0.0114	0.0090	0.0064
95% P.I. MOE (+/-)			0.0301	0.0222	0.0162	0.0283	0.0224	0.0159
95% P.I. Upper Limit			0.1573	0.1531	0.1348	1.3623	1.0502	0.3221
95% P.I. Lower Limit			0.0970	0.1087	0.1024	1.3057	1.0055	0.2902

Table 154. NHTSA Test No. 4, 59.9 m to 30 m, Reproducibility

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 59.9 m to 30 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.5106	0.4820	0.5346	1.2200	1.0410	0.1790
	B	1	0.5215	0.5013	0.5665	1.2100	1.0282	0.1818
	B	2	0.5536	0.5523	0.5916	1.2000	1.0305	0.1695
	C	1	0.5026	0.5120	0.5576	1.2100	1.0169	0.1931
	C	2	0.4933	0.5059	0.5513	1.2100	1.0227	0.1873
Mean			0.5163	0.5107	0.5603	1.2100	1.0278	0.1822
StdDev			0.0233	0.0258	0.0210	0.0071	0.0090	0.0089
95% P.I. MOE (+/-)			0.0577	0.0640	0.0521	0.0175	0.0224	0.0220
95% P.I. Upper Limit			0.5740	0.5746	0.6124	1.2275	1.0502	0.2042
95% P.I. Lower Limit			0.4587	0.4467	0.5082	1.1925	1.0055	0.1601

Table 155. NHTSA Test No. 4, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 4, Oncoming Left Curve 210 m Radius, 29.9 m to 15 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	1.8072	1.7821	1.4205	1.2100	1.0410	0.1690
	B	1	1.9081	1.8684	1.4712	1.2100	1.0282	0.1818
	B	2	2.0082	1.9844	1.5693	1.2100	1.0305	0.1795
	C	1	1.8593	1.8246	1.4663	1.2000	1.0169	0.1831
	C	2	1.8460	1.8284	1.4347	1.2000	1.0227	0.1773
Mean			1.8858	1.8576	1.4724	1.2060	1.0278	0.1782
StdDev			0.0774	0.0772	0.0582	0.0055	0.0090	0.0056
95% P.I. MOE (+/-)			0.1917	0.1913	0.1442	0.0136	0.0224	0.0138
95% P.I. Upper Limit			2.0775	2.0489	1.6166	1.2196	1.0502	0.1920
95% P.I. Lower Limit			1.6941	1.6663	1.3282	1.1924	1.0055	0.1643

Table 156. NHTSA Test No. 5, 100 m to 60 m, Reproducibility

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 100 m to 60 m												
Descriptive Statistic	**Aimer**	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	16	0.1364	0.1234	0.1111	0.1212	0.1192	0.1217	0.1397	1.3300	1.0855	0.2445
	B	14	0.1364	0.1274	0.1194	0.1341	0.1338	0.1249	0.1405	1.3300	1.0768	0.2532
	B	17	0.1634	0.1441	0.1403	0.1493	0.1393	0.1379	0.1511	1.3500	1.1020	0.2480
	C	15	0.1322	0.1277	0.1132	0.1267	0.1238	0.1205	0.1347	1.3400	1.0890	0.2510
	C	18	0.1222	0.1297	0.1113	0.1215	0.1236	0.1171	0.1342	1.3200	1.0812	0.2388
Mean			0.1381	0.1305	0.1191	0.1306	0.1280	0.1244	0.1401	1.3340	1.0869	0.2471
StdDev			0.0153	0.0079	0.0123	0.0117	0.0083	0.0080	0.0068	0.0114	0.0096	0.0057
95% P.I. MOE (+/-)			0.0379	0.0197	0.0305	0.0290	0.0206	0.0199	0.0168	0.0283	0.0238	0.0141
95% P.I. Upper Limit			0.1760	0.1502	0.1496	0.1595	0.1486	0.1443	0.1569	1.3623	1.1107	0.2612
95% P.I. Lower Limit			0.1003	0.1108	0.0885	0.1016	0.1073	0.1045	0.1232	1.3057	1.0631	0.2331

Table 157. NHTSA Test No. 5, 59.9 m to 30 m, Reproducibility

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 59.9 m to 30 m												
Descriptive Statistic	**Aimer**	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	16	0.4913	0.5696	0.5133	0.4882	0.4999	0.6239	0.4906	1.2100	1.0855	0.1245
	B	14	0.4903	0.5860	0.5243	0.4979	0.5157	0.6466	0.5116	1.2100	1.0768	0.1332
	B	17	0.5470	0.6260	0.5687	0.5483	0.5521	0.6988	0.5451	1.2200	1.1020	0.1180
	C	15	0.5016	0.5751	0.5292	0.4977	0.5104	0.6348	0.4997	1.2000	1.0890	0.1110
	C	18	0.4966	0.5850	0.5161	0.4948	0.4892	0.6314	0.5067	1.2100	1.0812	0.1288
Mean			0.5054	0.5884	0.5303	0.5054	0.5135	0.6471	0.5107	1.2100	1.0869	0.1231
StdDev			0.0237	0.0221	0.0224	0.0243	0.0239	0.0300	0.0208	0.0071	0.0096	0.0088
95% P.I. MOE (+/-)			0.0588	0.0548	0.0555	0.0602	0.0592	0.0744	0.0514	0.0175	0.0238	0.0218
95% P.I. Upper Limit			0.5642	0.6432	0.5858	0.5656	0.5727	0.7215	0.5621	1.2275	1.1107	0.1449
95% P.I. Lower Limit			0.4465	0.5335	0.4749	0.4452	0.4543	0.5726	0.4593	1.1925	1.0631	0.1013

Table 158. NHTSA Test No. 5, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 5, Same Direction Left Curve 210 m Radius, 29.9 m to 15 m												
Descriptive Statistic	**Aimer**	**Repetition**	**Truck Driver-Side Mirror (RH9) (lux)**	**Car Pass.-Side Mirror (RH7) (lux)**	**Cycle Right Mirror (RH3) (lux)**	**Cycle Left Mirror (RH2) (lux)**	**Car Inside Mirror (RH6) (lux)**	**Truck Pass.-Side Mirror (RH10) (lux)**	**Car Driver-Side Mirror (RH5) (lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	16	1.2367	2.3922	1.9718	1.7064	1.8129	1.9341	1.5565	1.2100	1.0855	0.1245
	B	14	1.2667	2.4663	2.0046	1.7169	1.8510	1.9384	1.5867	1.2000	1.0768	0.1232
	B	17	1.3522	2.6765	2.1398	1.8074	1.9717	2.1030	1.7183	1.2100	1.1020	0.1080
	C	15	1.2636	2.4542	2.0324	1.7317	1.8524	1.9614	1.5655	1.2100	1.0890	0.1210
	C	18	1.2163	2.4217	1.9607	1.6753	1.7989	1.9271	1.5706	1.2000	1.0812	0.1188
Mean			1.2671	2.4822	2.0219	1.7275	1.8574	1.9728	1.5995	1.2060	1.0869	0.1191
StdDev			0.0519	0.1124	0.0717	0.0492	0.0681	0.0739	0.0673	0.0055	0.0096	0.0066
95% P.I. MOE (+/-)			0.1285	0.2786	0.1777	0.1219	0.1687	0.1832	0.1667	0.0136	0.0238	0.0163
95% P.I. Upper Limit			1.3957	2.7608	2.1995	1.8495	2.0261	2.1560	1.7662	1.2196	1.1107	0.1354
95% P.I. Lower Limit			1.1386	2.2036	1.8442	1.6056	1.6887	1.7896	1.4328	1.1924	1.0631	0.1028

Table 159. NHTSA Test No. 6, 50 m to 30 m, Reproducibility

NHTSA Test No. 6, Oncoming Right Curve 210 m Radius, 50 m to 30 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.7812	0.8139	1.0170	1.1900	1.0537	0.1363
	B	1	0.7730	0.8204	1.0855	1.1700	1.0554	0.1146
	B	2	0.8198	0.8535	1.0705	1.1200	1.0190	0.1010
	C	1	0.8558	0.9026	1.1144	1.1700	1.0371	0.1329
	C	2	0.8047	0.8543	1.0725	1.1500	1.0118	0.1382
Mean			0.8069	0.8489	1.0720	1.1600	1.0354	0.1246
StdDev			0.0331	0.0352	0.0354	0.0265	0.0198	0.0162
95% P.I. MOE (+/-)			0.0819	0.0873	0.0876	0.0656	0.0490	0.0401
95% P.I. Upper Limit			0.8888	0.9362	1.1596	1.2256	1.0844	0.1647
95% P.I. Lower Limit			0.7250	0.7616	0.9843	1.0944	0.9864	0.0844

Table 160. NHTSA Test No. 6, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 6, Oncoming Right Curve 210 m Radius, 29.9 m to 15 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	2.3011	2.5112	1.5692	1.1400	1.0537	0.0863
	B	1	2.2629	2.5288	1.5696	1.1500	1.0554	0.0946
	B	2	2.3428	2.5707	1.6153	1.1100	1.0190	0.0910
	C	1	2.5002	2.7162	1.6902	1.1200	1.0371	0.0829
	C	2	2.4044	2.6104	1.6011	1.0800	1.0118	0.0682
Mean			2.3623	2.5875	1.6091	1.1200	1.0354	0.0846
StdDev			0.0932	0.0816	0.0496	0.0274	0.0198	0.0102
95% P.I. MOE (+/-)			0.2310	0.2022	0.1228	0.0679	0.0490	0.0253
95% P.I. Upper Limit			2.5933	2.7897	1.7319	1.1879	1.0844	0.1098
95% P.I. Lower Limit			2.1312	2.3853	1.4862	1.0521	0.9864	0.0593

Table 161. NHTSA Test No. 7, 220 m to 120 m, Reproducibility

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 220 m to 120 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.0451	0.0570	0.0363	1.2300	1.0510	0.1790
	B	1	0.0509	0.0463	0.0354	1.2200	1.0565	0.1635
	B	2	0.0452	0.0543	0.0381	1.2600	1.0604	0.1996
	C	1	0.0417	0.0462	0.0342	1.2600	1.0451	0.2149
	C	2	0.0415	0.0535	0.0385	1.2700	1.0406	0.2294
Mean			0.0449	0.0515	0.0365	1.2480	1.0507	0.1973
StdDev			0.0038	0.0049	0.0018	0.0217	0.0081	0.0266
95% P.I. MOE (+/-)			0.0095	0.0122	0.0045	0.0537	0.0200	0.0658
95% P.I. Upper Limit			0.0544	0.0637	0.0409	1.3017	1.0708	0.2631
95% P.I. Lower Limit			0.0354	0.0393	0.0320	1.1943	1.0307	0.1315

Table 162. NHTSA Test No. 7, 119.9 m to 60 m, Reproducibility

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 119.9 m to 60 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.1312	0.1307	0.1519	1.3400	1.0510	0.2890
	B	1	0.1338	0.1372	0.1707	1.3100	1.0565	0.2535
	B	2	0.1459	0.1438	0.1651	1.3300	1.0604	0.2696
	C	1	0.1263	0.1421	0.1466	1.3000	1.0451	0.2549
	C	2	0.1319	0.1335	0.1547	1.3100	1.0406	0.2694
Mean			0.1338	0.1375	0.1578	1.3180	1.0507	0.2673
StdDev			0.0073	0.0056	0.0099	0.0164	0.0081	0.0144
95% P.I. MOE (+/-)			0.0181	0.0138	0.0245	0.0407	0.0200	0.0356
95% P.I. Upper Limit			0.1520	0.1512	0.1823	1.3587	1.0708	0.3029
95% P.I. Lower Limit			0.1157	0.1237	0.1333	1.2773	1.0307	0.2317

Table 163. NHTSA Test No. 7, 59.9 m to 30 m, Reproducibility

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 59.9 m to 30 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.5283	0.5634	0.6065	1.2200	1.0510	0.1690
	B	1	0.5639	0.5699	0.6480	1.2100	1.0565	0.1535
	B	2	0.5592	0.6019	0.6697	1.2300	1.0604	0.1696
	C	1	0.5298	0.5535	0.6184	1.2200	1.0451	0.1749
	C	2	0.5405	0.5468	0.6108	1.2200	1.0406	0.1794
Mean			0.5443	0.5671	0.6307	1.2200	1.0507	0.1693
StdDev			0.0165	0.0214	0.0272	0.0071	0.0081	0.0098
95% P.I. MOE (+/-)			0.0408	0.0530	0.0674	0.0175	0.0200	0.0242
95% P.I. Upper Limit			0.5852	0.6201	0.6980	1.2375	1.0708	0.1935
95% P.I. Lower Limit			0.5035	0.5141	0.5633	1.2025	1.0307	0.1450

Table 164. NHTSA Test No. 7, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 7, Oncoming Left Curve 335 m Radius, 29.9 m to 15 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	1.9977	1.9978	1.5074	1.2100	1.0510	0.1590
	B	1	2.1093	2.1138	1.5645	1.2000	1.0565	0.1435
	B	2	2.1433	2.1672	1.6168	1.2300	1.0604	0.1696
	C	1	2.0339	2.0011	1.5308	1.2200	1.0451	0.1749
	C	2	2.0000	2.0053	1.5051	1.2200	1.0406	0.1794
Mean			2.0568	2.0570	1.5449	1.2160	1.0507	0.1653
StdDev			0.0661	0.0785	0.0468	0.0114	0.0081	0.0144
95% P.I. MOE (+/-)			0.1638	0.1946	0.1158	0.0283	0.0200	0.0356
95% P.I. Upper Limit			2.2207	2.2516	1.6607	1.2443	1.0708	0.2008
95% P.I. Lower Limit			1.8930	1.8624	1.4291	1.1877	1.0307	0.1297

Table 165. NHTSA Test No. 8, 70 m to 60 m, Reproducibility

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 70 m to 60 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.2279	0.2206	0.2559	1.1600	1.0226	0.1374
	B	1	0.2554	0.2286	0.2632	1.1200	1.0073	0.1127
	B	2	0.2317	0.2285	0.2756	1.1400	1.0066	0.1334
	C	1	0.2283	0.2280	0.2782	1.1300	0.9965	0.1335
	C	2	0.2269	0.2252	0.2656	1.1400	0.9784	0.1616
Mean			0.2340	0.2262	0.2677	1.1380	1.0023	0.1357
StdDev			0.0121	0.0034	0.0092	0.0148	0.0163	0.0174
95% P.I. MOE (+/-)			0.0300	0.0085	0.0228	0.0368	0.0403	0.0431
95% P.I. Upper Limit			0.2640	0.2346	0.2905	1.1748	1.0426	0.1789
95% P.I. Lower Limit			0.2040	0.2177	0.2450	1.1012	0.9619	0.0926

Table 166. NHTSA Test No. 8, 59.9 m to 30 m, Reproducibility

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 59.9 m to 30 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	0.6427	0.6687	0.9011	1.1600	1.0226	0.1374
	B	1	0.6783	0.6706	0.9743	1.1400	1.0073	0.1327
	B	2	0.6797	0.7000	0.9688	1.1400	1.0066	0.1334
	C	1	0.6877	0.7327	0.9650	1.1200	0.9965	0.1235
	C	2	0.6869	0.6697	0.9462	1.1000	0.9784	0.1216
Mean			0.6751	0.6883	0.9511	1.1320	1.0023	0.1297
StdDev			0.0186	0.0280	0.0298	0.0228	0.0163	0.0068
95% P.I. MOE (+/-)			0.0460	0.0695	0.0739	0.0565	0.0403	0.0169
95% P.I. Upper Limit			0.7211	0.7578	1.0250	1.1885	1.0426	0.1467
95% P.I. Lower Limit			0.6291	0.6189	0.8771	1.0755	0.9619	0.1128

Table 167. NHTSA Test No. 8, 29.9 m to 15 m, Reproducibility

NHTSA Test No. 8, Oncoming Right Curve 335 m Radius, 29.9 m to 15 m								
Descriptive Statistic	**Aimer**	**Repetition**	**Car Eye Pt (RH4)(lux)**	**Cycle Eye Pt (RH1)(lux)**	**Truck Eye Pt (RH8)(lux)**	**Pitch Maximum Over Measurement Distance Sub-Range (degrees)**	**Pitch Average Across Test Scenario Measurement Distance Range (degrees)**	**Difference Between Pitch Maximum (sub-range) and Pitch Average (entire measurement distance range) (degrees)**
	A	1	2.1289	2.3125	1.5460	1.1200	1.0226	0.0974
	B	1	2.2460	2.3620	1.5553	1.1100	1.0073	0.1027
	B	2	2.1999	2.3336	1.5726	1.1100	1.0066	0.1034
	C	1	2.2662	2.4428	1.6035	1.1000	0.9965	0.1035
	C	2	2.1850	2.3529	1.5522	1.0600	0.9784	0.0816
Mean			2.2052	2.3608	1.5659	1.1000	1.0023	0.0977
StdDev			0.0540	0.0496	0.0232	0.0235	0.0163	0.0094
95% P.I. MOE (+/-)			0.1337	0.1230	0.0575	0.0581	0.0403	0.0232
95% P.I. Upper Limit			2.3389	2.4838	1.6234	1.1581	1.0426	0.1209
95% P.I. Lower Limit			2.0715	2.2378	1.5084	1.0419	0.9619	0.0746

4.0 DISCUSSION

4.1 Findings for Test Repeatability Associated With the Measurement System

Measurement system repeatability (gauge repeatability) for the NHTSA test procedure was found to have standard deviations of 0.0570 or less across all test scenarios. For oncoming scenario test scenarios 1, 3, 4 and 7, for the 220 m -120 m measurement distance sub-range, all standard deviations were 0.005 lux or less. For the 150 m to 120 m measurement distance sub-range, all standard deviations were 0.0101 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all standard deviations were 0.0091 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0156 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0338 lux or less. For the same-direction NHTSA test scenarios 2 and 5, for the 100 m to 60 m measurement distance sub-range, all standard deviations were 0.0144 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.02214 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0570 lux or less.

For oncoming SAE test drives 1 and 2, for the 155 m measurement distance, all standard deviations were 0.0142 lux or less. For the 120 m measurement distance, all standard deviations were 0.0146 lux or less. For the 60 m measurement distance, all standard deviations were 0.0171 lux or less. For the 30 m measurement distance, all standard deviations were 0.0216 lux or less. For the preceding SAE test drives 10 and 11, for the 155 m measurement distance, all standard deviations were 0.0209 lux or less. For the 120 m measurement distance, all standard deviations were 0.0259 lux or less. For the 60 m measurement distance, all standard deviations were 0.0254 lux or less. For the 30 m measurement distance, all standard deviations were 0.0218 lux or less.

Somewhat higher standard deviations were for NHTSA test scenarios 6 and 8, as well as for SAE test drives 3 and 12. For NHTSA test scenario 6, for the 50 m to 30 m measurement distance sub-range, all standard deviations were 0.5593 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0270 lux or less. For NHTSA test scenario 8, for the 70 m to 60 m measurement distance sub-range, all standard deviations were 0.2185 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.1805 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0346 lux or less. For SAE test drive 3, for the 155 m measurement distance, all standard deviations were 0.0851 lux or less. For the 120 m measurement distance, all standard deviations were 0.0878 lux or less. For the 60 m measurement distance, all standard deviations were 0.0787 lux or less. For the 30 m measurement distance, all standard deviations were 0.018 lux or less. For SAE test drive 12, for the 155 m measurement distance, all standard deviations were 0.0887 lux or less. For the 120 m measurement distance, all standard deviations were 0.1186 lux or less. For the 60 m measurement distance, all standard deviations were 0.0974 lux or less. For the 30 m measurement distance, all standard deviations were 0.1230 lux or less.

The table below presents measurement system standard deviation results showing that the measurement system resulted in standard deviations of 0.0570 lux or less for most test scenarios for both the NHTSA and SAE test procedures. Overall, these data showed that the measurement system used in this testing contributed very little variability to the measurements.

Table 168. Measurement System: Standard Deviation Results

NHTSA	Oncoming NHTSA Test Scenarios 1, 3, 4, 7	Same-Direction NHTSA Test Scenarios 2, 5	Oncoming Right NHTSA Test Scenario 6	Oncoming Right NHTSA Test Scenario 8
Measurement Distance Sub-Range	**All standard deviations were at or below:**			
220 m - 120 m	0.0049 lux	-	-	-
150 m - 120 m	0.0101 lux	-	-	-
119.9 m - 60 m	0.0091 lux	-	-	-
100 m - 60 m	-	0.0144 lux	-	-
70 m - 60 m	-	-	-	0.2185 lux
59.9 m - 30 m	0.0156 lux	0.0221 lux	-	0.1805 lux
50 m - 30 m	-	-	0.5593 lux	-
29.9 m - 15 m	0.0338 lux	0.0570 lux	0.0270 lux	0.0346 lux
SAE	**Oncoming SAE Test Drives 1, 2**	**Preceding SAE Test Drives 10, 11, 12**	**Oncoming SAE Test Drive 3**	**Preceding SAE Test Drive 12**
Measurement Distance	**All standard deviations were at or below:**			
155 m	0.0142 lux	0.0209 lux	0.0851 lux	0.0887 lux
120 m	0.0146 lux	0.0259 lux	0.0878 lux	0.1186 lux
60 m	0.0171 lux	0.0254 lux	0.0787 lux	0.0973 lux
30 m	0.0216 lux	0.0218 lux	0.0180 lux	0.1230 lux

The maximum range of expected values for the measurement system over 8 NHTSA test scenarios, for each of the measurement sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Table 169. Expected Range of Values of the Measurement System (NHTSA Test)

95th Percentile Prediction Interval Margin of Error								
Measurement Distance Sub-Range	**Test Scenario 1**	**Test Scenario 3**	**Test Scenario 4**	**Test Scenario 6**	**Test Scenario 7**	**Test Scenario 8**	**Test Scenario 2**	**Test Scenario 5**
	Car Eye Point (RH4) (lux)						**Passenger Side Mirror (RH7) (lux)**	
220 m - 120 m	+/- 0.0117	-	-	-	+/- 0.0094	-	-	-
150 m - 120 m	-	-	+/- 0.0202	-	-	-	-	-
119.9 m - 60 m	+/- 0.0144	-	+/- 0.0212	-	+/- 0.0141	-	-	-
100 m - 60 m	-	-	-	-	-	-	+/- 0.0199	+/- 0.0124
70 m - 60 m	-	-	-	-	-	+/- 0.5184	-	-
50 m - 30 m	-	-	-	+/- 1.3270	-	-	-	-
59.9 m - 30 m	+/- 0.0245	+/- 0.0179	+/- 0.0253	-	+/- 0.0208	+/- 0.4283	+/- 0.0382	+/- 0.0252
29.9 m - 15 m	+/- 0.0704	+/- 0.0286	+/- 0.0411	+/- 0.0641	+/- 0.0624	+/- 0.0770	+/- 0.1352	+/- 0.0712

The maximum range of expected values for the measurement system over 6 SAE test drives, for each of the measurement sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Table 170. Expected Range of Values of the Measurement System (SAE Test)

95th Percentile Prediction Interval Margin of Error						
Measurement Distance	**Test Drive 1**	**Test Drive 2**	**Test Drive 3**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
	Car Eye Point (RH4) (lux)			**Car PSM (RH7) (lux)**		
155 m	+/- 0.0193	+/- 0.0238	+/- 0.2019	+/- 0.0169	+/- 0.0361	+/- 0.2038
120 m	+/- 0.0230	+/- 0.0346	+/- 0.2083	+/- 0.0159	+/- 0.0195	+/- 0.1755
60 m	+/- 0.0196	+/- 0.0301	+/- 0.1868	+/- 0.0167	+/- 0.0193	+/- 0.1370
30 m	+/- 0.0315	+/- 0.0513	+/- 0.0426	+/- 0.0156	+/- 0.0373	+/- 0.0592

4.2 Test Procedure Repeatability Findings

Test procedure repeatability analysis results indicated good repeatability of test results for the NHTSA test procedure. For the test procedure repeatability results, for the oncoming NHTSA test scenarios 1, 3, 4, and 7, for the 220 m to 120 m measurement distance sub-range, all standard deviations were 0.0076 lux or less. For the 150 m to 120 m measurement distance sub-range, all standard deviations were 0.0068 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all standard deviations were 0.015 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0599 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0713 lux or less. For the same-direction NHTSA Test Scenarios 2 and 5, for the 100 m to 60 m measurement distance sub-range, all standard deviations were 0.0153 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0494 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.1324 lux or less.

For the oncoming SAE test drives 1 and 2, for the 155 m measurement distance, all standard deviations were 0.0141 lux or less. For the 120 m measurement distance, all standard deviations were 0.0132 lux or less. For the 60 m measurement distance, all standard deviations were 0.0219 lux or less. For the 30 m measurement distance, all standard deviations were 0.0380 lux or less. For the preceding SAE test drives 10 and 11, for the 155 m measurement distance, all standard deviations were 0.0228 lux or less. For the 120 m measurement distance, all standard deviations were 0.0231 lux or less. For the 60 m measurement distance, all standard deviations were 0.0226 lux or less. For the 30 m measurement distance, all standard deviations were 0.0338 lux or less.

Like the measurement system repeatability (gauge) results, test procedure repeatability results revealed the two right curve scenarios, NHTSA Test Scenarios 6 and 8, to produce less repeatable results than the other test scenarios. For test scenario 6 for the 50 m to 30 m measurement distance sub-range, all standard deviations were 0.9648 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0651 lux or less. For NHTSA test scenario 8 for the 70 m to 60 m measurement distance sub-range, all standard deviations were 0.5996 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.5921 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0602 lux or less.

Test procedure repeatability results also revealed higher standard deviations for SAE test drives 3 and 12, which are the two test drives for which the fixture is located to the right of the test vehicle's path. For the 155 m measurement distance, all standard deviations were 0.1234 lux or less. For the 120 m measurement distance, all standard deviations were 0.1489 lux or less. For the 60 m measurement distance, all standard deviations were 0.2464 lux or less. For the 30 m measurement distance, all standard deviations were 0.0413 lux or less. For SAE test drive 12, for the 155 m measurement distance, all standard deviations were 0.1436 lux or less. For the 120 m measurement distance, all standard deviations were 0.1909 lux or less. For the 60 m measurement distance, all standard deviations were 0.3020 lux or less. For the 30 m measurement distance, all standard deviations were 0.3503 lux or less.

Both measurement system (gauge) repeatability results and full test repeatability results revealed that results for NHTSA test scenarios involving right curves to be less repeatable than the other test scenarios. A similar trend was observed for SAE test drive 3. The three scenarios that showed a pattern of higher standard deviations with respect to the other scenarios, were all scenarios in which the test fixture was positioned to the right of the vehicle's path for at least a portion of the maneuver. Variability was concluded to be attributable to the illumination cutoff at the right portion of the headlamp illumination pattern falling near the location of some of the light sensors. U.S. vehicle headlighting systems' illumination patterns often have a higher right-side horizontal cutoff for each lamp. This cutoff for both Volvo headlamps' rightmost illumination area was closer to the height of the car and motorcycle eyepoint receptor heads. This can be reasonably remedied by minor modifications to the headlamp illumination pattern produced when ADB is active as compared to the lower beam pattern evaluated for this repeatability study. With such modifications (designing a lamp to meet the requirements of this final rule) the agency anticipates that similar repeatability will be obtained for right curves as is obtained for the other scenarios. SAE test scenarios in which the test fixture was located to the right of the test vehicle also showed a pattern of higher standard deviations as compared to the other scenarios.

NHTSA performed tests to assess whether test scenarios could be executed with sufficiently steady vehicle dynamics such that, in lower beam mode, headlamp illumination measured during the dynamic test scenario would match that measured in the same location with the vehicle stationary. Measured illuminance and pitch data values were extracted for both dynamic and static test trials at specific scenario path points corresponding to an end of a glare limit distance range. NHTSA's testing demonstrated that by minimizing test vehicle accelerations during performance of test scenarios it is generally possible to maintain pitch within less than 0.3 degrees of the average pitch recorded throughout the entire measurement distance of a test scenario. Thus, this study found that dynamically-influenced variation was not a major contributor to variability in the test.

Test procedure repeatability analysis results based on the 10 test repetitions resulted in the standard deviation values shown in the table below. The table pools the standard deviation for each measurement distance sub-range for the oncoming straight and left curve scenarios (Test Scenarios 1, 3, 4, 7 – each of these tests provide similar means) and the same-direction straight and left curve scenarios (Test Scenarios 2, 5), and separately lists the standard deviation observed for the oncoming right medium curve (Test Scenario 6) and oncoming right large curve (Test Scenario 8).

Table 171. Test Procedure: Standard Deviation Results

NHTSA	Oncoming NHTSA Test Scenarios 1, 3, 4, 7	Same-Direction NHTSA Test Scenarios 2, 5	Oncoming Right NHTSA Test Scenario 6	Oncoming Right NHTSA Test Scenario 8
Measurement Distance Sub-Range	**All standard deviations were at or below:**			
220 m - 120 m	0.0076 lux	-	-	-
150 m - 120 m	0.0068 lux	-	-	-
119.9 m - 60 m	0.0156 lux	-	-	-
100 m - 60 m	-	0.0153 lux	-	-
70 m - 60 m	-	-	-	0.5996 lux
59.9 m - 30 m	0.0599 lux	0.0494 lux	-	0.5921 lux
50 m - 30 m	-	-	0.9648 lux	-
29.9 m - 15 m	0.0713 lux	0.1324 lux	0.0651 lux	0.0602 lux
SAE	**Oncoming SAE Test Drives 1, 2**	**Preceding SAE Test Drives 10, 11, 12**	**Oncoming SAE Test Drive 3**	**Preceding SAE Test Drive 12**
Measurement Distance	**All standard deviations were at or below:**			
155	0.0141 lux	0.0228 lux	0.1234 lux	0.1436 lux
120	0.0132 lux	0.0231 lux	0.1489 lux	0.1909 lux
60	0.0219 lux	0.0226 lux	0.2464 lux	0.3020 lux
30	0.0380 lux	0.0341 lux	0.0413 lux	0.3503 lux

The 95th percentile prediction intervals are calculated for the values measured in each of the measurement distance sub-ranges in the 8 NHTSA test scenarios. They are the maximum expected ranges of values that would be obtained using the test procedure described and are summarized in the following table.

Table 172. Expected Range of Values of the Test Procedure (NHTSA Test)

95th Percentile Prediction Interval Margin of Error								
Measurement Distance Sub-Range	**Test Scenario 1**	**Test Scenario 3**	**Test Scenario 4**	**Test Scenario 6**	**Test Scenario 7**	**Test Scenario 8**	**Test Scenario 2**	**Test Scenario 5**
	Car Eye Point (RH4) (lux)						**Car PSM (RH7) (lux)**	
220 m -120 m	+/- 0.0113	-	-	-	+/- 0.0128	-	-	-
150 m - 120 m	-	-	+/- 0.0145	-	-	-	-	-
119.9 m - 60 m	+/- 0.0357	-	+/- 0.0238	-	+/- 0.0171	-	-	-
100 m - 60 m	-	-	-	-	-	-	+/- 0.0331	+/- 0.0189
70 m - 60 m	-	-	-	-	-	+/- 1.4225	-	-
50 m - 30 m	-	-	-	+/- 2.2890	-	-	-	-
59.9 m - 30 m	+/- 0.0741	+/- 0.0690	+/- 0.0933	-	+/- 0.0812	+/- 1.4047	+/- 0.0963	+/- 0.1121
29.9 m - 15 m	+/- 0.1436	+/- 0.1672	+/- 0.1693	+/- 0.1534	+/- 0.1637	+/- 0.1427	+/- 0.2348	+/- 0.3141

The prediction intervals shown in the above table are small compared to the limits that are finalized for each measurement distance sub-range.

The maximum range of expected values for the test procedure over 6 SAE test drives, for each of the measurement sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Table 173. Expected Range of Values of the Test Procedure (SAE J3069 Test)

95th Percentile Prediction Interval Margin of Error						
Measurement Distance	**Test Drive 1**	**Test Drive 2**	**Test Drive 3**	**Test Drive 10**	**Test Drive 11**	**Test Drive 12**
	Car Eye Point (RH4) (lux)			**Car PSM (RH7) (lux)**		
155 m	+/- 0.0167	+/- 0.0243	+/- 0.2928	+/- 0.0193	+/- 0.0211	+/- 0.3407
120 m	+/- 0.0241	+/- 0.0314	+/- 0.3532	+/- 0.0138	+/- 0.0108	+/- 0.2761
60 m	+/- 0.0349	+/- 0.0519	+/- 0.5845	+/- 0.0232	+/- 0.0324	+/- 0.5164
30 m	+/- 0.0461	+/- 0.0749	+/- 0.0981	+/- 0.0586	+/- 0.0803	+/- 0.1862

4.3 Test Outcome Repeatability Analysis Findings

Analysis of test outcome repeatability showed glare limits were consistently met for the 6 NHTSA test scenarios having straight or left curve paths, but the two right curve scenarios were less repeatable and had glare limit exceedances for some measurement distance sub-ranges at the car driver eye point location. NHTSA ADB test scenario numbers 1 to 5 and 7 showed consistent test outcomes for all test set repetitions. For these scenarios, glare limits were consistently met for all measurement distance sub-ranges for all test repetitions resulting in passing outcomes. However, for NHTSA test scenarios 6 and 8, both oncoming right curve scenarios, some or all repetitions showed glare limit exceedances for some measurement distance sub-ranges at the car driver eye point location. For NHTSA Test Scenario 6, all 10 repetitions had at least one receptor head with a maximum illuminance value exceeding the glare limit for the 50 m to 30 m measurement distance sub-range. For NHTSA Test Scenario 8, all 10 repetitions had at least one receptor head with a maximum illuminance value exceeding the glare limits for both the 70 m to 60 m and 59.9 m to 30 m measurement distance sub-ranges. For NHTSA Test Scenario 8, for the 59.9 m to 30 m measurement distance sub-range, 5 repetitions had at least one receptor head with a maximum illuminance value exceeding the glare limit.

Breaking down the 8 NHTSA test scenarios by measurement distance sub-range and measurement points (light sensor locations) gives a total of 99 data points. The finalized test method found the same pass/fail results for 97 of the 99 data points in every one of the 10 test procedure repetitions. For the vehicle's lower beam headlamps under test, 94 of those data points, without fail, were under the glare limit criteria and 3 of the data points consistently exceeded the glare limits. The vehicle consistently failed to meet the glare criteria for Test Scenario 6 (medium right curve) at the car eye point for the sub-range 50 m to 30 m. It also consistently failed to meet the glare criterion for Test Scenario 8 (Large Right Curve) at the Car Eye and Cycle Eye point for the sub-range 70 m to 60 m. The two data points with inconsistent results (sometimes the test reported that the vehicle met the criteria and other times it reported a failure) were also found on these two right curve tests. Test Scenario 6 had mixed results at the cycle eye point for the sub-range 50 m to 30 m and test scenario 8 had mixed results at the car eye point for the sub-range 59.9 m to 30 m.

SAE J3069 test scenarios showed consistent test outcome repeatability for SAE test drives 1, 2, 10, and 11. Illuminance measurements for all receptor heads did not exceed glare limits for SAE test drives 1, 2, 10, 11, and 12. However, for SAE test drive 3, multiple receptor heads had

illuminance measurements exceeding glare limits, particularly for the 155 m, 120 m, and 60 m measurement distances. All 10 test repetitions of SAE test drive 3 had at least one receptor head with an illuminance value exceeding the glare limit for the 155 m measurement distance. Nine of the 10 test repetitions of SAE test drive 3 had at least one receptor head with an illuminance value exceeding the glare limits for the 120 m and 60 m measurement distances.

4.4 Test Procedure Margin of Error to Glare Limit Ratio Findings

The ratio of prediction interval margins of error to specific fixture measurement distance sub-ranges were calculated to estimate how much space under the glare limit is accounted for by test procedure measurement error. The prediction interval margin of error for each receptor head of each fixture measurement distance sub-range was divided by the specific glare limit for that measurement distance sub-range.

This analysis found that for the NHTSA test procedure, all ratios for test scenarios 1, 2, 3, 4, 5, and 7 were 7.9% of the glare limit or less. Exceptions to this were for test scenarios 6 and 8. For test scenario 6, the ratio was above 50% for the 50 m – 30 m measurement distance sub-range for both the Car Eye Point receptor head and the Motorcycle Eye Point receptor head. For test scenario 8, the ratio was above 50% for the 70 m – 60 m measurement distance sub-range for both the Car Eye Point receptor head and the Motorcycle Eye Point receptor head. For test scenario 8, the ratio was also above 50% for the 59.9 m – 3 0m measurement distance sub-range for the Car Eye Point receptor head.

For the SAE test procedure, all ratios for test drives 1, 2, 10, 11, and 12 were 16% of the glare limit or less. Exceptions to this were for test drive 3 which had higher ratios compared to the other drives. For test drive 3, the ratio was above 50% for the 155 m measurement distance sub-range, 120 m measurement distance sub-range, and 60 m measurement distance sub-range for the Car Eye Point receptor head. The ratio was also above 50% for the 155 m measurement distance sub-range and the 120 m measurement distance sub-range for the Motorcycle Eye Point.

4.5 Limited Test Reproducibility Assessment Findings

A limited examination or test reproducibility was conducted to examine the effects of different operators performing headlamp aiming prior to running a test set on the test results. All other aspects of these tests, including test equipment and test setup, remained the same such that the headlamp aiming process could be examined to determine if different operators following a headlight aiming procedure would result in the same test outcomes. Thus, this examination determined whether the headlight aiming procedure was reproducible, by comparison of test outcome results.

This analysis found only small differences in illuminance measurements between datasets associated with different headlamp aiming operators. More specifically, for the oncoming scenarios, Test Scenarios 1, 3, 4, 6, 7, and 8, for 220 m to 120 m measurement distance sub-range, all standard deviations were 0.0056 lux or less. For the 150 m to 120 m measurement distance sub-range, all standard deviations were 0.0068 lux or less. For the 119.9 m to 60 m measurement distance sub-range, all standard deviations were 0.0122 lux or less. For the 70 m to 50 m measurement distance sub-range, all standard deviations were 0.0121 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0365 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.0932 lux or less.

For the same-direction NHTSA Test Scenarios 2 and 5, for the 100 m to 60 m measurement distance sub-range, all standard deviations were 0.0153 lux or less. For the 59.9 m to 30 m measurement distance sub-range, all standard deviations were 0.0521 lux or less. For the 29.9 m to 15 m measurement distance sub-range, all standard deviations were 0.1264 lux or less.

Table 174. Reproducibility: Standard Deviation Results

	Oncoming NHTSA Test Scenarios 1, 3, 4, 6, 7, 8	**Same-Direction NHTSA Test Scenarios 2, 5**
Measurement Distance Sub-Range	**All standard deviations were at or below:**	
220 m - 120 m	0.0054 lux	-
150 m - 120 m	0.0068 lux	-
119.9 m - 60 m	0.0122 lux	-
100 m - 60 m	-	0.0152 lux
70 m - 60 m	0.0121 lux	-
59.9 m - 30 m	0.0365 lux	0.0520 lux
50 m - 30 m	0.0354 lux	-
29.9 m - 15 m	0.0932 lux	0.1263 lux

The maximum range of expected values for the test procedure performed by different aimers over 8 NHTSA test scenarios, including each of the measurement distance sub-ranges as quantified by the 95th percentile prediction interval, is as follows:

Table 175. Expected Range of Values of the Measurement System With Different Individuals Performing Headlamp Aiming (NHTSA ADB Test Procedure)

95th Percentile Prediction Interval Margin of Error								
Measurement Distance Sub-Range	**Test Scenario 1**	**Test Scenario 3**	**Test Scenario 4**	**Test Scenario 6**	**Test Scenario 7**	**Test Scenario 8**	**Test Scenario 2**	**Test Scenario 5**
	Car Eye Point (RH4) (lux)						**Car PSM (RH7) (lux)**	
220 m - 120 m	+/- 0.0134				+/- 0.0095			
150 m - 120 m			+/- 0.0148					
119.9 m - 60 m	+/- 0.0247		+/- 0.0301		+/- 0.0181			
100 m - 60 m							+/- 0.0183	+/- 0.0197
70 m - 60 m						+/- 0.0300		
50 m - 30 m				+/- 0.0819				
59.9 m - 30 m	+/- 0.0767	+/- 0.0407	+/- 0.0577		+/- 0.0408	+/- 0.0460	+/- 0.0787	+/- 0.0548
29.9 m - 15 m	+/- 0.2111	+/- 0.1331	+/- 0.1917	+/- 0.2310	+/- 0.1638	+/- 0.1337	+/- 0.3133	+/- 0.2786

5.0 SUMMARY

This report describes an assessment of test procedure repeatability for an ADB performance test procedure. The work described in this report involved modifying the test procedure proposed in the NPRM to use stimulus test fixtures instead of stimulus vehicles. A modified set of fewer test scenarios was also used. Testing per that the modified test procedure was conducted to provide the data needed for this analysis and to support resolution of comments on NHTSA's proposal. Testing based on SAE's Surface Vehicle Recommended Practice J3069 "Adaptive Driving Beam" test procedure was also conducted for comparison.

The assessment of test procedure repeatability based on data from 10 repetitions showed in standard deviations of 0.091 lux or less for most NHTSA test scenarios and SAE J3069 test drives. Measurement system repeatability, or gauge repeatability, for both the NHTSA and SAE J3069 ADB test procedures produced results having good repeatability as evidenced by low standard deviations and prediction intervals. Thus, the measurement system used in this testing contributed very little variability to the measurements. In general, prediction intervals demonstrated that lower beam illuminance values will consistently meet glare limits.

Exceptions to the trend of analysis results indicating favorable test repeatability were NHTSA test scenarios and the SAE test drive that involve scenario paths in which the test fixture is located to the right of the test vehicle for at least a portion of the scenario. Both measurement system (gauge) repeatability results and full test repeatability results revealed NHTSA test scenarios involving right curves (Test Scenarios 6 and 8) to be less repeatable than the other test scenarios. These two scenarios showed a pattern of higher standard deviations with respect to the other NHTSA test scenarios. SAE test drive 3, in which the test fixture was located to the right of the test vehicle, also showed a pattern of higher standard deviations as compared to the other scenarios. U.S. vehicle headlighting systems' illumination patterns often have a higher right-side horizontal cutoff for each lamp. Variability was concluded to be attributable to the illumination cutoff at the right portion of the headlamp illumination pattern falling near the location of some of the light sensors. This can be reasonably remedied by minor modifications to the headlamp illumination pattern produced when ADB is active as compared to the lower beam pattern evaluated for this repeatability study. With such modifications (designing a lamp to meet the requirements of this final rule) the agency anticipates that similar repeatability will be obtained for the right curve scenarios as is obtained for the other scenarios.

Analysis of test outcome repeatability showed glare limits were consistently met for the 6 NHTSA test scenarios having straight or left curve paths, but the two right curve scenarios were less repeatable and had glare limit exceedances for some measurement distance sub-ranges at the car driver eye point location.

Additionally, a limited examination of reproducibility was conducted to examine the effects of different operators performing headlamp aiming prior to running a test set. This analysis found only small differences in illuminance measurements between datasets associated with different headlamp aiming operators, the only variable in this analysis. Variability associated with using different individuals performing headlamp aiming was very low with standard deviations of 0.1264 lux or less for all receptor heads in all NHTSA test scenarios.

NHTSA's testing demonstrated that by minimizing test vehicle accelerations during performance of test scenarios it is generally possible to maintain pitch within less than 0.3 degrees of the average pitch recorded throughout the entire measurement distance of a test scenario. Thus, this study found that dynamically-influenced variation was not a major contributor to variability in the test. Overall, NHTSA's testing has demonstrated that measurement of headlamp illuminance in full-vehicle, dynamic testing can be accomplished in a repeatable manner.

6.0 REFERENCES

49 CFR Sec. 571.108, Standard No. 108; Lamps, reflective devices, and associated equipment.

FR 83, No. 198/pp. 51766-51813. Federal Motor Vehicle Safety Standards; Lamps, Reflective Devices, and Associated Equipment. Notice of Proposed Rulemaking.

Garrott, W. R., Hoover, R. L., Snyder, A., & Gerdus, E. (2016, December 23). Repeatability, reproducibility, and sameness of quiet vehicle test data. Docket No. NHTSA-2016-0125-0006. National Highway Traffic Safety Administration. https://regulations.gov/document/NHTSA-2016-0125-0006.

SAE J3069, Surface Vehicle Recommended Practice: Adaptive Driving Beam, Issued June 2016, www.sae.org/standards/content/j3069_201606/.