NHTSA Report No. 108-CAN-18-015-I

LAMPS, REFLECTIVE DEVICES AND ASSOCIATED EQUIPMENT FMVSS-108

Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

CALCOAST – ITL
Lighting Technology
683 Thornton Street
San Leandro, CA 94577

23 July 2018

FINAL INDICANT REPORT

PREPARED FOR

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, D.C. 20590

NHTSA Report No. 108-CAN-18-015-I

Prepared By: 

Approved By: 

Approval Date: 23 July 2018

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: 

Acceptance Date: 12/20/2018

HS # 645797

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 108-CAN-18-015-I	**2. Government Accession No.** N/A	**3. Recipient's Catalog No.** N/A	
4. Title and Subtitle Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp		**5. Report Date** 23 July 2018	
		6. Performing Organization Code N/A	
7. Author(s) Douglas Cummins, Photometric Engineer Mark Evans, Laboratory Director		**8. Performing Organization Report No.** 180410-02A	
9. Performing Organization Name and Address Calcoast - ITL 683 Thornton Street San Leandro, CA 94577		**10. Work Unit No.** N/A	
		11. Contract or Grant No. DTNH22-14-D-00370L	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance 1200 New Jersey Avenue SE West Building – 4th Floor – NVS222 Washington, D.C. 20590		**13. Type of Report and Period Covered**	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract The scope of this testing was to compare the performance from aged headlamps with lens haze against the performance from a brand new headlamp with no haze.			
17. Key Words Federal Motor Vehicle Safety Standard 108 Lamps, Reflective Devices and Associated Equipment		**18. Distribution Statement** Unlimited	
19. Security Classif. (of this report) Unclassified	**20. Security Classif. (of this report)** Unclassified	**21. No. of Pages** 17	**22. Price** N/A

Report No.: 180410-02A Page 1 of 17

INDICANT TEST REPORT

Report Date: 23 July 2018

Project Name: Haze Study -
2012 Ford F150 VOR Replaceable Bulb Headlamp
NHTSA Indicant Report 108-CAN-18-015-I

Submitted by: NHTSA Office of Vehicle Safety Compliance
Washington, D.C. 20590

Test Laboratory: Calcoast – ITL
San Leandro, CA 94577

Samples Submitted: One (1) new 2012 Ford F150 LH Replaceable Bulb Headlamp, purchased by CCITL, designated "LH1"

Two (2) aged 2012 Ford F150 LH Replaceable Bulb Headlamps, supplied by NHTSA, designated "H-LH1" and "H-LH2"

SUMMARY

The above samples' Lower Beam function were measured and compared to determine the effect of haze due to age and exposure.

Written by:

Douglas G. Cummins
Photometric Engineer

Approved by:

Mark A. Evans
Laboratory Director

SUMMARY SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

DESCRIPTION:

Two (2) aged driver's side (Left Hand or LH) headlamps from 2012 Ford F150s were purchased by NHTSA from various auto recycling yards and sent directly to CCITL. CCITL labeled the headlamps H-LH1 and H-LH2.

Brand new 2012 Ford F150 Headlamps were purchased from a local Ford Dealership by CCITL as a part of NHTSA Compliance Report No. 108-CAN-18-015. Sample LH1 was used as a comparison to the aged headlamps. LH1's bulb was used as a light source for the aged headlamps.

PROCEDURE:

Samples mounted on headlamp fixture provided by the lamp manufacturer. Headlamp fixture was mounted on level goniometer with Lower Beam light source located at goniometer center of rotation and tilt with fixture markings aligned parallel and perpendicular to detector axis at HV, then adjusted the headlamp aim hardware until the Lower Beam cutoff was located at H/2.0R and balanced from H/1.0R to H/3.0R (VOR aim). If the Lower Beam cutoff was not suitable for aiming photoelectrically (e.g. on lamps with noticeable haze), the test engineer would attempt to aim the beam visually. If the beam was not able to be aimed visually, the Lower Beam maximum was placed at the same approximate vertical location as on the new headlamp.

After aiming, each sample was tested to FMVSS 108 Table XIX Lower Beam requirements and its color measured at 1.5D/2.0R. Then the luminous intensity from 5U to 10D, 20L to 20R was measured in 0.5° increments and compiled into an isoscan plot. Two additional 5° x 5° isoscan sub-plots were provided to highlight key areas in the scan. The luminous intensity in vertical slices from 10U to 10D in 0.1° increments was also measured at the 1L and V horizontal locations.

The isoscan measured data was then used to generate an isolux plot of the illuminance on the road. The data from the single LH headlamp sample was used to produce the isolux plot of a pair of headlamps with the given mounting height and lamp separation. No data was provided on the headlamps' mounting height or separation so arbitrary values were used representing the mounting height and separation of a similar vehicle's headlamps.

PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

Headlamp Aim

LH1 (New)

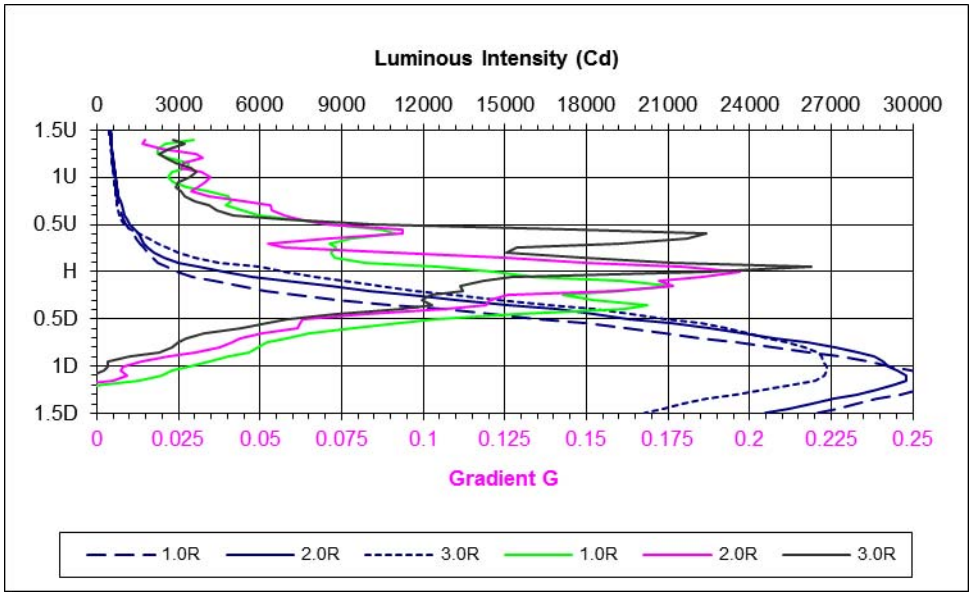
VOR Aim

Maximum Vertical Gradient

Location	Value	Required
0.15D/1.0R	0.176	> 0.13
H/2.0R	0.197	
0.05U/3.0R	0.219	

Horizontal width of cutoff is greater than 2° centered at 2.0R.

Maximum inclination of cutoff is within ±0.2°.



H-LH1 (Haze)

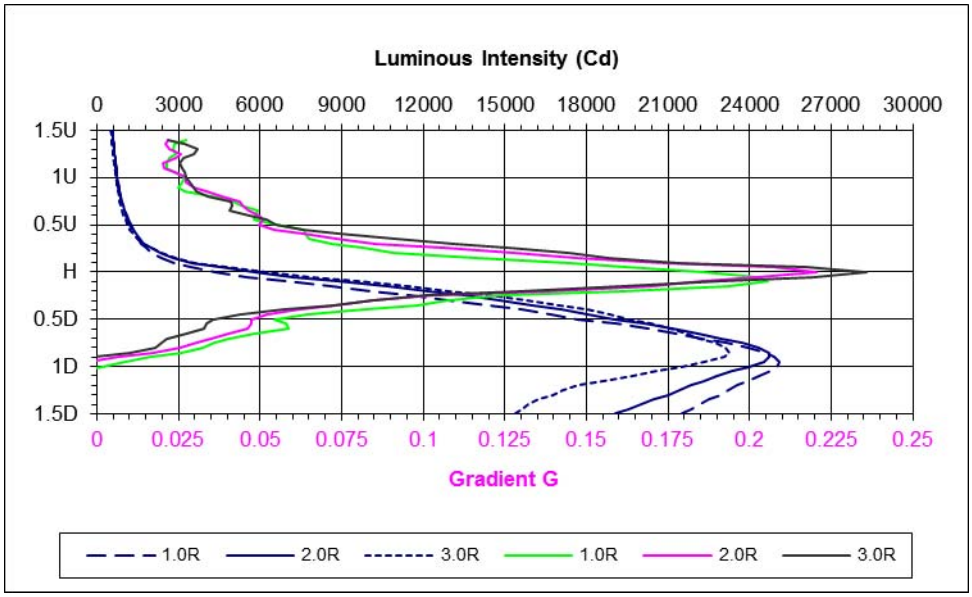
VOR Aim

Maximum Vertical Gradient

Location	Value	Required
0.10D/1.0R	0.205	> 0.13
H/2.0R	0.221	
H/3.0R	0.236	

Horizontal width of cutoff is greater than 2° centered at 2.0R.

Maximum inclination of cutoff is within ±0.2°.



New sample meets S10.18.9 Visual/Optical Aiming cutoff requirements.
Aged samples meet S10.18.9 Visual/Optical Aiming cutoff requirements.

PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

Headlamp Aim

H-LH2 (Haze)

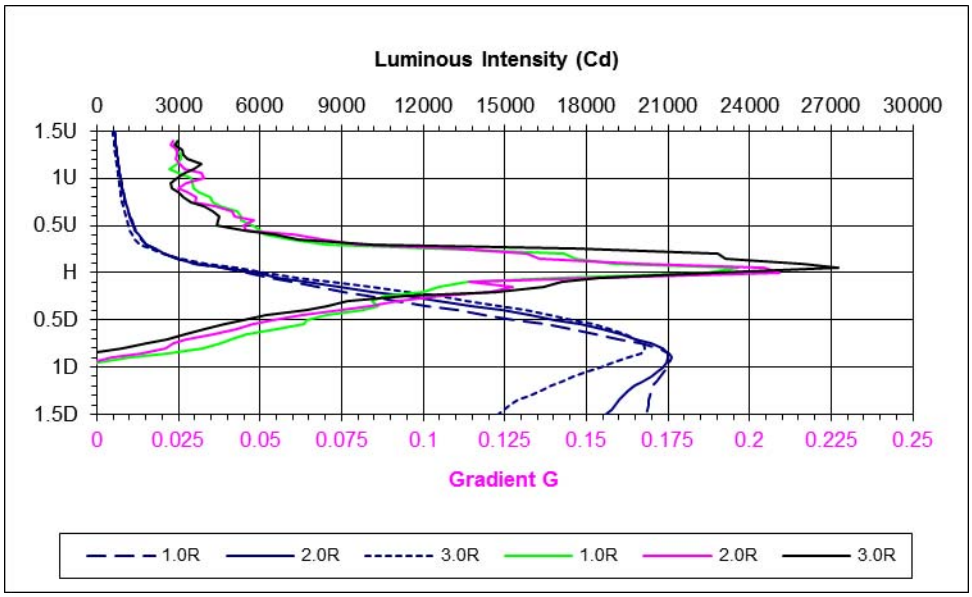
VOR Aim

Maximum Vertical Gradient

Location	Value	Required
0.05U/1.0R	0.196	> 0.13
H/2.0R	0.209	
0.05U/3.0R	0.227	

Horizontal width of cutoff is greater than 2° centered at 2.0R.

Maximum inclination of cutoff is within ±0.2°.



Aged samples meet S10.18.9 Visual/Optical Aiming cutoff requirements.

PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

Sample Number: LH1 (new)

Specification: FMVSS108 Table XIX-a: LB2V (VO Headlamp - 2 Lamp System)
Color: White, Lower Beam
Luminous Intensity, Candela

Test	Point	Location	Measured	Reaim	Minimum	Maximum
4.0U	8.0L		216.81		64	-
4.0U	8.0R		176.29		64	-
2.0U	4.0L		271.95		135	-
1.5U	1.0R TO 3.0R	3.0R	467.95		200	-
1.5U	1.0R TO R	1.8R	526.78		-	1400
1.0U	1.5L TO L	1.5L	547.10		-	700
0.5U	1.5L TO L	1.5L	794.68		-	1000
0.5U	1.0R TO 3.0R	2.9R	1033.98		500	-
0.5U	1.0R TO 3.0R	2.1R	1278.99		-	2700
H	8.0L		838.45		64	-
H	4.0L		1468.17		135	-
H	V		2558.87		-	-
0.6D	1.3R		20834.68		10000	-
0.9D	3.5L		11230.43		1800	12000
0.9D	V		26039.02		4500	-
1.5D	2.0R		24434.67		15000	-
2.0D	15.0L		2777.37		1000	-
2.0D	9.0L		6716.12		1250	-
2.0D	9.0R		4713.36		1250	-
2.0D	15.0R		2151.85		1000	-
4.0D	20.0L		1892.83		300	-
4.0D	V		5801.20		-	-
4.0D	4.0R		4868.52		-	12500
4.0D	20.0R		969.25		300	-
MAXIMUM		1.2D 0.5R	31556.39		-	-
MX(10U-90U/90L-90R)		10.0U 3.0R	78.05		-	125

Sample meets test requirements at all points.

Bulb: Seasoned Sylvania H13 furnished with sample @ 12.80V / 4.581A

Aim: Sample mounted on fixture provided by Ford. Fixture mounted on level goniometer with H13 filament located at goniometer center of rotation and tilt with fixture markings aligned parallel and perpendicular to detector axis at HV. Adjusted aim hardware until LB Gmax located at H/2.0R and level from H/1.0R to H/3.0R (VOR aim).

PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

Sample Number: H-LH1 (aged)

Specification: FMVSS108 Table XIX-a: LB2V (VO Headlamp - 2 Lamp System)
Color: White, Lower Beam
Luminous Intensity, Candela

Test	Point	Location	Measured	Reaim	Minimum	Maximum
4.0U	8.0L		221.56		64	-
4.0U	8.0R		186.25		64	-
2.0U	4.0L		323.87		135	-
1.5U	1.0R TO 3.0R	2.7R	492.25		200	-
1.5U	1.0R TO R	1.7R	590.83		-	1400
1.0U	1.5L TO L	1.5L	682.61		-	700
0.5U	1.5L TO L	1.5L	986.45		-	1000
0.5U	1.0R TO 3.0R	3.0R	1135.99		500	-
0.5U	1.0R TO 3.0R	1.5R	1279.29		-	2700
H	8.0L		716.84		64	-
H	4.0L		1500.72		135	-
H	V		3912.77		-	-
0.6D	1.3R		21022.55		10000	-
0.9D	3.5L		12102.43	8338.96	1800	12000
0.9D	V		25989.53		4500	-
1.5D	2.0R		19000.19		15000	-
2.0D	15.0L		2767.62		1000	-
2.0D	9.0L		6100.85		1250	-
2.0D	9.0R		3844.00		1250	-
2.0D	15.0R		1888.31		1000	-
4.0D	20.0L		1767.39		300	-
4.0D	V		4642.13		-	-
4.0D	4.0R		4104.42		-	12500
4.0D	20.0R		891.15		300	-
MAXIMUM		0.9D 0.5R	25748.63		-	-
MX(10U-90U/90L-90R)		10.0U 5.2L	101.76		-	125

Sample meets test requirements at all points.

Bulb: Seasoned Sylvania H13 furnished with new sample "LH1" @ 12.80V / 4.584A

Aim: Sample mounted on fixture provided by Ford. Fixture mounted on level goniometer with H13 filament located at goniometer center of rotation and tilt with fixture markings aligned parallel and perpendicular to detector axis at HV. Adjusted aim hardware until LB Gmax located at H/2.0R and level from H/1.0R to H/3.0R (VOR aim).

PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

Sample Number: H-LH2 (aged)

Specification: FMVSS108 Table XIX-a: LB2V (VO Headlamp - 2 Lamp System)
Color: White, Lower Beam
Luminous Intensity, Candela

Test	Point	Location	Measured	Reaim	Minimum	Maximum
4.0U	8.0L		190.49		64	-
4.0U	8.0R		186.81		64	-
2.0U	4.0L		331.99		135	-
1.5U	1.0R TO 3.0R	3.0R	585.86		200	-
1.5U	1.0R TO R	1.2R	653.61		-	1400
1.0U	1.5L TO L	1.5L	789.79	633.69	-	700
0.5U	1.5L TO L	1.5L	1080.26	885.76	-	1000
0.5U	1.0R TO 3.0R	3.0R	1160.33		500	-
0.5U	1.0R TO 3.0R	1.4R	1400.06		-	2700
H	8.0L		834.89		64	-
H	4.0L		1715.28		135	-
H	V		6068.77		-	-
0.6D	1.3R		18333.94		10000	-
0.9D	3.5L		11783.81		1800	12000
0.9D	V		21252.22		4500	-
1.5D	2.0R		18770.49		15000	-
2.0D	15.0L		2410.92		1000	-
2.0D	9.0L		5892.55		1250	-
2.0D	9.0R		4094.76		1250	-
2.0D	15.0R		2005.05		1000	-
4.0D	20.0L		1390.18		300	-
4.0D	V		4701.00		-	-
4.0D	4.0R		4114.97		-	12500
4.0D	20.0R		781.50		300	-
MAXIMUM		0.9D 0.9R	21565.05		-	-
MX(10U-90U/90L-90R)		10.0U 4.1L	119.29		-	125

Sample meets test requirements at all points.

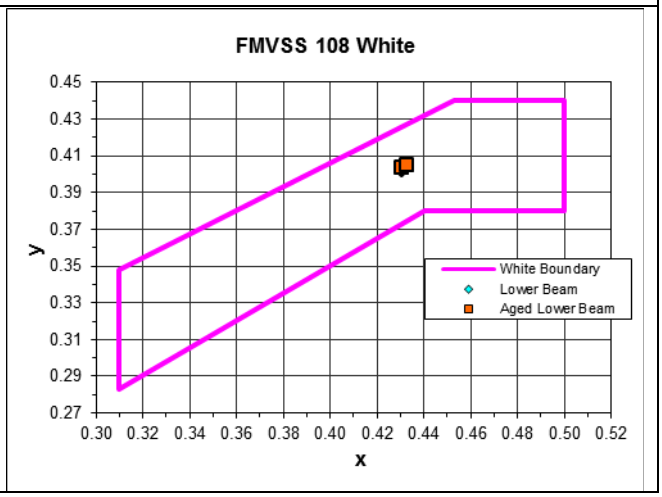
Bulb: Seasoned Sylvania H13 furnished with new sample "LH1" @ 12.80V / 4.584A

Aim: Sample mounted on fixture provided by Ford. Fixture mounted on level goniometer with H13 filament located at goniometer center of rotation and tilt with fixture markings aligned parallel and perpendicular to detector axis at HV. Adjusted aim hardware until LB Gmax located at H/2.0R and level from H/1.0R to H/3.0R (VOR aim).

COLOR TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

Requirement: FMVSS 108 S14.4.1 Color Test
Test Method: FMVSS 108 S14.4.1.4 Tristimulus Method
Average of 3 reads
Instrument: Photo Research PR-655 Spectroradiometer with SRS-3 Target
Location: 1.5D/2.0R (Lower Beam), 25 ft
Voltages: 12.8V (Lower Beam)

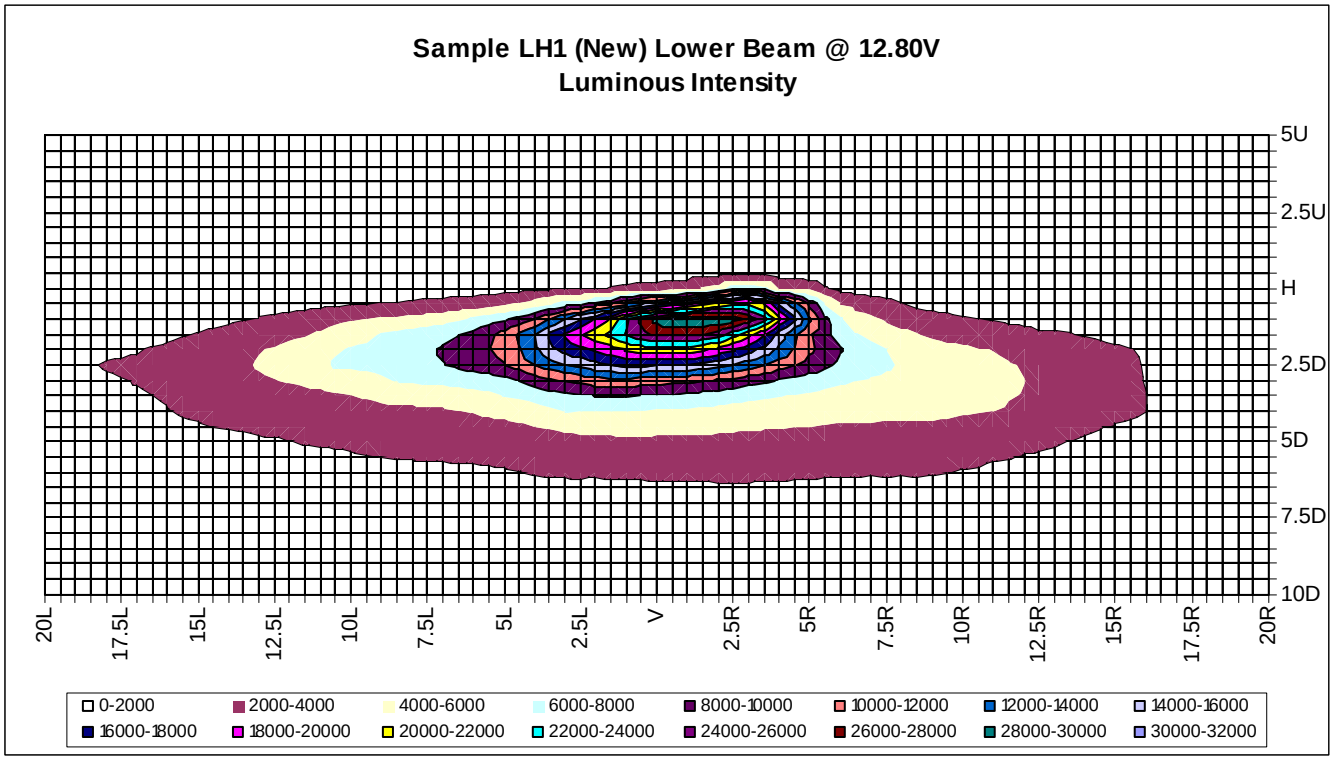
Measured (x, y)	Required	Chart
New LH1 (0.4304, 0.4023) Aged H-LH1 (0.4307, 0.4035) H-LH2 (0.4329, 0.4045)	0.31 ≤ x ≤ 0.50 0.38 ≤ y ≤ 0.44 y ≥ 0.75x + 0.05 y ≤ 0.64x + 0.15	

PHOTOMETRIC TEST DATA SHEET

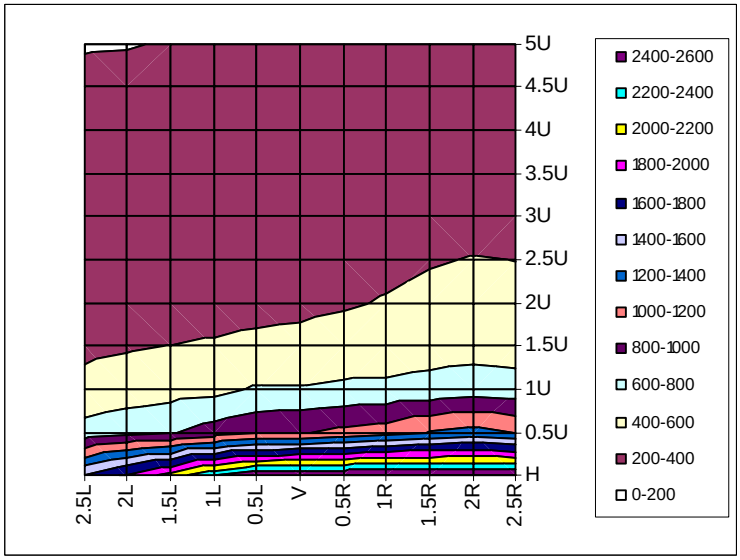
Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

ISO Scans

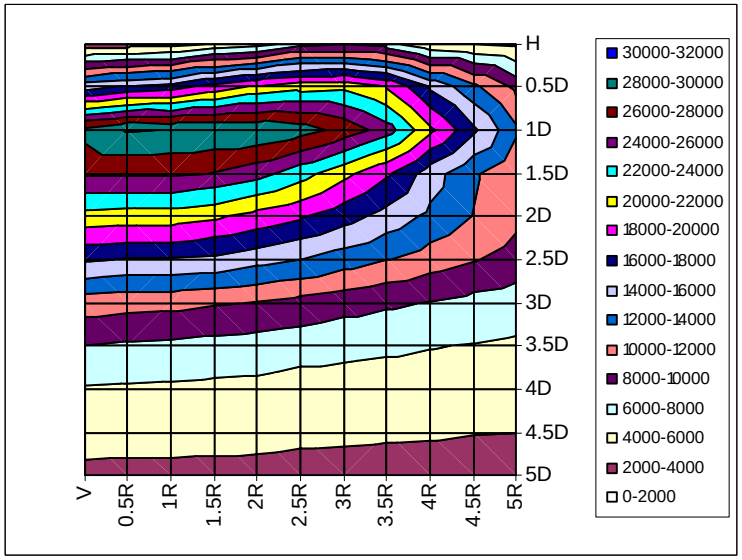
5U to 10D / 20L to 20R / 0.5° increments



Max Intensity: 30248 Cd @ 1.0D / 0.5R
Beam Flux: 391 Lm



5U to H / 2.5L to 2.5R



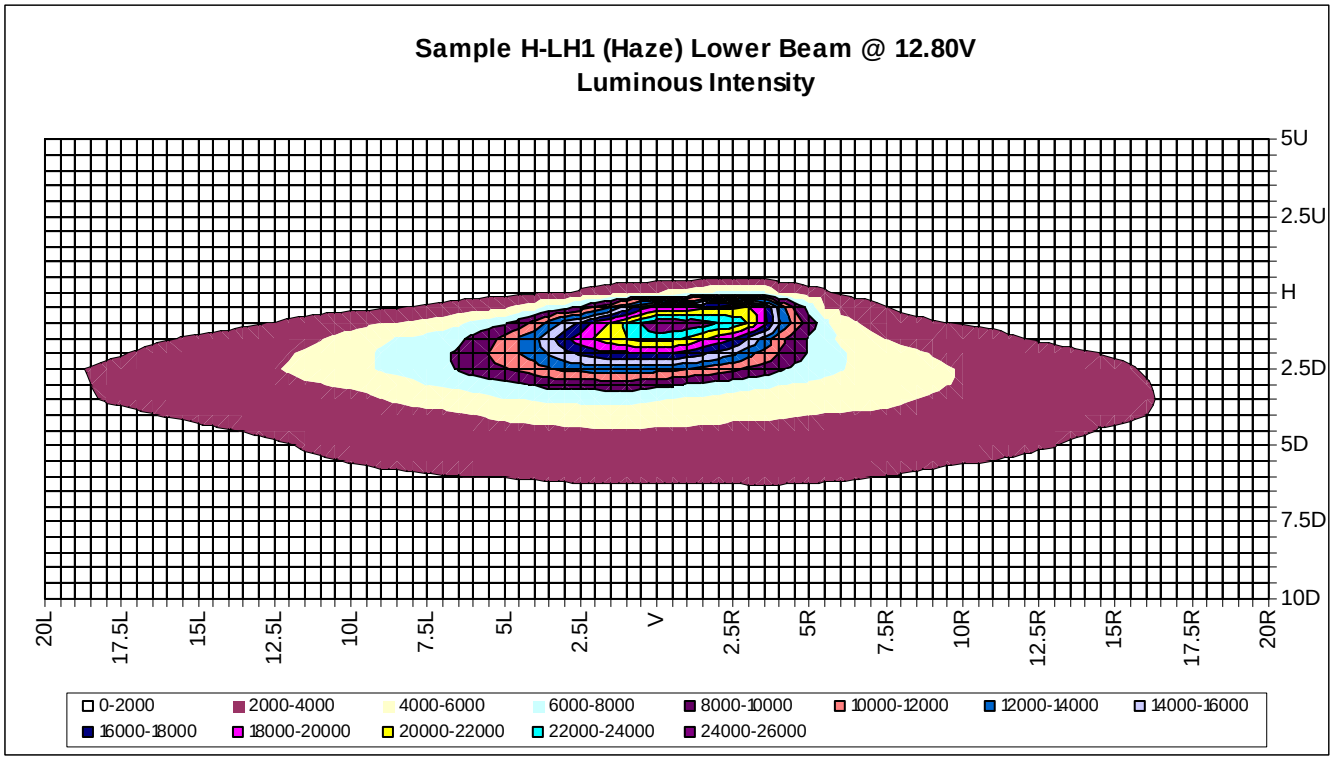
H to 5D / V to 5R

PHOTOMETRIC TEST DATA SHEET

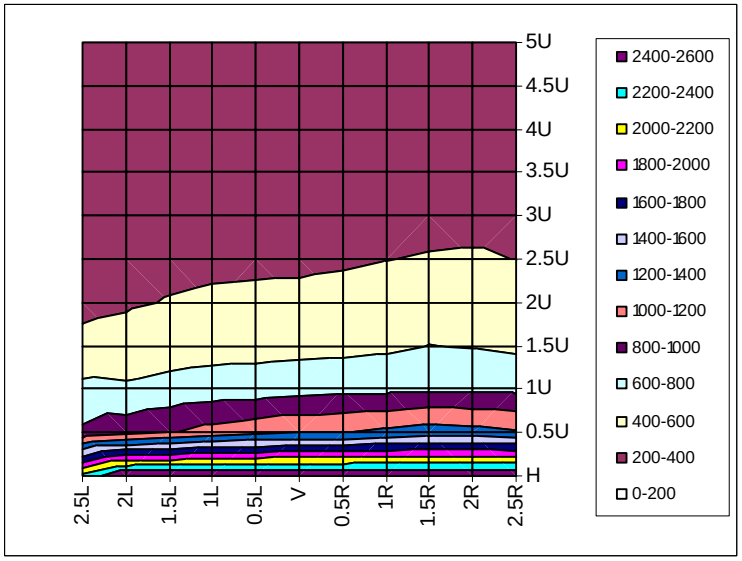
Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

ISO Scans

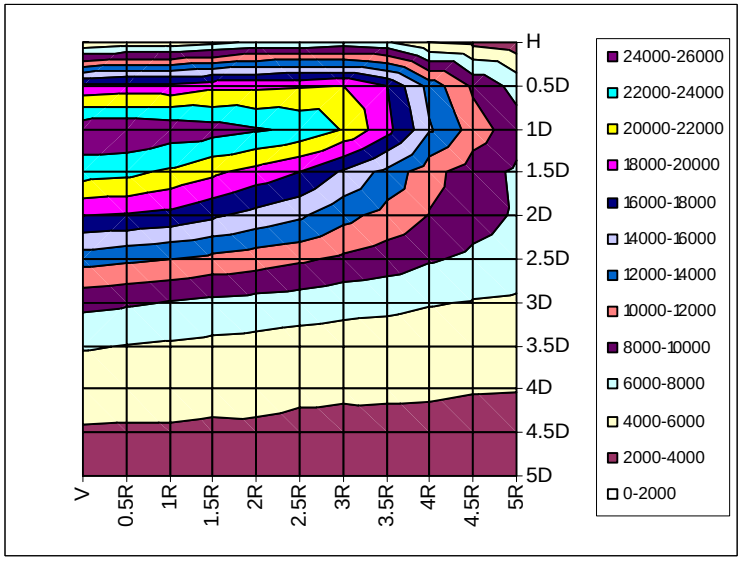
5U to 10D / 20L to 20R / 0.5° increments



Max Intensity: 25654 Cd @ 1.0D / V
Beam Flux: 356 Lm



5U to H / 2.5L to 2.5R



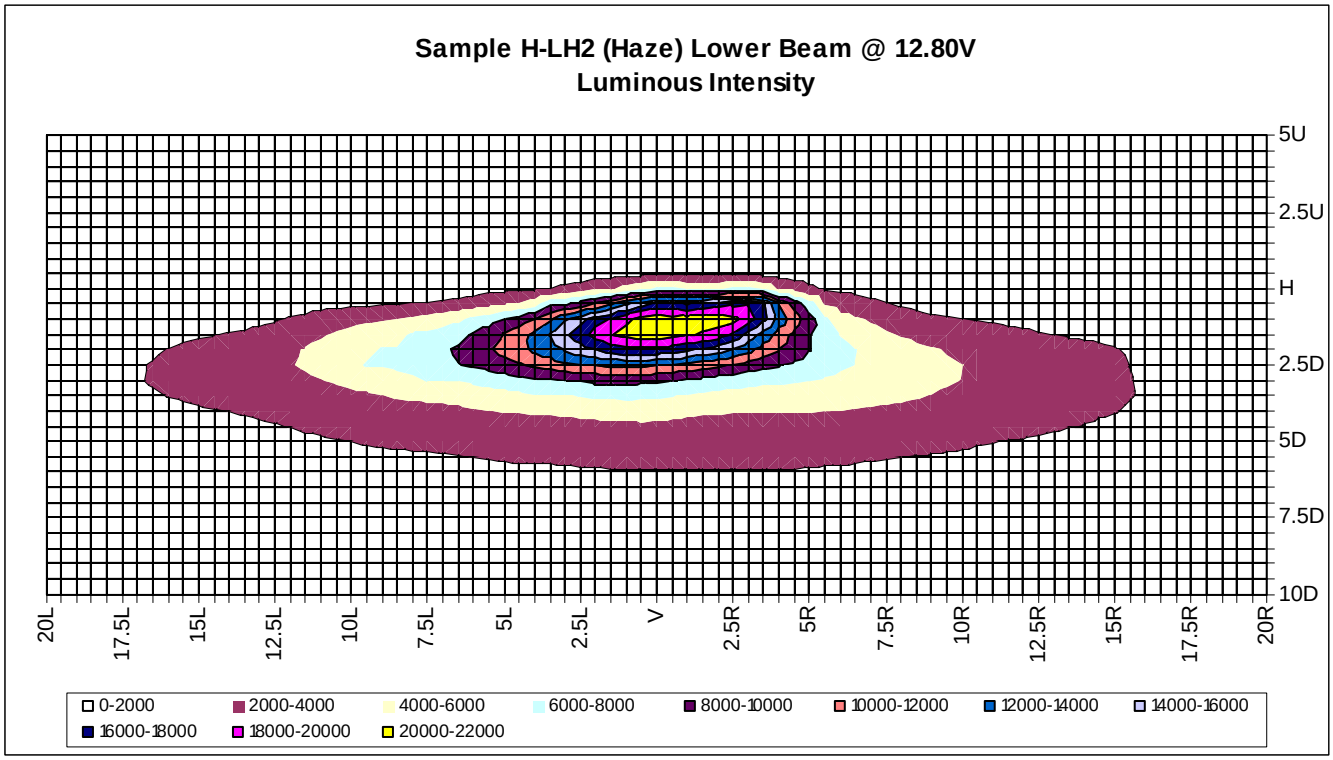
H to 5D / V to 5R

PHOTOMETRIC TEST DATA SHEET

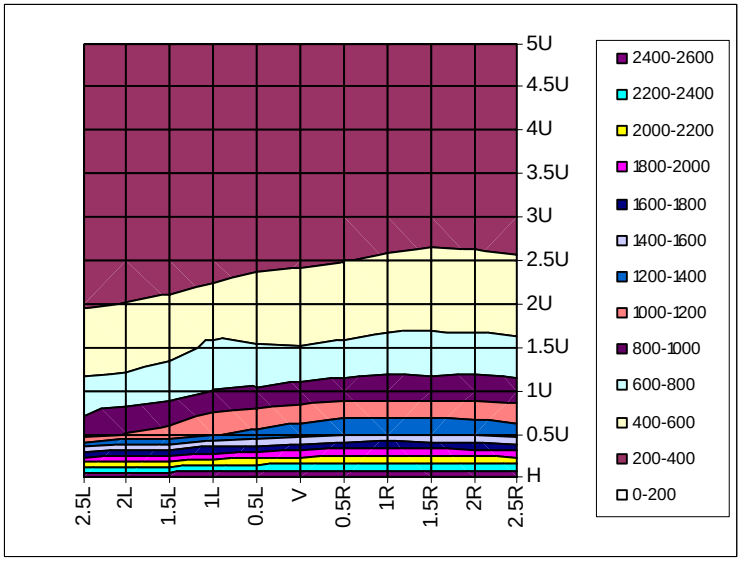
Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

ISO Scans

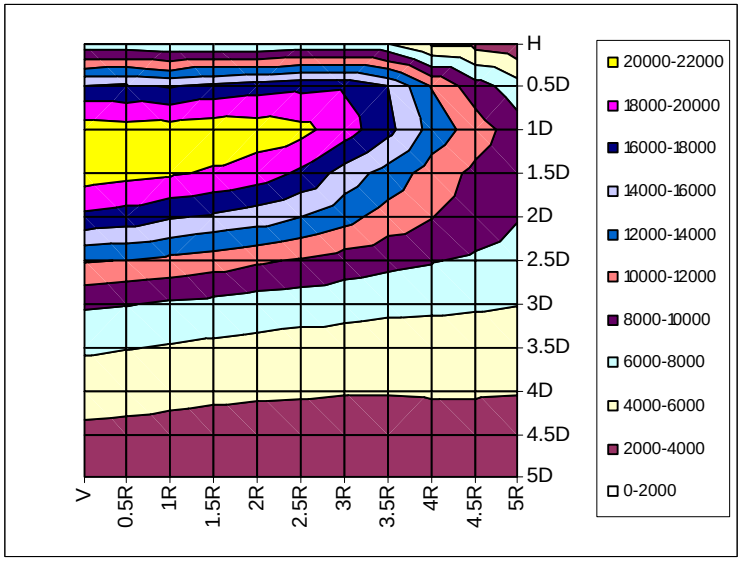
5U to 10D / 20L to 20R / 0.5° increments



Max Intensity: 21371 Cd @ 1.0D / 1.5R
Beam Flux: 335 Lm



5U to H / 2.5L to 2.5R



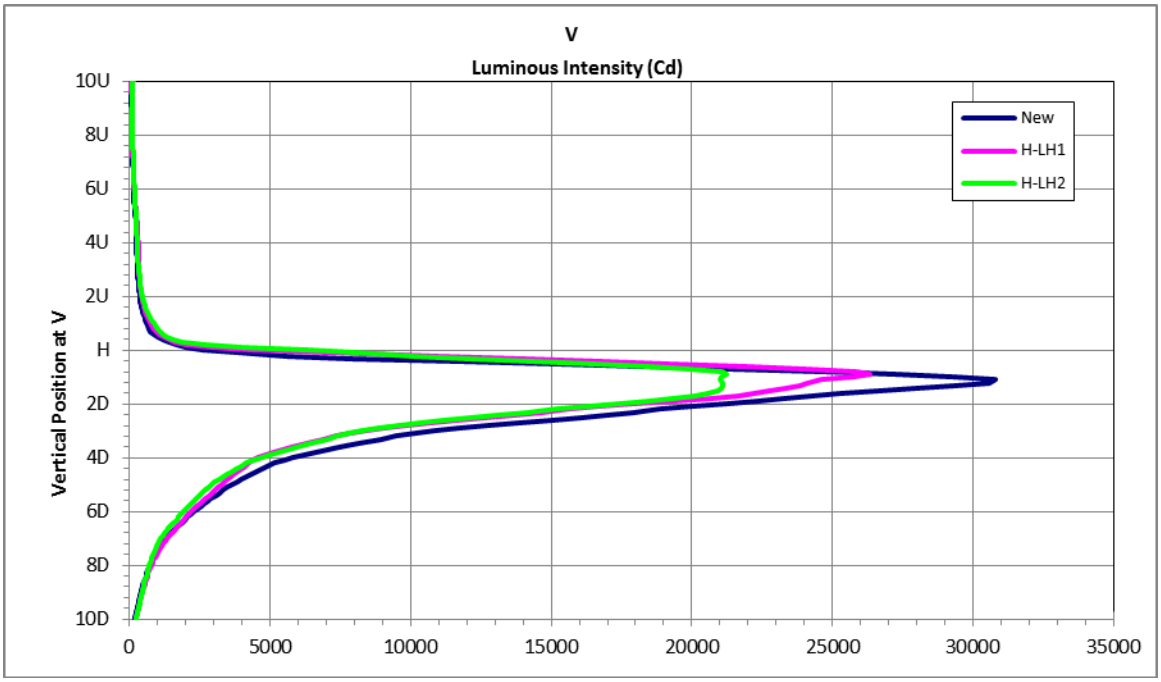
H to 5D / V to 5R

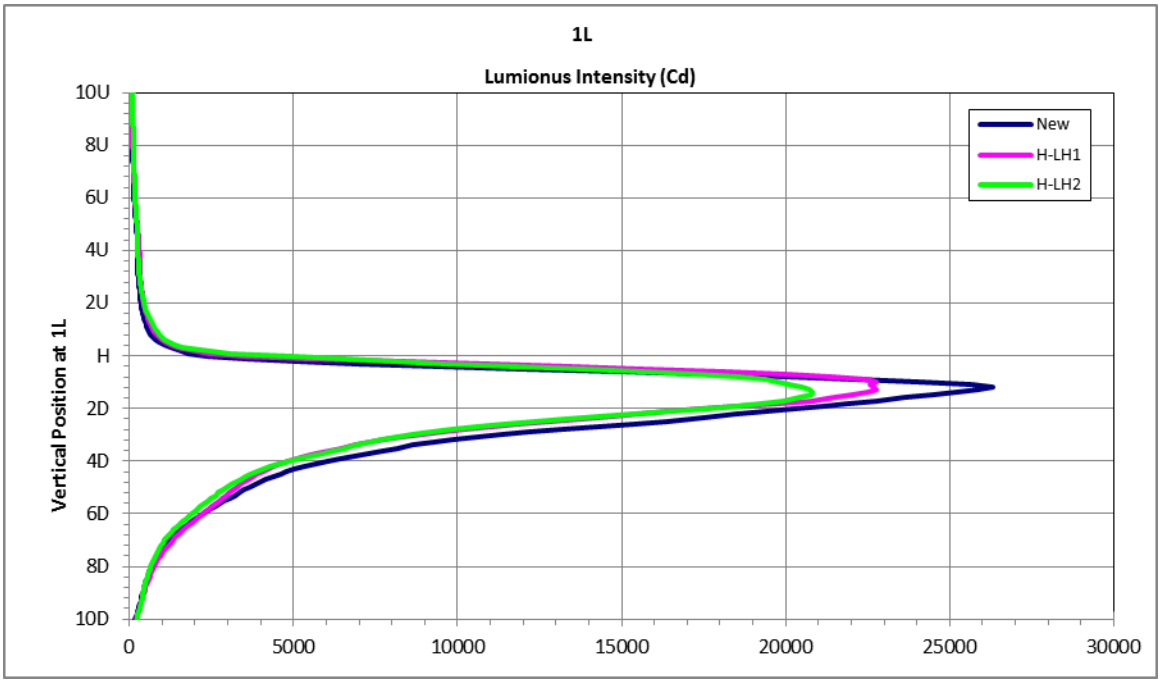
PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

Vertical Line Scans

10U to 10D / 0.1° increments along the V-V line and at 1L





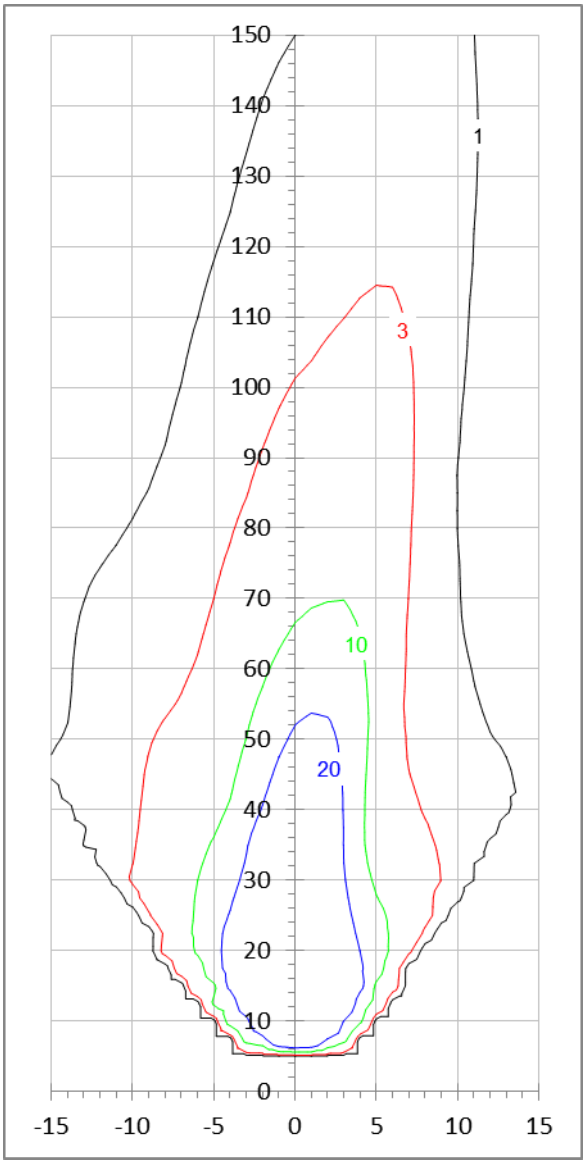
PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

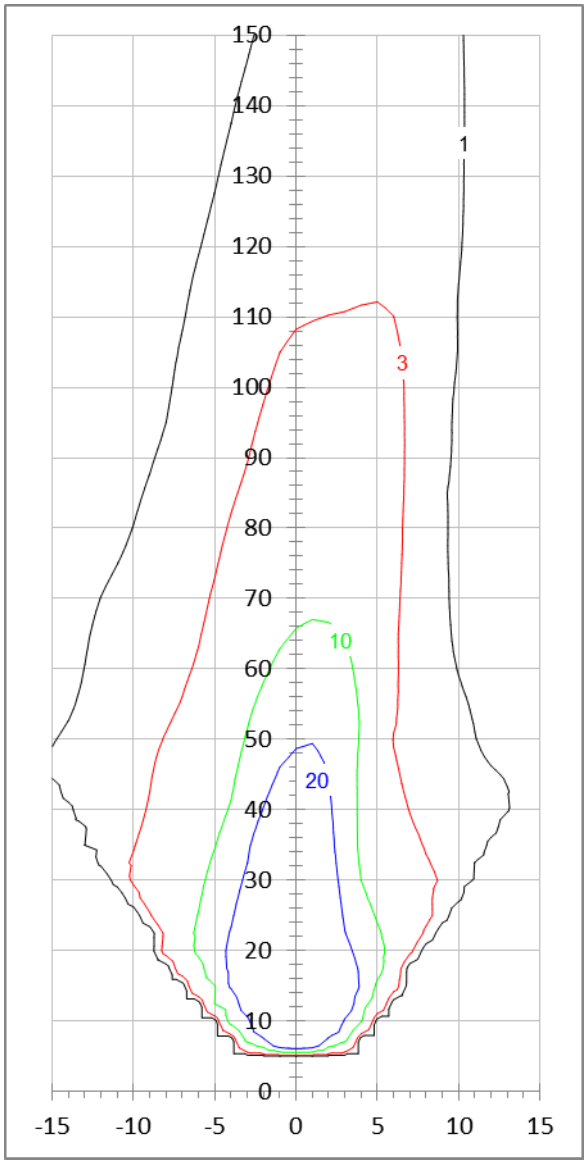
IsoLux projection on road

Lateral dimensions (from vehicle centerline): -15 m to 15 m, 1 m increments
Road Dimension (from lamp source): 0 m to 150 m, 2.5 m increments
Isolux contour lines of 1, 3, 10, and 20 lux

Mounting Height: 0.91 m
Headlamp Separation: 1.52 m



LH1 (New)



H-LH1 (Haze)

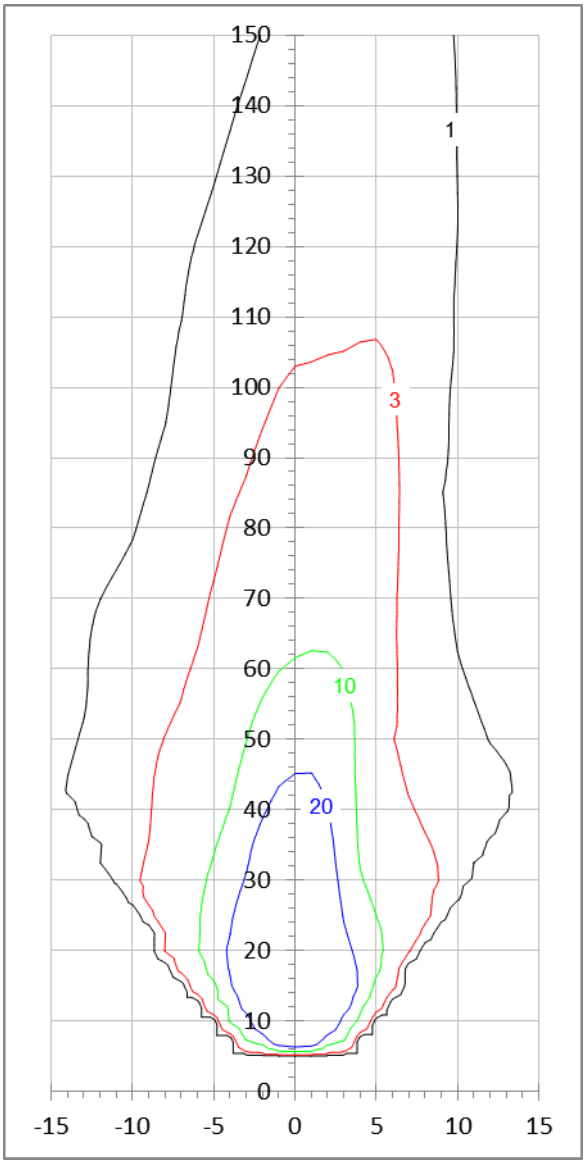
PHOTOMETRIC TEST DATA SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

IsoLux projection on road

Lateral dimensions (from vehicle centerline): -15 m to 15 m, 1 m increments
Road Dimension (from lamp source): 0 m to 150 m, 2.5 m increments
Isolux contour lines of 1, 3, 10, and 20 lux

Mounting Height: 0.91 m
Headlamp Separation: 1.52 m



H-LH2 (Haze)

PHOTOGRAPH SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

LH1 (New) for 2012 Ford F150

Lamp on Provided Fixture

PHOTOGRAPH SHEET

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

H-LH1 from 2012 Ford F150

H-LH2 from 2012 Ford F150

EQUIPMENT LIST

Project Name: Haze Study - 2012 Ford F150 VOR Replaceable Bulb Headlamp

PHOTOMETRY / COLOR — Last Calibrated

Goniometer
ITL Custom with Aerotech ART-330, 320 Stepper Motors .....07 Jan 2015
[resolution 0.001°, accuracy ±0.01°(±0.05%)] .....[due every 5 years]

Luminous Intensity
Hoffman TSP-7501(HG), S/N 1060 .....15 Jan 2018
[0.1 Cd to 600 kCd, ±0.01 Cd, accuracy ±2.0%] ..... [due every 12 months]

Color – Spectroradiometric
Photoresearch PR-655 w/MS-75 lens & SRS-3 target,
S/N 65160706 ..... 20 June 2018
[resolution ±2nm, (x, y) ±0.001, ±4% luminance] ..... [due every 12 months]

ELECTRICAL — Last Calibrated

DC Power Supply
HP6652A, S/N 3347A-01634 .....N/A
[500W, 0-20V, 0-25A] ..... [use DMMs for measurement]

Voltage
Fluke 45 (#1), S/N 7934019 .....15 Jan 2018
[resolution 0.01V, accuracy ±0.02%] ..... [due every 12 months]

Current
Keithley 197A (#1), S/N 741430 .....15 Jan 2018
[resolution 0.001A, accuracy ±0.02%] ..... [due every 12 months]