

**LAMPS, REFLECTIVE DEVICES AND ASSOCIATED EQUIPMENT FMVSS-108**

**Haze Study - 2012 Toyota Corolla VOR RBHL**

**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

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NHTSA Report No. 108-CAN-18-011-I

Prepared By:




Approved By:



Approval Date: 23 July 2018

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By:



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Acceptance Date:

14/20/2018

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HS # 645799

TECHNICAL REPORT STANDARD TITLE PAGE

<b>1. Report No.</b> 108-CAN-18-011-I	<b>2. Government Accession No.</b> N/A	<b>3. Recipient's Catalog No.</b> N/A	
<b>4. Title and Subtitle</b> Haze Study - 2012 Toyota Corolla VOR RBHL		<b>5. Report Date</b> 23 July 2018	
<b>7. Author(s)</b> Douglas Cummins, Photometric Engineer Mark Evans, Laboratory Director		<b>6. Performing Organization Code</b> N/A	
<b>9. Performing Organization Name and Address</b> Calcoast - ITL 683 Thornton Street San Leandro, CA 94577		<b>8. Performing Organization Report No.</b> 180417-01A	
<b>12. Sponsoring Agency Name and Address</b> U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance 1200 New Jersey Avenue SE West Building - 4 <sup>th</sup> Floor - NVS222 Washington, D.C. 20590		<b>10. Work Unit No.</b> N/A	
<b>15. Supplementary Notes</b>		<b>11. Contract or Grant No.</b> DTNH22-14-D-00370L	
<b>16. Abstract</b> 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.		<b>13. Type of Report and Period Covered</b>	
<b>17. Key Words</b> Federal Motor Vehicle Safety Standard 108 Lamps, Reflective Devices and Associated Equipment		<b>14. Sponsoring Agency Code</b>	
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## INDUSTRIAL TESTING LABORATORY

Report No.: 180417-01A

Page 1 of 17

**INDICANT TEST REPORT**

Report Date: 23 July 2018

Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL  
NHTSA Indicant Report 108-CAN-18-011-ISubmitted by: NHTSA Office of Vehicle Safety Compliance  
Washington, D.C. 20590Test Laboratory: Calcoast - ITL  
San Leandro, CA 94577Samples Submitted: One (1) new 2007 Toyota Corolla RBHL,  
purchased by CCITL, designated "LH1"  
Two (2) aged 2012 Toyota Corolla RBHLs,  
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:

Approved by:

Handwritten signature of Douglas G. Cummins in blue ink.

Douglas G. Cummins  
Photometric Engineer

Handwritten signature of Mark A. Evans in blue ink.

Mark A. Evans  
Laboratory Director

**SUMMARY SHEET**

Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL

**DESCRIPTION:**

Two (2) aged driver's side (Left Hand or LH) headlamps from 2012 Toyota Corollas 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 Toyota Corolla Headlamps were purchased from a local Toyota Dealership by CCITL as a part of NHTSA Compliance Report No. 108-CAN-18-011. 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 Toyota Corolla VOR RBHL

Headlamp Aim

LH1 (New)

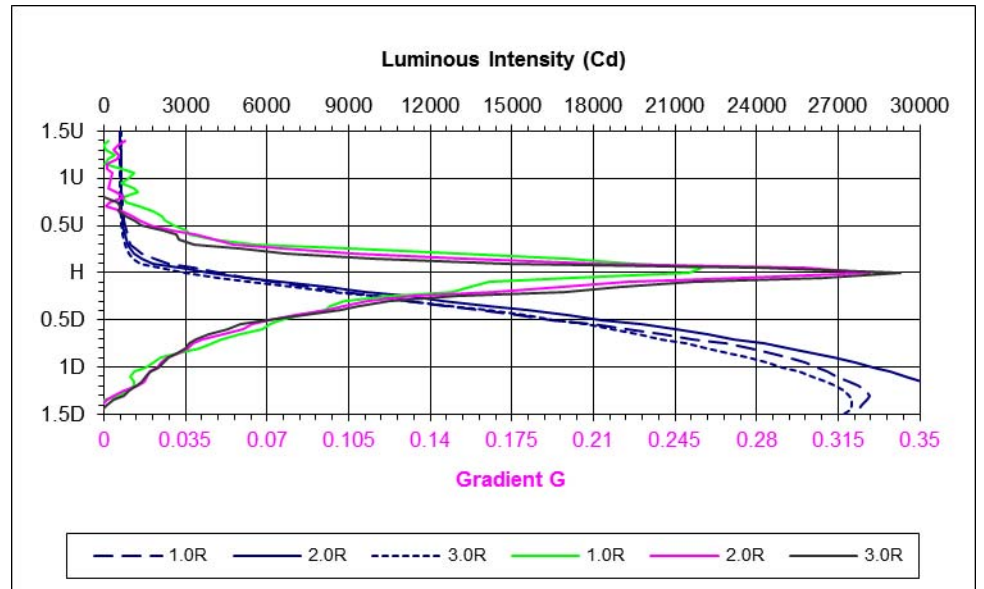
VOR Aim

Maximum Vertical Gradient

Location	Value	Required
0.05U/1.0R	0.257	> 0.13
H/2.0R	0.329	
H/3.0R	0.342	

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

Maximum inclination of cutoff is within ±0.2°.



H-LH1 (Haze)

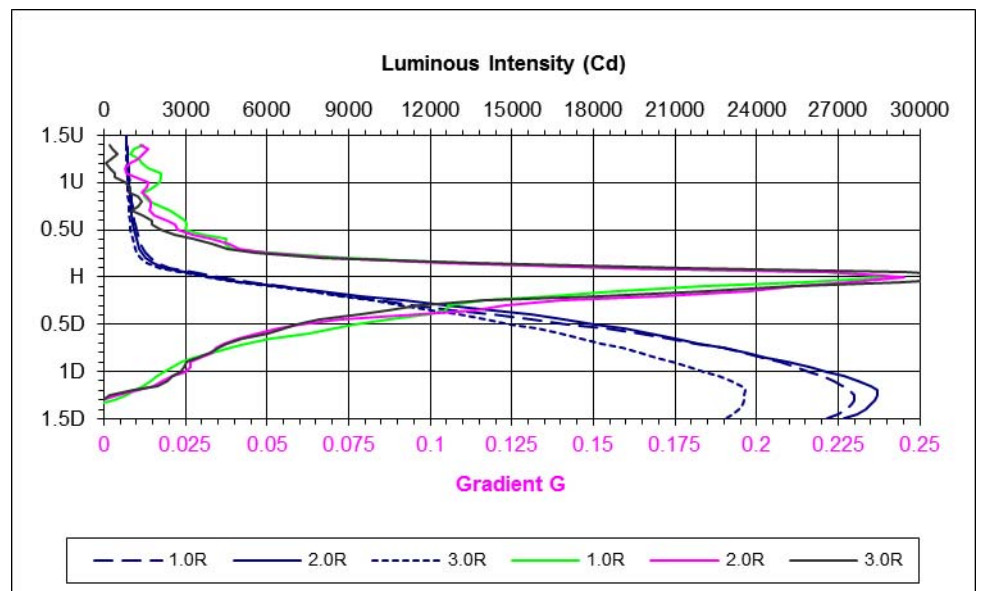
VOR Aim

Maximum Vertical Gradient

Location	Value	Required
H/1.0R	0.242	> 0.13
H/2.0R	0.245	
H/3.0R	0.270	

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 Toyota Corolla VOR RBHL

Headlamp Aim

H-LH2 (Haze)

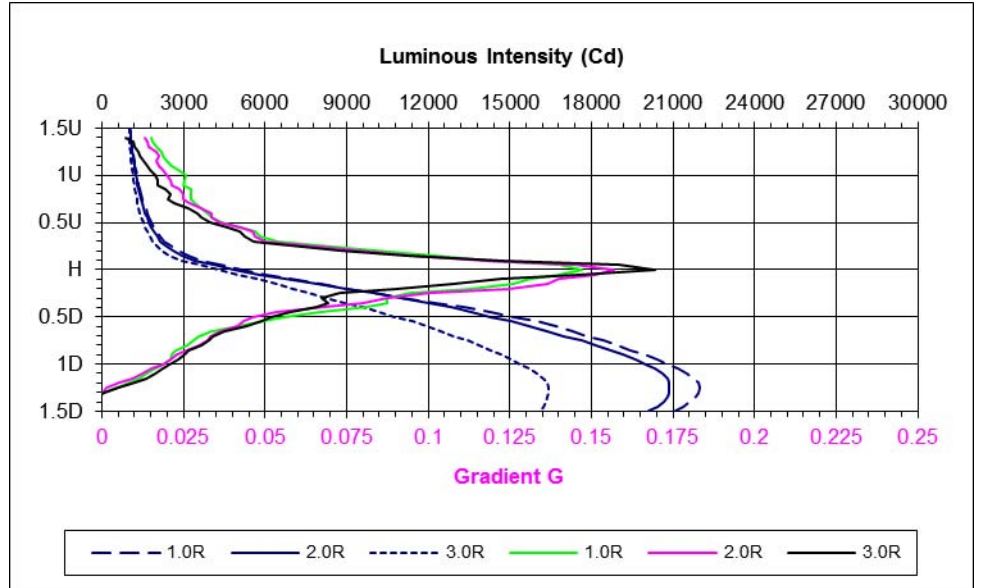
VOR Aim

Maximum Vertical Gradient

Location	Value	Required
H/1.0R	0.147	> 0.13
H/2.0R	0.157	
H/3.0R	0.170	

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 Toyota Corolla VOR RBHL

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		242.59		64	-
4.0U 8.0R		231.73		64	-
2.0U 4.0L		377.67		135	-
1.5U 1.0R TO 3.0R	1.8R	571.63		200	-
1.5U 1.0R TO R	3.3R	672.37		-	1400
1.0U 1.5L TO L	1.5L	448.33		-	700
0.5U 1.5L TO L	1.5L	544.28		-	1000
0.5U 1.0R TO 3.0R	3.0R	649.44		500	-
0.5U 1.0R TO 3.0R	1.1R	790.04		-	2700
H 8.0L		643.73		64	-
H 4.0L		996.22		135	-
H V		2560.43		-	-
0.6D 1.3R		20615.59		10000	-
0.9D 3.5L		6855.88		1800	12000
0.9D V		18119.37		4500	-
1.5D 2.0R		29858.02		15000	-
2.0D 15.0L		2977.25		1000	-
2.0D 9.0L		5858.00		1250	-
2.0D 9.0R		3636.02		1250	-
2.0D 15.0R		1331.04		1000	-
4.0D 20.0L		1898.34		300	-
4.0D V		8705.02		-	-
4.0D 4.0R		7736.53		-	12500
4.0D 20.0R		815.41		300	-
MAXIMUM	1.3D 1.8R	30950.46		-	-
MX(10U-90U/90L-90R)	10.0U 6.5L	79.21		-	125

Sample meets test requirements at all points.

Bulb: Seasoned Sylvania HB4 furnished with sample @ 12.80V / 4.217A

Aim: Sample mounted on fixture provided by NAL. Fixture mounted on level goniometer with HB4 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 Toyota Corolla VOR RBHL

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		268.56		64	-
4.0U 8.0R		257.69		64	-
2.0U 4.0L		496.95		135	-
1.5U 1.0R TO 3.0R	1.2R	805.66		200	-
1.5U 1.0R TO R	2.3R	832.47		-	1400
1.0U 1.5L TO L	1.5L	818.86	691.46	-	700
0.5U 1.5L TO L	1.5L	995.66		-	1000
0.5U 1.0R TO 3.0R	3.0R	983.40		500	-
0.5U 1.0R TO 3.0R	1.0R	1193.65		-	2700
H 8.0L		818.09		64	-
H 4.0L		1294.06		135	-
H V		3060.45		-	-
0.6D 1.3R		21030.51		10000	-
0.9D 3.5L		6955.15		1800	12000
0.9D V		18856.64		4500	-
1.5D 2.0R		27230.18		15000	-
2.0D 15.0L		2928.50		1000	-
2.0D 9.0L		5729.88		1250	-
2.0D 9.0R		3545.70		1250	-
2.0D 15.0R		1309.85		1000	-
4.0D 20.0L		1984.45		300	-
4.0D V		8552.03		-	-
4.0D 4.0R		7072.83		-	12500
4.0D 20.0R		538.66		300	-
MAXIMUM	1.2D 1.7R	28950.52		-	-
MX(10U-90U/90L-90R)	10.0U 7.3L	93.76		-	125

Sample meets test requirements at all points.

Bulb: Seasoned Sylvania HB4 furnished with "LH1" sample @ 12.80V / 4.217A

Aim: Sample mounted on fixture provided by NAL. Fixture mounted on level goniometer with HB4 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 Toyota Corolla VOR RBHL

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		354.32		64	-
4.0U 8.0R		321.48		64	-
2.0U 4.0L		634.45		135	-
1.5U 1.0R TO 3.0R	3.0R	984.67		200	-
1.5U 1.0R TO R	2.0R	1026.42		-	1400
1.0U 1.5L TO L	1.5L	1161.86	978.07*	-	700
0.5U 1.5L TO L	1.5L	1549.78	1272.31*	-	1000
0.5U 1.0R TO 3.0R	3.0R	1537.63		500	-
0.5U 1.0R TO 3.0R	1.0R	1835.32		-	2700
H 8.0L		1133.61		64	-
H 4.0L		1816.44		135	-
H V		4500.77		-	-
0.6D 1.3R		16918.97		10000	-
0.9D 3.5L		6848.93		1800	12000
0.9D V		17041.81		4500	-
1.5D 2.0R		20162.73		15000	-
2.0D 15.0L		2723.93		1000	-
2.0D 9.0L		5186.03		1250	-
2.0D 9.0R		2922.75		1250	-
2.0D 15.0R		1080.95		1000	-
4.0D 20.0L		1927.51		300	-
4.0D V		7448.65		-	-
4.0D 4.0R		5851.63		-	12500
4.0D 20.0R		429.97		300	-
MAXIMUM	1.2D 1.0R	22199.71		-	-
MX(10U-90U/90L-90R)	10.0U 4.9L	131.76*		-	125

\* - Denotes Failure.

Bulb: Seasoned Sylvania HB4 furnished with "LH1" sample @ 12.80V / 4.217A

Aim: Sample mounted on fixture provided by NAL. Fixture mounted on level goniometer with HB4 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 Toyota Corolla VOR RBHL

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)

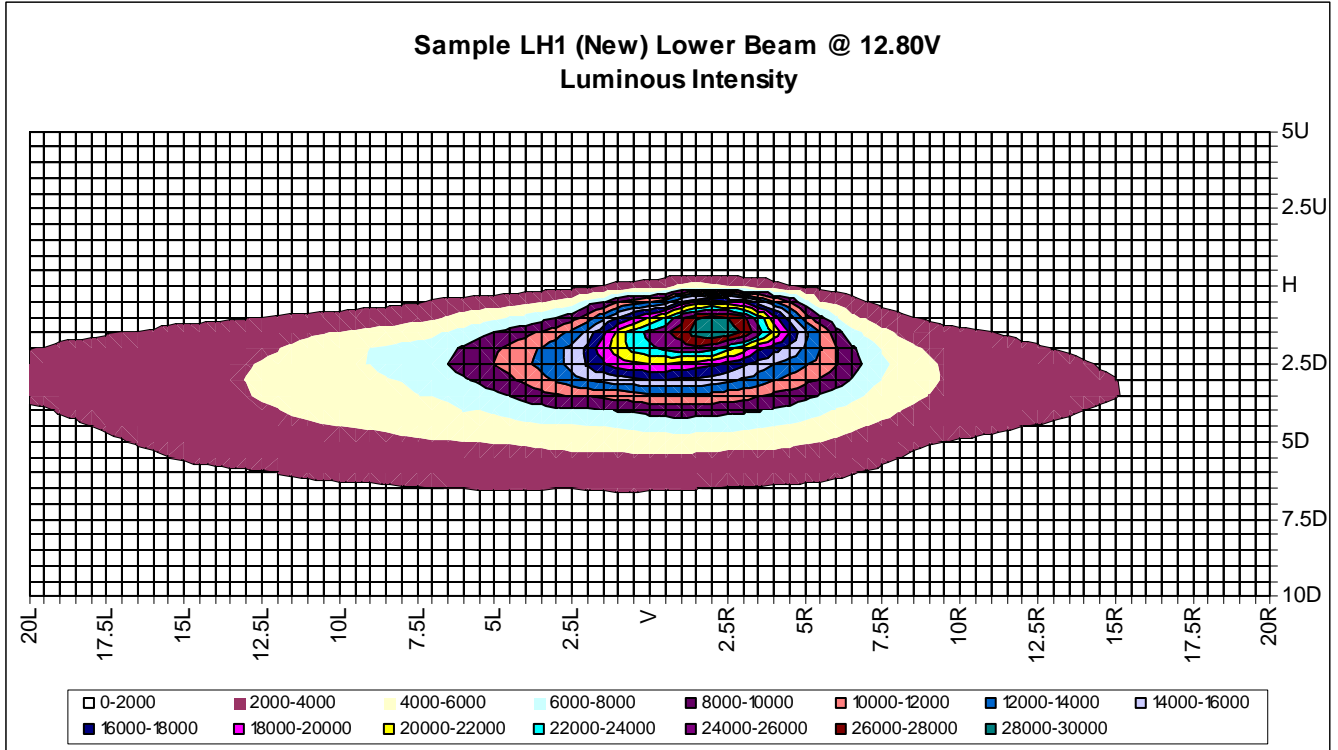
Measured (x, y)	Required	Chart
<u>New</u> LH1 (0.4295, 0.4020)	$0.31 \leq x \leq 0.50$ $0.38 \leq y \leq 0.44$	
<u>Aged</u> H-LH1 (0.4314, 0.4034)	$y \geq 0.75x + 0.05$	
H-LH2 (0.4401, 0.4062)	$y \leq 0.64x + 0.15$	

**PHOTOMETRIC TEST DATA SHEET**

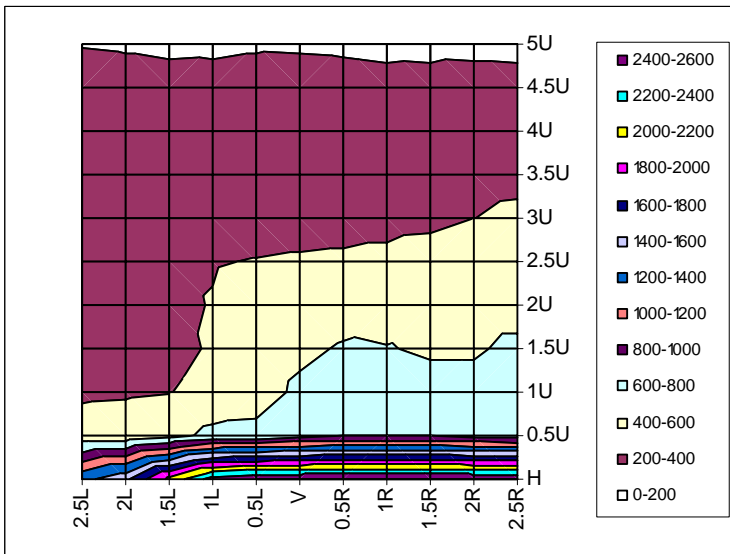
Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL

ISO Scans

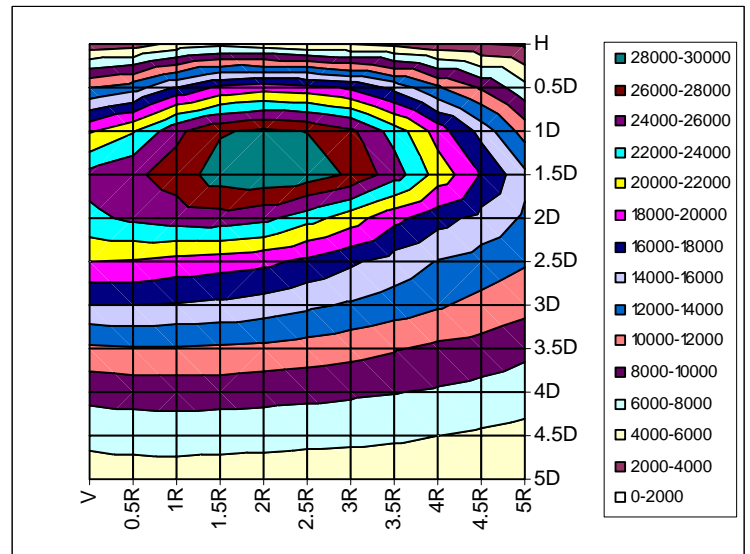
5U to 10D / 20L to 20R / 0.5° increments



Max Intensity: 29606 Cd @ 1.5D / 2.0R  
Beam Flux: 403 Lm



5U to H / 2.5L to 2.5R



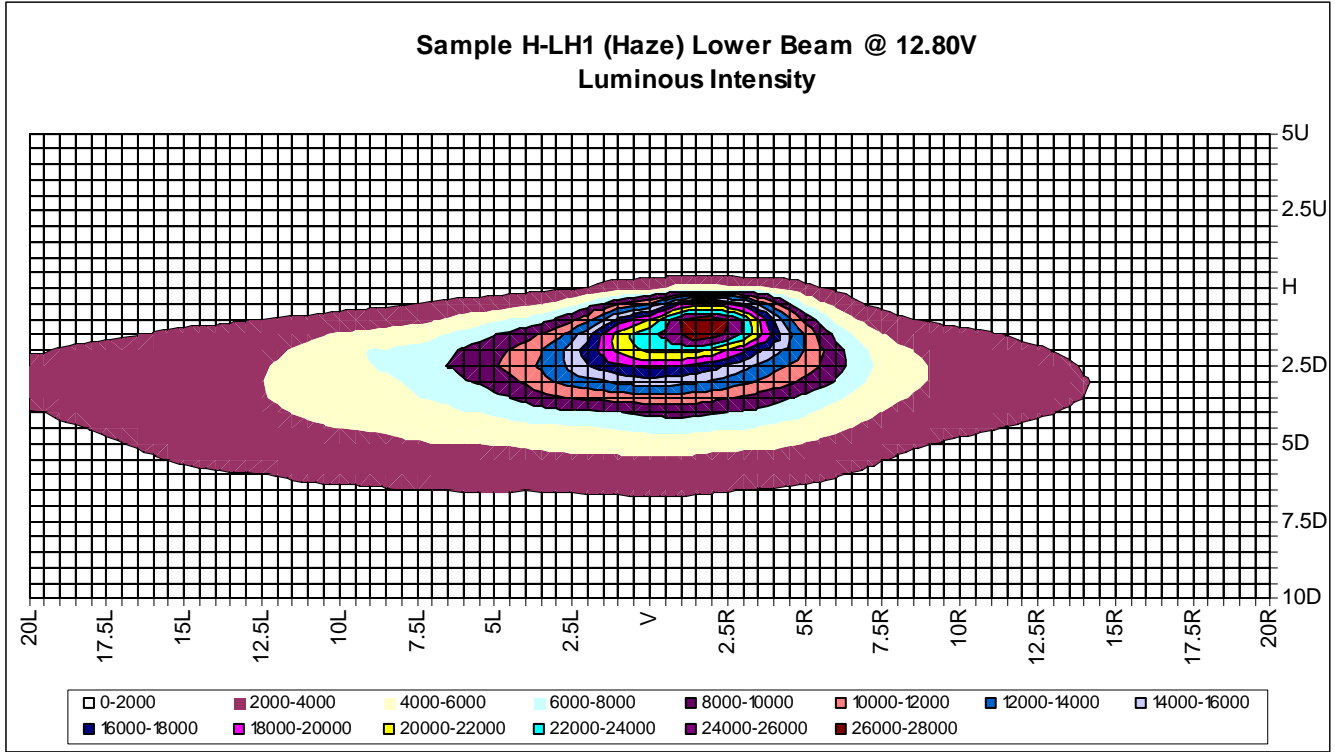
H to 5D / V to 5R

**PHOTOMETRIC TEST DATA SHEET**

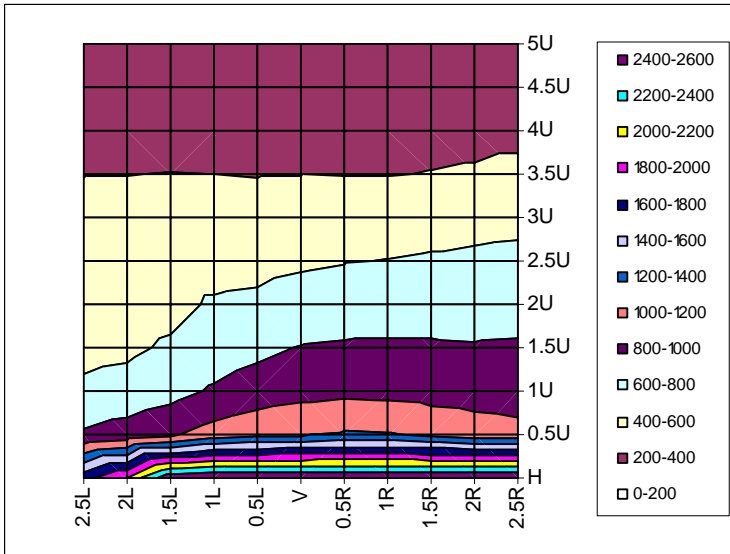
Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL

ISO Scans

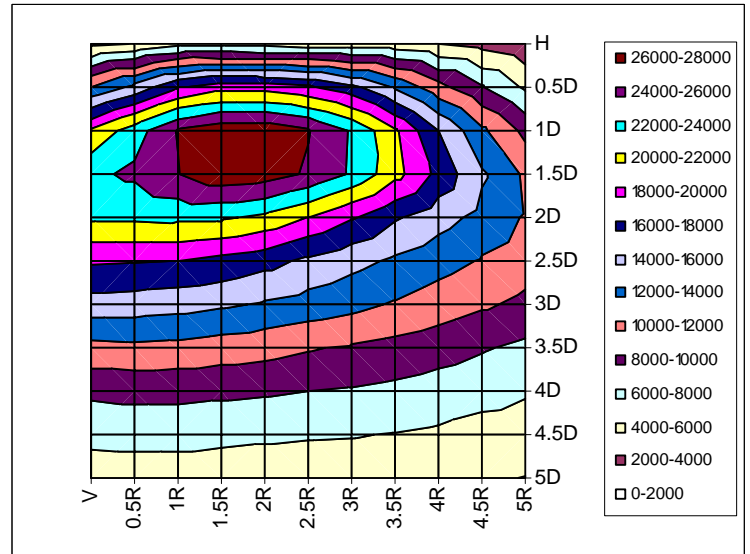
5U to 10D / 20L to 20R / 0.5° increments



Max Intensity: 27473 Cd @ 1.0D / 2.0R  
Beam Flux: 396 Lm



5U to H / 2.5L to 2.5R



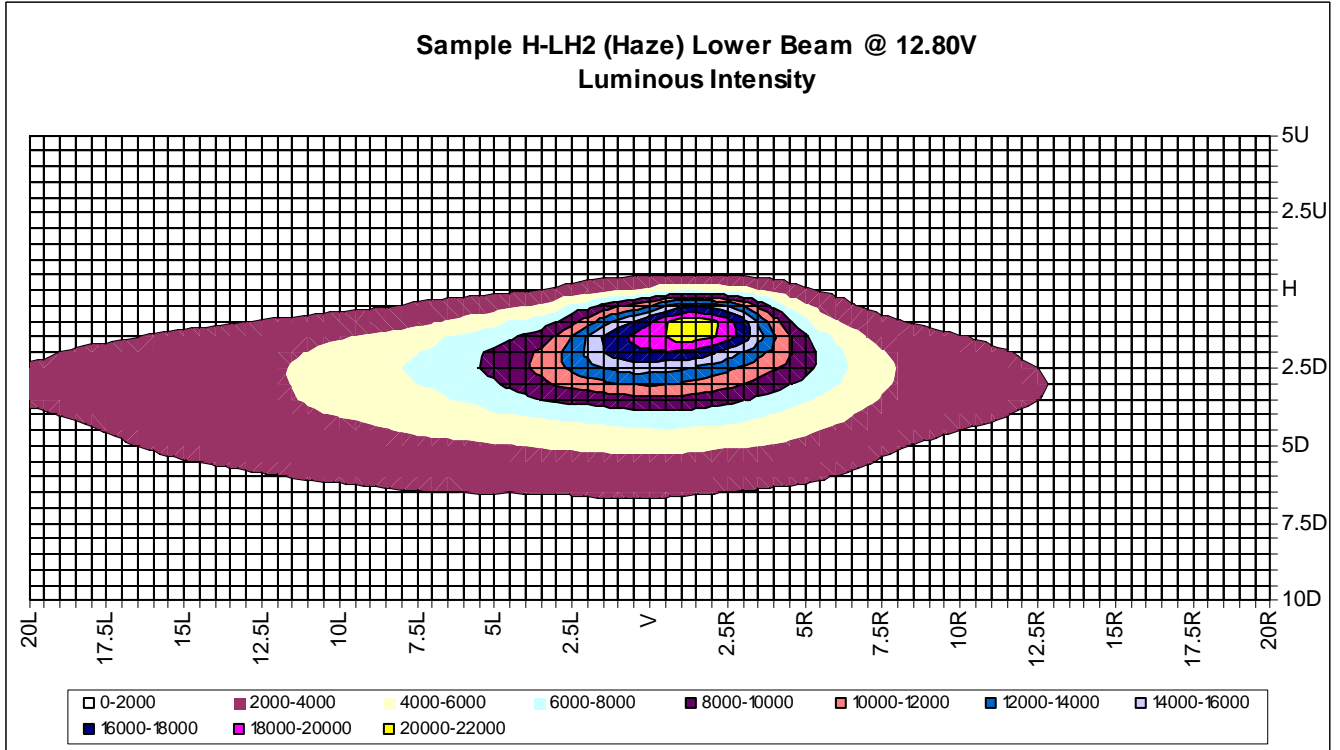
H to 5D / V to 5R

**PHOTOMETRIC TEST DATA SHEET**

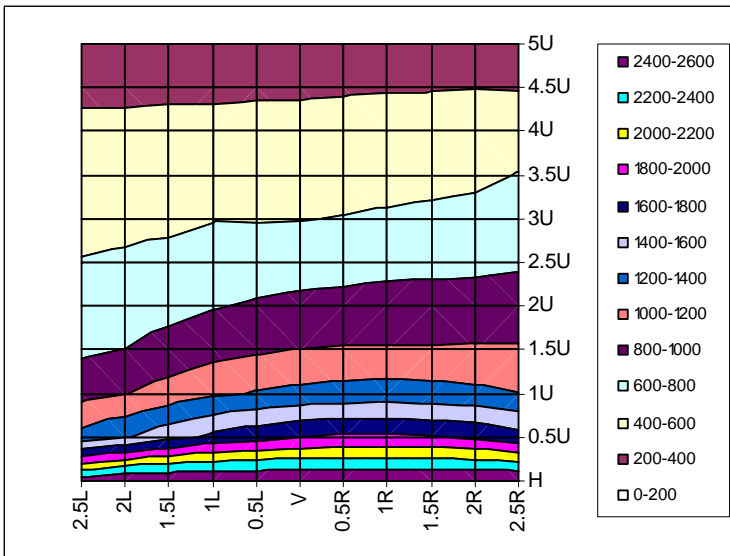
Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL

ISO Scans

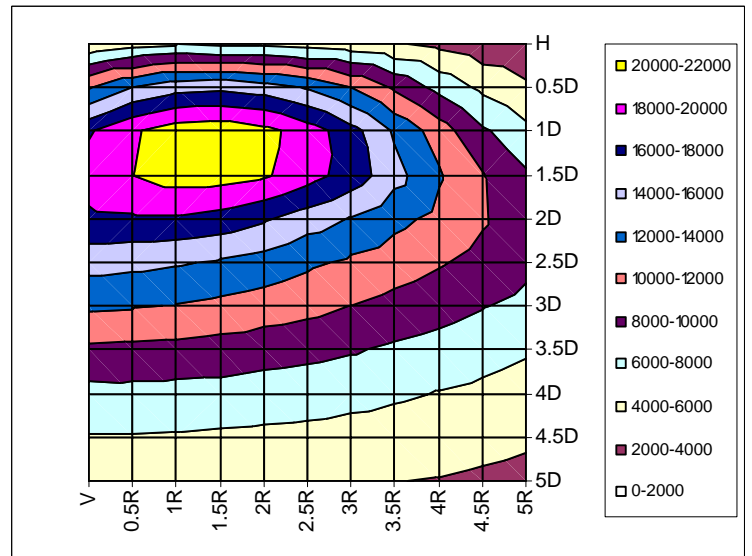
5U to 10D / 20L to 20R / 0.5° increments



Max Intensity: 21336 Cd @ 1.0D / 1.5R  
Beam Flux: 357 Lm



5U to H / 2.5L to 2.5R



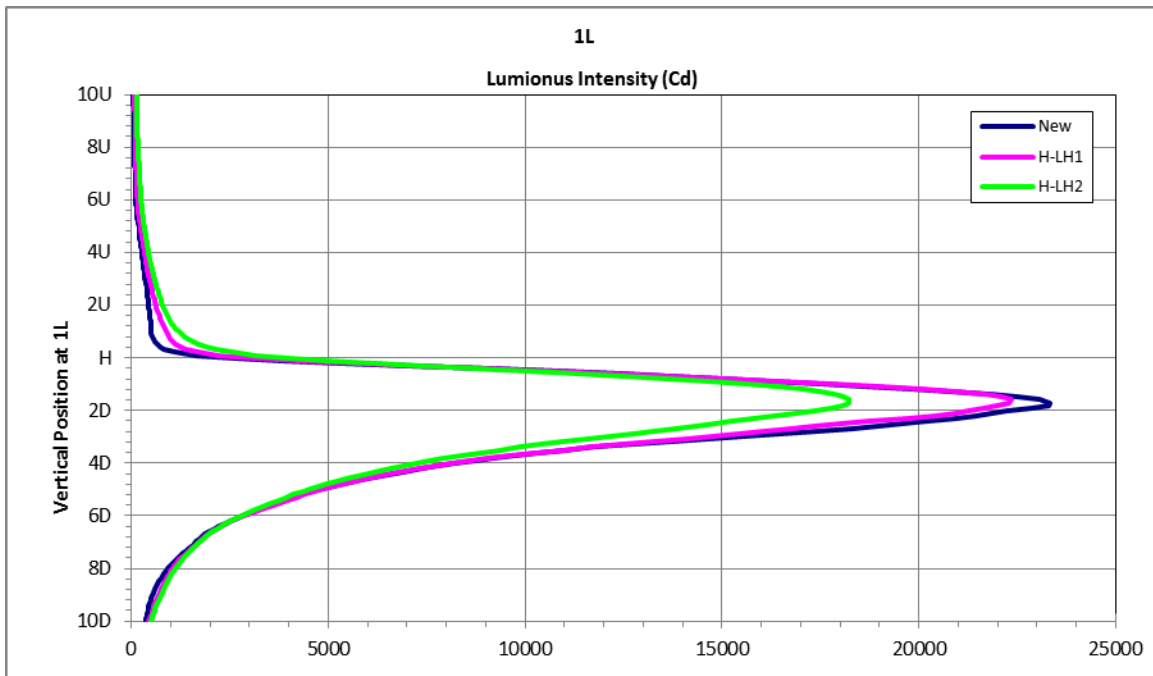
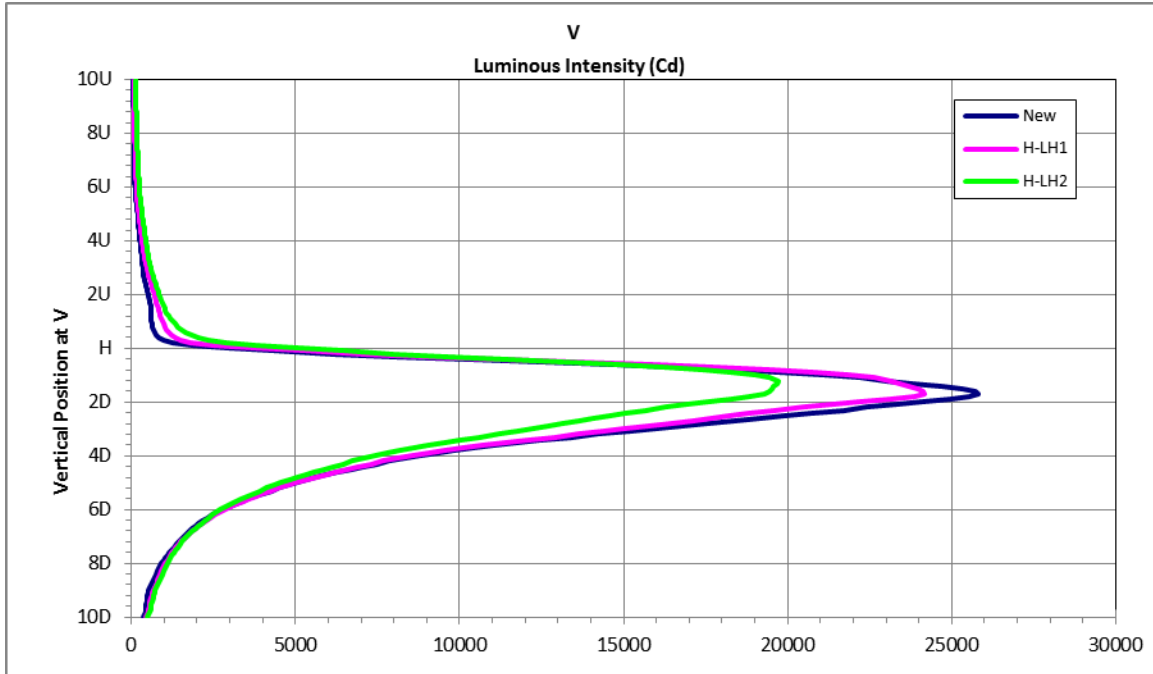
H to 5D / V to 5R

**PHOTOMETRIC TEST DATA SHEET**

Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL

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 Toyota Corolla VOR RBHL

IsoLux projection on road

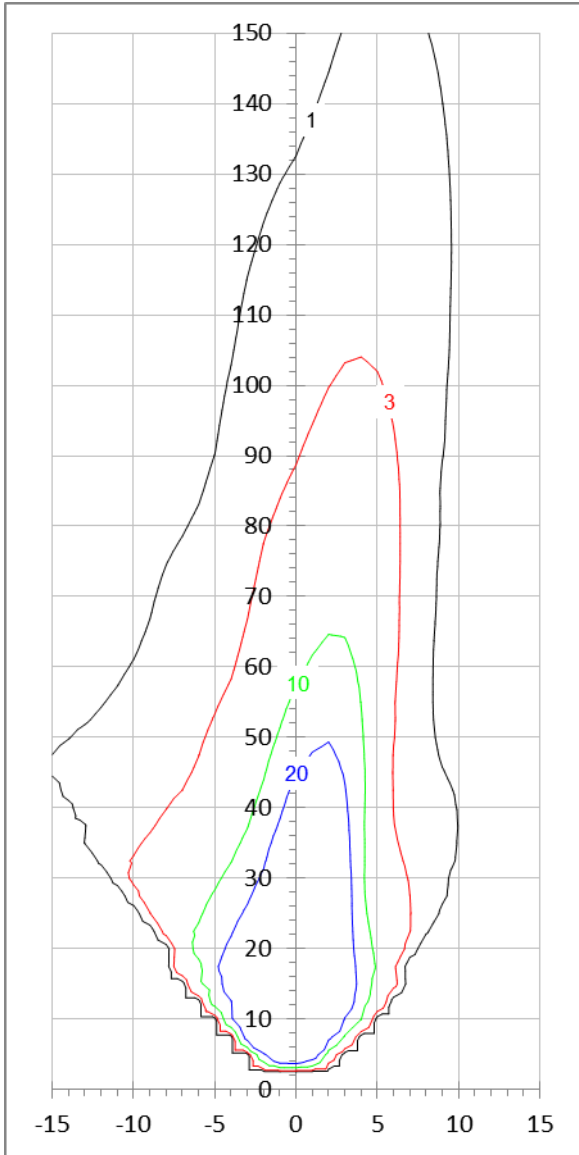
Lateral dimensions (from vehicle centerline): -15 m to 15 m, 1 m increments

Road Dimension (from lamp source): 0 m to 150 m, 2.5 m increments

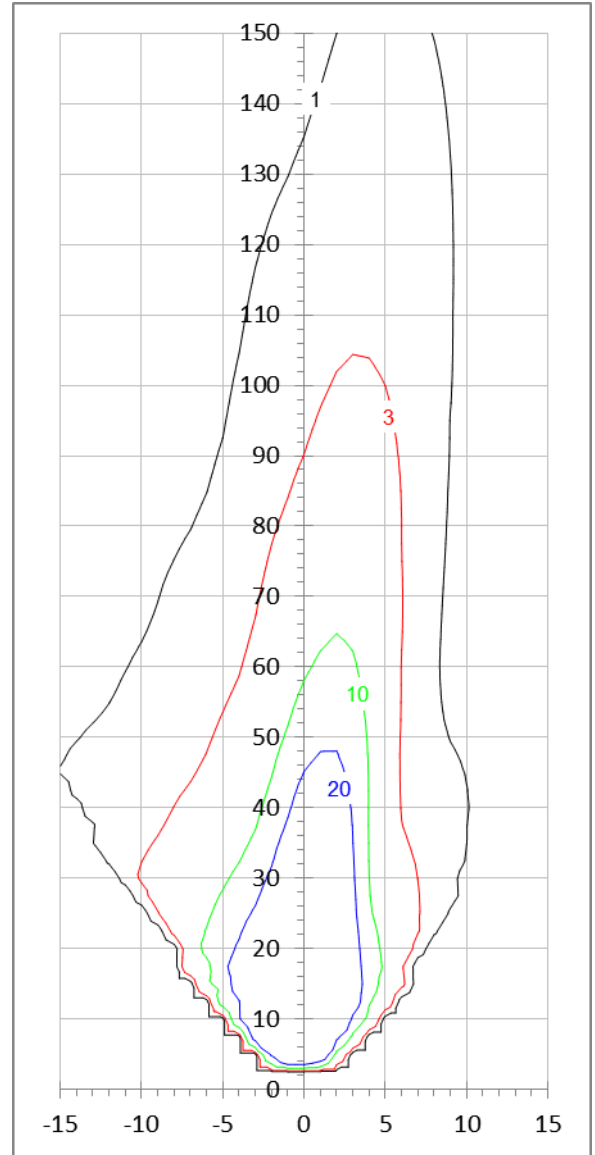
Isolux contour lines of 1, 3, 10, and 20 lux

Mounting Height: 0.75 m

Headlamp Separation: 1.4 m



LH1 (New)



H-LH1 (Haze)



**PHOTOMETRIC TEST DATA SHEET**

Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL

IsoLux projection on road

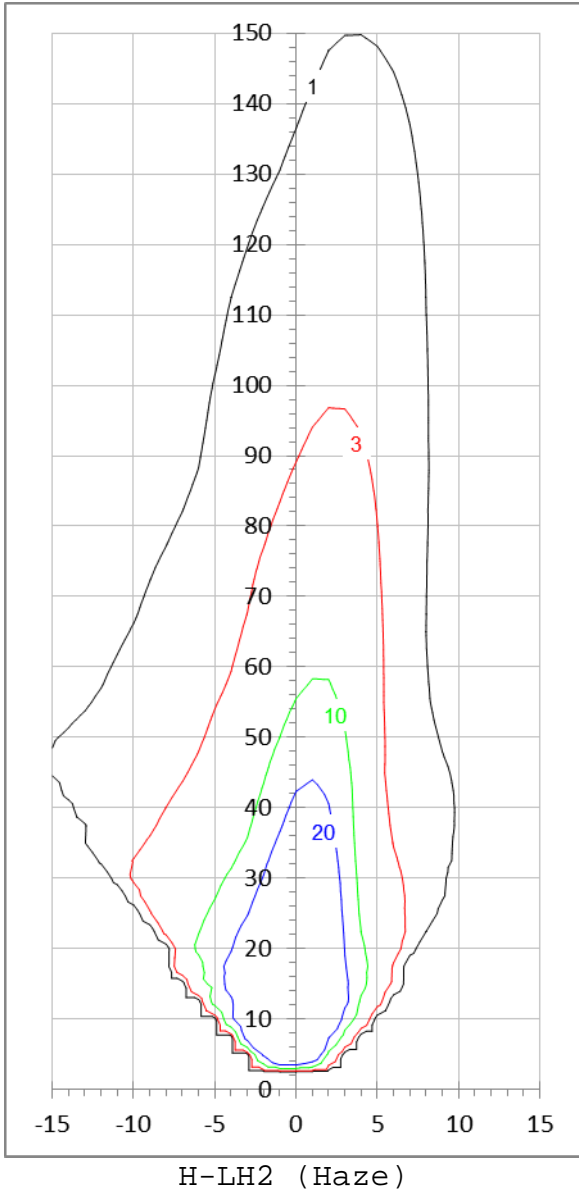
Lateral dimensions (from vehicle centerline): -15 m to 15 m, 1 m increments

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: 0.75 m

Headlamp Separation: 1.4 m



**PHOTOGRAPH SHEET**

Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL



LH1 (New) for 2012 Toyota Corolla



Lamp on Provided Fixture

**PHOTOGRAPH SHEET**

Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL



H-LH1 from 2013 Toyota Corolla



H-LH2 from 2012 Toyota Corolla

**EQUIPMENT LIST**

Project Name: Haze Study - 2012 Toyota Corolla VOR RBHL

## 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]