MORIMOTO

THE AUTOMOTIVE LIGHTING BENCHMARK

SAE J583 Test Results

May 2022

WHO, WHAT AND WHY:

WHO: Independent testing was conducted by Calcoast Itl., an industrial testing laboratory specializing in automotive certification and compliance. With over 50 years of experience serving over 200 clients from the automotive industry, Calcoast is a subject matter expert, and one of few specialized labs in n. America capable of producing trustworthy, independent results.

WHAT: SAE J583 provides test procedures and performance requirements for front fog lamps. lamps that are not photometrically compliant with J583 are not legal or safe for use as a fog light on public roads, as they will produce too much glare for oncoming traffic, or will not effectively illuminate the ground if they cannot be properly aimed according to the standard. J583 also provides insight into other important characteristics.

WHY: With the 4Banger being a new entrant into a now-mature category within lighting, we wanted to learn how our product compares to some of the most reputable brands in the space. For this test, we benchmarked the pods that each brand advertises as “SAE compliant” as this beam pattern makes up nearly 80% of total market demand.

- **Dual-purpose:** when developing the SAE wide beam optics for the 4Banger, our goal was to create something that would offer impressive (and safe) performance both on and off road.

THE LINEUP: TOP "SAE COMPLIANT" LED PODS

SAE-Compliant LED Pods were purchased from (or donated by) each respective brand and drop-shipped directly to the Calcoast testing lab in California. Download the full reports using the hyperlinks below.

Diode Dynamics SS3 Pro SAE Fog
(#6130)

Rigid Industries D-Series SAE Fog
(#504813)

Morimoto 4Banger NCS SAE Fog
(#BAF005)

Baja Designs Squadron SAE Fog
(#257805)

Diode Dynamics SS3 max SAE Fog
(with backlight)
(#6897)

Morimoto 4Banger HXB SAE Fog
(#BAF011)

TEST 1: PHOTOMETRICS

Photometrics: Despite the fact that we designed the optics on the 4Banger with compliance in mind, we were slow to make the claim that they were in-fact, compliant. Not until we could verify that through an independent lab test…because false claims have resulted in damaged reputations, PR disasters, even recalls for other brands in the past.

At time this testing was performed, Diode Dynamics, Baja Designs, and Rigid industries all advertise their products as SAE-compliant, which is what SAE J583 is all about.

SAE-Compliant fog lights need to pass two different photometric tests:

- SAE J583: Gradient Cutoff Characteristics (determines aim-ability)
- SAE J583: Figure 1 (Light distribution table)

Here's what testing revealed:

Passed:

- Morimoto 4Banger HXB SAE fog
- Morimoto 4Banger NCS SAE fog
- Rigid Industries D-Series SAE fog

Failed:

- Diode Dynamics SS3 Pro SAE fog
- Diode Dynamics SS3 Max SAE fog (with and without backlight)
- Baja Designs Squadron SAE fog

PHOTOMETRIC TEST 1 OF 2: CUTOFF CRITERIA

Aim (SAE J583 MAY2020)

#1

Maximum Vertical Gradient

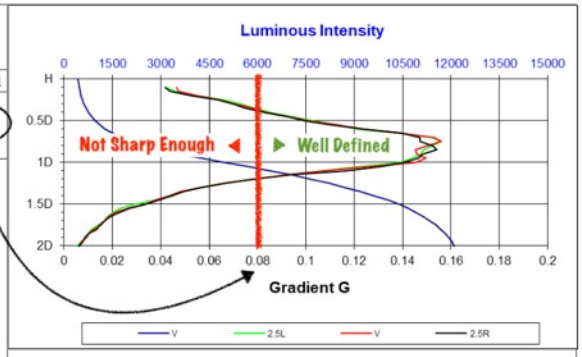
Location	Value	Required
0.75D/2.5L	0.156	≥ 0.08
0.75D/V	0.156	
0.85D/2.5R	0.154	

Maximum vertical gradient Glog is ≥ 0.08

Plot of Glog demonstrates a well-defined single peak.

Horizontal width of cutoff is greater than ±2.5° centered at V-V.

Maximum inclination of cutoff is within ±0.2°.



- The beam must have a well-defined upper cutoff line with a clear peak in intensity.
- This contrast between the brightest part of the beam and the darkness above it acts as a visual indicator of where the upper cutoff line is, which enables the ability to aim the height of the fog light.
- Test results show that the Rigid D-Series SAE had the sharpest cutoff line, well above the J583 Minimum value of 0.08 (example left)

PHOTOMETRIC TEST 2 OF 2: FIGURE 1

Specification: SAE J583 MAY2020 Figure 1 (Front Fog Lamp)
Color: White
Luminous Intensity, Candela

Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	1.2L	250.12		-	295
1.0U 15.0L TO 15.0R	1.5L	316.86		-	435
H 10.0L TO 10.0R	2.5R	564.20		-	585
H V		557.68		-	-
1.5D 9.0L		3860.70		1200	-
1.5D 3.0L		4145.47		2400	12000
1.5D 3.0R		4345.38		2400	12000
1.5D 9.0R		4217.47		1200	-
3.0D 15.0L		13007.59		1200	-
3.0D 15.0R		13271.83		1200	-
MX(10U-60U/15L-15R)	14.6U 0.7R	106.21		-	150
MAXIMUM	4.5D 0.5L	22615.38		-	-

Sample meets test requirements at all points @ t >30 minutes.

- The lamp will be set to the standard aim of .75D and Intensity will be measured at a series of pre-defined test points throughout the beam. If it doesn't pass, it can be re-aimed .25D up to three more times before complete failure. (max 1- degree downward aim)
- The intensity must measure above the minimum, and below the maximum in order to pass.
- This test also reveals the "max" intensity, and its location within the beam pattern. In the example, 4Banger HXB passed all test-points and was the brightest.

CUTOFF CHARACTERISTICS: RESULTS

1: 4Banger HXB SAE Fog

#1

Maximum Vertical Gradient

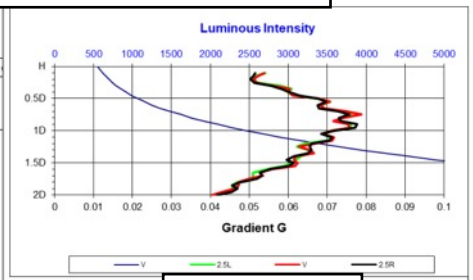
Location	Value	Require
0.75D/2.5L	0.076	
0.75D/V	0.079	≥ 0.08
0.90D/2.5R	0.078	

Maximum vertical gradient Glog is ≥ 0.08 when measured values rounded off

Plot of Glog demonstrates a well-defined single peak.

Horizontal width of cutoff is greater than ±2.5° centered at V-V.

Maximum inclination of cutoff is within ±0.2°.



PASSED

2: DD SS3 Max Back-lit SAE Fog

Maximum Vertical Gradient

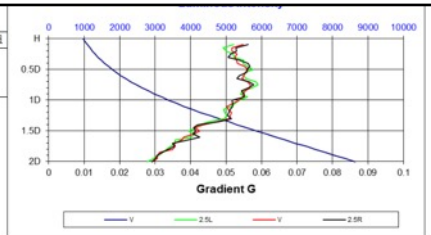
Location	Value	Required
0.75D/2.5L	0.059	
0.75D/V	0.057	≥ 0.08
0.75D/2.5R	0.058	

Maximum vertical gradient Glog **is not** ≥ 0.08

Plot of Glog **does not** demonstrate a well-defined single peak.

Unknown if horizontal width of cutoff is greater than ±2.5° centered at V-V because the Gmax is insufficient.

Maximum inclination of cutoff is within ±0.2°.



FAILED

3: 4Banger NCS SAE Fog

#2

Maximum Vertical Gradient

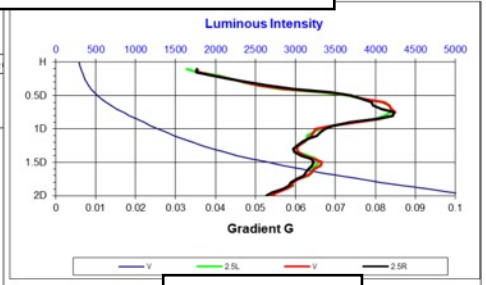
Location	Value	Require
0.70D/2.5L	0.084	
0.75D/V	0.085	≥ 0.08
0.75D/2.5R	0.085	

Maximum vertical gradient Glog is ≥ 0.08

Plot of Glog demonstrates a well-defined single peak.

Horizontal width of cutoff is greater than ±2.5° centered at V-V.

Maximum inclination of cutoff is within ±0.2°.



PASSED

4: DD SS3 Pro SAE Fog

Maximum Vertical Gradient

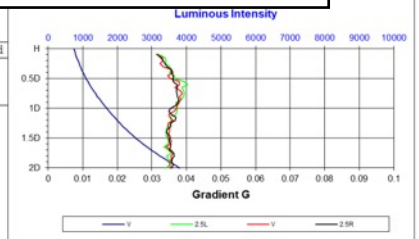
Location	Value	Required
0.60D/2.5L	0.040	
0.75D/V	0.039	≥ 0.08
0.85D/2.5R	0.038	

Maximum vertical gradient Glog **is not** ≥ 0.08

Plot of Glog **does not** demonstrate a well-defined single peak.

Unknown if horizontal width of cutoff is greater than ±2.5° centered at V-V because the Gmax is insufficient.

Maximum inclination of cutoff is within ±0.2°.



FAILED

5: Rigid D-series SAE Fog

Maximum Vertical Gradient

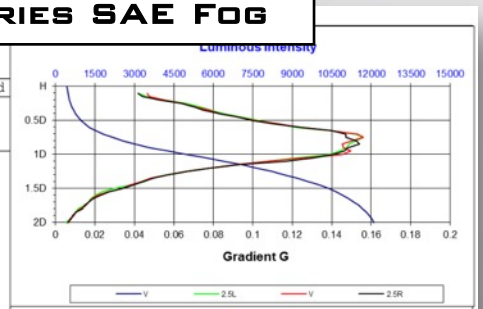
Location	Value	Required
0.75D/2.5L	0.156	
0.75D/V	0.156	≥ 0.08
0.85D/2.5R	0.154	

Maximum vertical gradient Glog is ≥ 0.08

Plot of Glog demonstrates a well-defined single peak.

Horizontal width of cutoff is greater than ±2.5° centered at V-V.

Maximum inclination of cutoff is within ±0.2°.



PASSED ***SHARPEST**

6: Baja Squadron SAE fog

Maximum Vertical Gradient

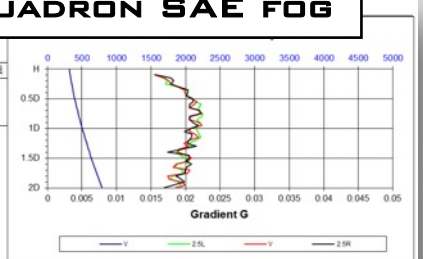
Location	Value	Required
0.75D/2.5L	0.022	
0.75D/V	0.022	≥ 0.08
0.75D/2.5R	0.022	

Maximum vertical gradient Glog **is not** ≥ 0.08

Plot of Glog **does not** demonstrates a well-defined single peak.

Unknown if horizontal width of cutoff is greater than ±2.5° centered at V-V because the Gmax is insufficient.

m inclination of is within ±0.2°.



FAILED

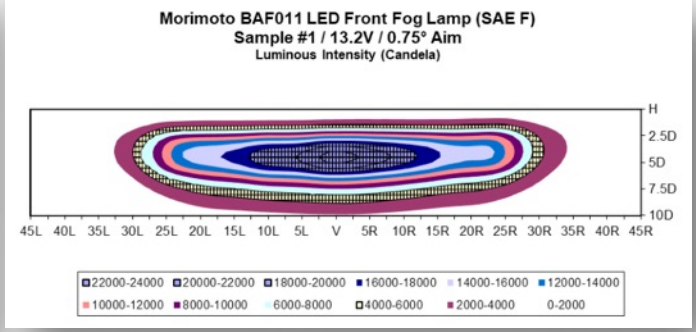
The three failed lamps could not be aimed according to the SAE J583 standard. Photometry was measured at the aim which does not produce excess glare.

TEST TABLE: PASSED

1: 4Banger HXB SAE Fog

Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	1.2L	250.12		-	295
1.0U 15.0L TO 15.0R	1.5L	316.86		-	435
H 10.0L TO 10.0R	2.5R	564.20		-	585
H V		557.68		-	-
1.5D 9.0L		3990.70		1200	-
1.5D 3.0L		4145.47		2400	12000
1.5D 3.0R		4345.38		2400	12000
1.5D 9.0R		4217.47		1200	-
3.0D 15.0L		13007.59		1200	-
3.0D 15.0R		13271.83		1200	-
MX(10U-60U/15L-15R)	14.6U 0.7R	106.21		-	150
MAXIMUM	4.5D 0.5L	22615.38		-	-

Sample meets test requirements at all points @ t >30 minutes.

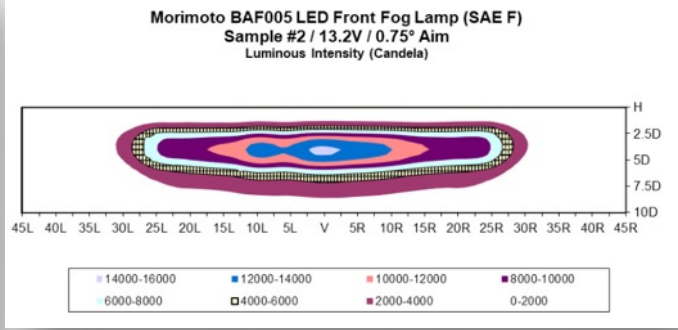


- The 4Banger HXB passed all test points without the need to re-aim.
- It was the brightest by a 23% margin over the next closest competitor (SS3 Max Backlit)

2: 4Banger NCS SAE Fog

Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	1.4R	150.94		-	295
1.0U 15.0L TO 15.0R	1.6R	186.94		-	435
H 10.0L TO 10.0R	1.8R	294.74		-	585
H V		291.57		-	-
1.5D 9.0L		2527.83		1200	-
1.5D 3.0L		2569.72		2400	12000
1.5D 3.0R		2627.42		2400	12000
1.5D 9.0R		2501.76		1200	-
3.0D 15.0L		9068.57		1200	-
3.0D 15.0R		8888.80		1200	-
MX(10U-60U/15L-15R)	17.3U 5.1L	80.95		-	150
MAXIMUM	4.0D 0.6L	14443.77		-	-

Sample meets test requirements at all points.

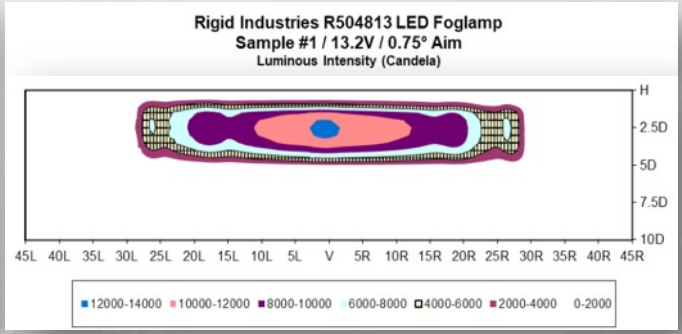


- The 4Banger NCS passed all test points without the need to re-aim.

3: Rigid D-series SAE Fog

Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	2.1L	164.40		-	295
1.0U 15.0L TO 15.0R	0.4L	236.04		-	435
H 10.0L TO 10.0R	0.9L	423.24		-	585
H V		421.37		-	-
1.5D 9.0L		9225.11		1200	-
1.5D 3.0L		10144.28		2400	12000
1.5D 3.0R		9838.57		2400	12000
1.5D 9.0R		8918.16		1200	-
3.0D 15.0L		8343.22		1200	-
3.0D 15.0R		8920.11		1200	-
MX(10U-60U/15L-15R)	10.0U 0.2L	53.44		-	150
MAXIMUM	2.6D 0.8L	12533.70		-	-

Sample meets test requirements at all points.



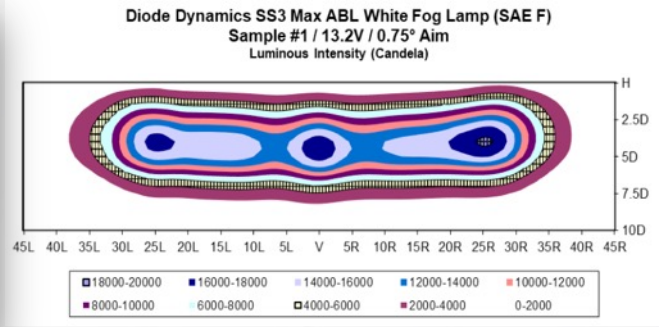
- The Rigid D-Series passed all test points without the need to re-aim.
- The sharp cutoff allowed for the highest aim, bringing the hotspot upwards, which allowed it to excel at 1.5D L/R relative to the others.

TEST TABLE: FAILED

4: DD SS3 Max Back-lit SAE Fog

Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	0.3L	252.33		-	295
1.0U 15.0L TO 15.0R	V	335.49		-	435
H 10.0L TO 10.0R	0.5L	670.51	546.02	-	585
H V		669.33		-	-
1.5D 9.0L		3410.72		1200	-
1.5D 3.0L		3655.18		2400	12000
1.5D 3.0R		3476.90		2400	12000
1.5D 9.0R		3412.24		1200	-
3.0D 15.0L		11561.99		1200	-
3.0D 15.0R		11138.15		1200	-
MX(10U-60U/15L-15R)	10.0U 5.7R	132.65		-	150
MAXIMUM	4.6D 0.2L	17624.16		-	-

Had to be re-aimed to avoid excess glare...
Sample meets test requirements at all po: These figures represent performance at an acceptable aim



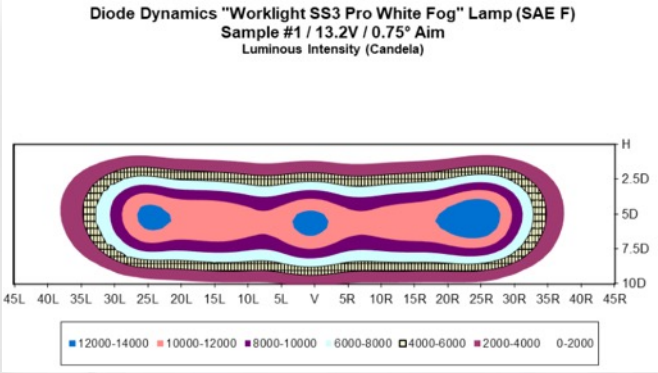
- After 4 attempts to re-aim lower to prevent excess glare, the SS3 Max backlit was finally able to pass all test points.
- The SS3 Max has the widest beam pattern of all options tested.

5: DD SS3 Pro SAE Fog

Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	0.2R	265.96		-	295
1.0U 15.0L TO 15.0R	V	372.09		-	435
H 10.0L TO 10.0R	0.4L	632.20	545.79	-	585
H V		631.28		-	-
1.5D 9.0L		1848.43		1200	-
1.5D 3.0L		2027.32	2478.28	2400	12000
1.5D 3.0R		1878.45	2286.97*	2400	12000
1.5D 9.0R		1821.10		1200	-
3.0D 15.0L		6340.06		1200	-
3.0D 15.0R		6090.05		1200	-
MX(10U-60U/15L-15R)	10.0U 4.2R	145.38		-	150
MAXIMUM(S)	5.8D 0.7L	12802.21		-	-
	5.4D 24.4L	12800.49		-	-
	5.4D 24.2R	13954.69		-	-

* - Denotes Failure.

Had to be re-aimed to avoid excess glare...
These figures represent performance at an acceptable aim



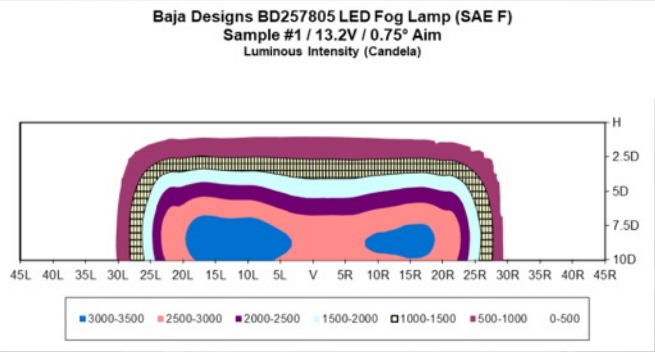
- After several attempts to re-aim lower to prevent glare, The SS3 Pro failed to meet the minimum cd requirement at 1.5D The brightest point wasn't in the center either, it was on the far right side of the beam at 24.2R.
- Though unfit for use as an SAE fog light, it was very wide.

6: Baja Squadron SAE fog

Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	1.4R	252.12		-	295
1.0U 15.0L TO 15.0R	1.5R	274.02		-	435
H 10.0L TO 10.0R	0.7L	314.41		-	585
H V		313.50		-	-
1.5D 9.0L		628.75	706.42*	1200	-
1.5D 3.0L		626.75	699.98*	2400	12000
1.5D 3.0R		619.36	696.29*	2400	12000
1.5D 9.0R		599.70	674.32*	1200	-
3.0D 15.0L		1250.06		1200	-
3.0D 15.0R		1186.44	1301.55	1200	-
MX(10U-60U/15L-15R)	10.0U 10.8L	91.44		-	150
MAXIMUM(S)	8.5D 9.5L	3343.08		-	-
	8.7D 14.9R	3159.15		-	-

* - Denotes Failure.

Had to be re-aimed to avoid excess glare...
These figures represent performance at an acceptable aim



- The BD Squadron had no discernable cutoff line, making it impossible to aim.
- Once aimed low enough to prevent glare, It failed to meet the minimum requirements for intensity at every point in the center of the beam.
- The maximum intensity topped out at 3343.08 cd, which is extremely low relative to all others

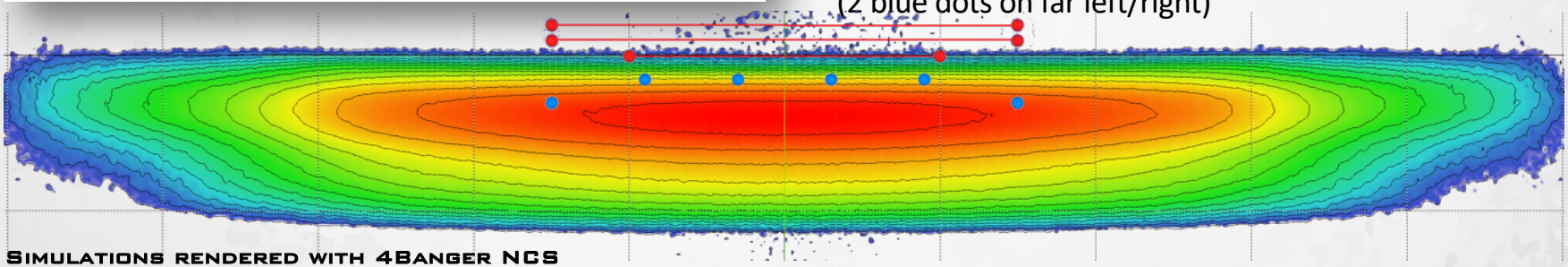
TABLE DATA: ON-ROAD PROJECTION

This information is simply included to help you visualize how each point on the test table correlates with the road ahead.

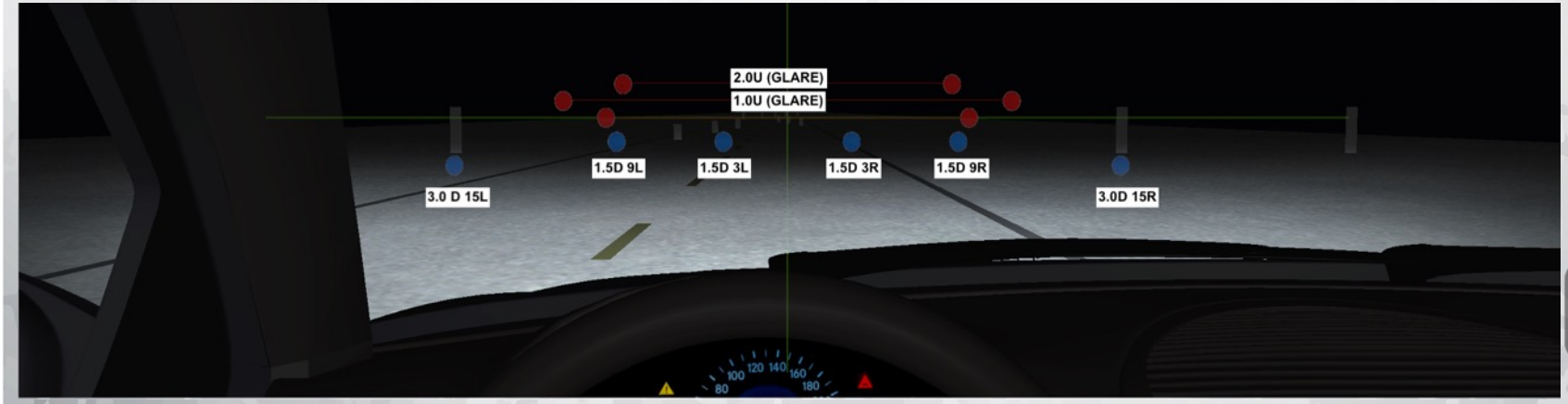
Test Point	Location	Measured	Reaim	Minimum	Maximum
2.0U 15.0L TO 15.0R	1.2L	250.12		-	295
1.0U 15.0L TO 15.0R	1.5L	316.86		-	435
H 10.0L TO 10.0R	2.5R	564.20		-	585
H V		557.68		-	-
1.5D 9.0L		3860.70		1200	-
1.5D 3.0L		4145.47		2400	12000
1.5D 3.0R		4345.38		2400	12000
1.5D 9.0R		4217.47		1200	-
3.0D 15.0L		13007.59		1200	-
3.0D 15.0R		13271.83		1200	-
MX(10U-60U/15L-15R)	14.6U 0.7R	106.21		-	150
MAXIMUM	4.5D 0.5L	22615.38		-	-

Sample meets test requirements at all points @ t >30 minutes.

- **1.0/2.0U Group**: Represents glare zone (Red dots)
- **1.5D Group**: Represents central intensity at the farthest / upper extent of the beam. (4 Blue dots in middle)
- **3.0D Group**: Represents illumination within the beam at each edge of the road. (2 blue dots on far left/right)



SIMULATIONS RENDERED WITH 4BANGER NCS



TEST 2: PEAK INTENSITY OVER TIME

In the Enthusiast Aftermarket it is common to measure output (in candela) once fully stabilized. The problem is, everybody has their own definition of when this reading should be taken, or what "stabilized" means:

…it's the length of time I picked. 30 minutes, of course!
…it's when the heat sink is too hot for me to touch, obviously.
…There is a real answer.

The J583 standard considers a lamp to have "stabilized" once the drop in intensity doesn't exceed 3% over a 15-minute span.

…the amount of time that takes will vary depending on a variety of factors including the initial power, thermal capability of the heatsink, and the logic programmed into the circuitry.

Results Summary:

- **Most intense:** 4Banger HXB (22,615cd)
- **Least intense:** Baja Squadron (3,343cd)

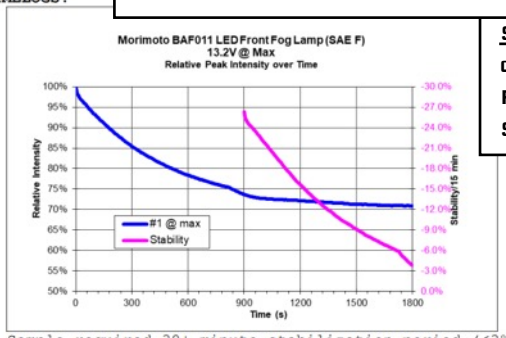
- **Most efficient:** 4Banger NCS (925.8 cd/watt)
- **Least efficient:** Baja Squadron (159 cd/Watt)

- **Fastest stabilization:** 4Banger NCS (20 minutes)
- **Longest stabilization:** Diode SS3 (Max/Pro) (37 minutes [Estimated])

TEST 2: PEAK INTENSITY OVER TIME (DETAIL)

1: 4Banger HXB SAE Fog

TIMELOGS:

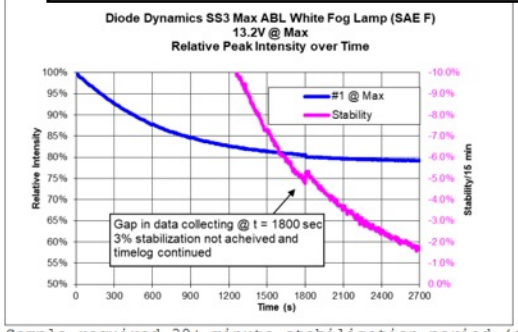


Sample required 30+ minute stabilization period (<3%/15 min).

Stabilized Figures:
- Output: 22,615 cd
- Power: 38.8W
- Stable: 31 min

2: DD SS3 Max Back-lit SAE Fog

TIMELOG

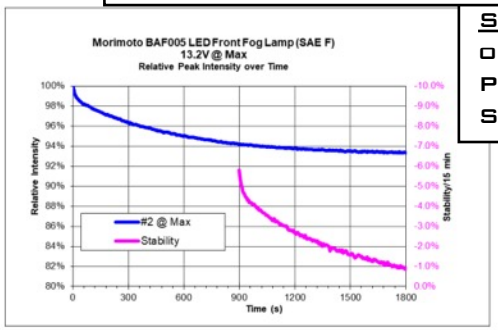


Sample required 30+ minute stabilization period (<3%/15 min).

Stabilized Figures:
- Output: 17,619 cd
- Power: 39.2W
- Stable: 37 min (Est)

3: 4Banger NCS SAE Fog

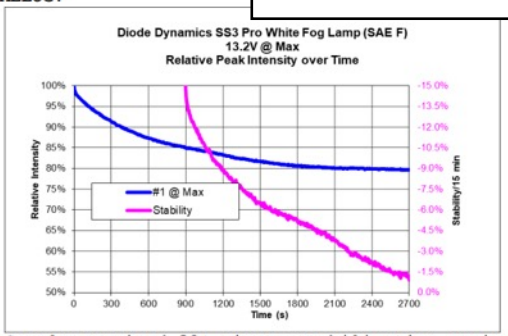
TIMELOGS:



Stabilized Figures:
- Output: 14,443 cd
- Power: 15.6W
- Stable: 20 min

4: DD SS3 Pro SAE Fog

TIMELOG:

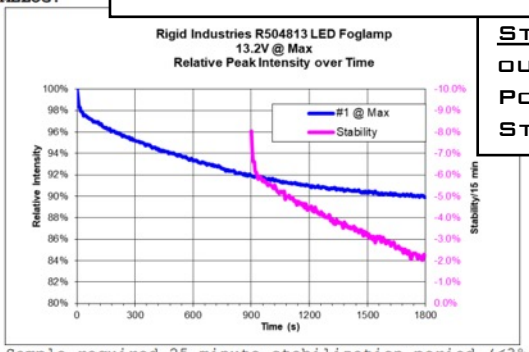


Sample required 30+ minute stabilization period (<3%/15 min).

Stabilized Figures:
- Output: 13,913 cd
- Power: 33.5W
- Stable: 37 min (est)

5: Rigid D-series SAE Fog

TIMELOG:

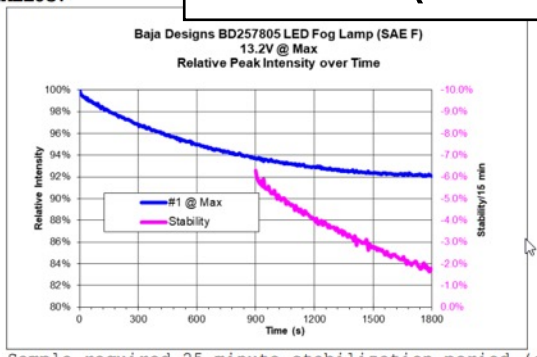


Sample required 25 minute stabilization period (<3%/15 min).

Stabilized Figures:
- Output: 12,533 cd
- Power: 21.5W
- Stable: 25 min

6: Baja Squadron SAE fog

TIMELOG:



Sample required 25 minute stabilization period (<3%/15 min).

Stabilized Figures:
- Output: 3,343 cd
- Power: 21.0W
- Stable: 25 min

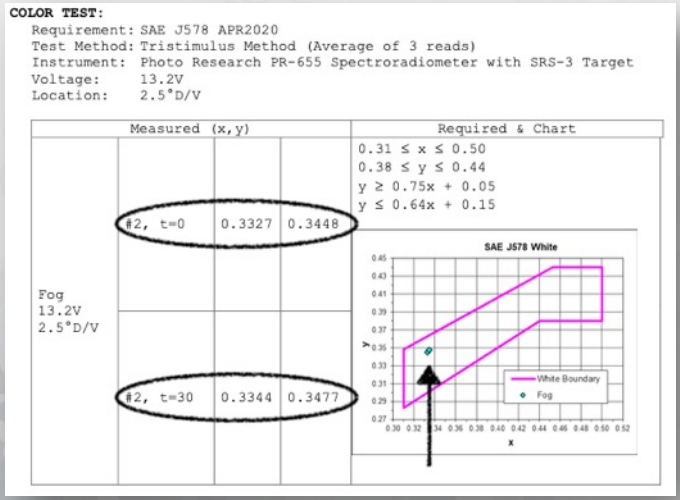
TEST 3: COLOR-SHIFT

SAE J583 requires that the color of light emitted from a fog lamp remain within a certain range of “white” when first illuminated and after remaining illuminated for 30 minutes (since LEDs typically color-shift as they heat up)

The Results are displayed on a chart with two dots. One dot represents color at t=0 (test start) and the other represents color at t=30 (30 minutes later).

The Dots ultimately represent kelvin measurements, but the distance between the two is representative of how stressed the LEDs were by the heat. Closer together = happy & healthy. Farther apart = more heat soaked. Over time, heat will reduce output & lifespan.

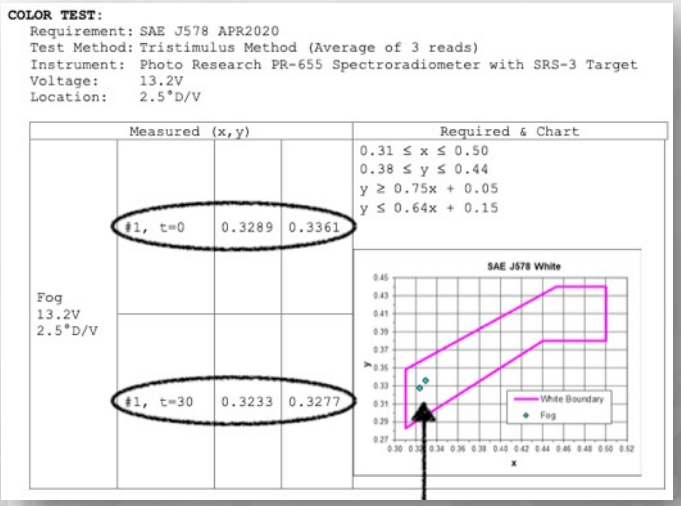
Many Consumers: falsely assume that they can gauge how “thermally capable” or “reliable” a LED pod will be by its surface temperature or size/shape. What’s most critical is the junction-temperature between the LED and the PCB, which this test actually-Illustrates. A heat sink that’s hot to the touch is generally a good thing, since that means its drawing the heat away from the LED chips.



COLOR TEST:
Requirement: SAE J578 APR2020
Test Method: Tristimulus Method (Average of 3 reads)
Instrument: Photo Research PR-655 Spectroradiometer with SRS-3 Target
Voltage: 13.2V
Location: 2.5°D/V

	Measured (x,y)			Required & Chart
Fog 13.2V 2.5°D/V	#2, t=0	0.3327	0.3448	$0.31 \le x \le 0.50$ $0.38 \le y \le 0.44$ $y \ge 0.75x + 0.05$ $y \le 0.64x + 0.15$
	#2, t=30	0.3344	0.3477	

Close together: Little impact from heat



COLOR TEST:
Requirement: SAE J578 APR2020
Test Method: Tristimulus Method (Average of 3 reads)
Instrument: Photo Research PR-655 Spectroradiometer with SRS-3 Target
Voltage: 13.2V
Location: 2.5°D/V

	Measured (x,y)			Required & Chart
Fog 13.2V 2.5°D/V	#1, t=0	0.3289	0.3361	$0.31 \le x \le 0.50$ $0.38 \le y \le 0.44$ $y \ge 0.75x + 0.05$ $y \le 0.64x + 0.15$
	#1, t=30	0.3233	0.3277	

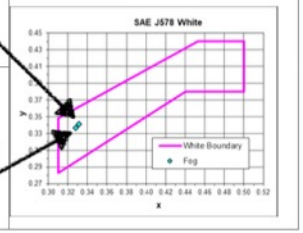
Farther apart: more impact from heat

TEST 3: COLOR SHIFT (REPORT DETAIL)

1: 4Banger HXB SAE Fog

0.31 ≤ x ≤ 0.50
0.38 ≤ y ≤ 0.44
y ≥ 0.75x + 0.05
y ≤ 0.64x + 0.15

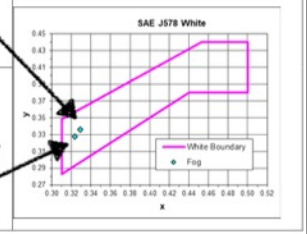
Fog 13.2V 2.5°D/V	#2, t=0	0.3310	0.3410
	#2, t=30	0.3281	0.3367



2: DD SS3 Max Back-lit SAE Fog

0.31 ≤ x ≤ 0.50
0.38 ≤ y ≤ 0.44
y ≥ 0.75x + 0.05
y ≤ 0.64x + 0.15

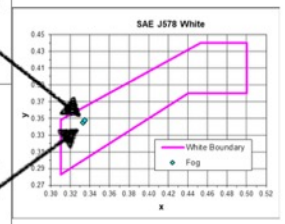
Fog 13.2V 2.5°D/V	#1, t=0	0.3289	0.3361
	#1, t=30	0.3233	0.3277



3: 4Banger NCS SAE Fog

0.31 ≤ x ≤ 0.50
0.38 ≤ y ≤ 0.44
y ≥ 0.75x + 0.05
y ≤ 0.64x + 0.15

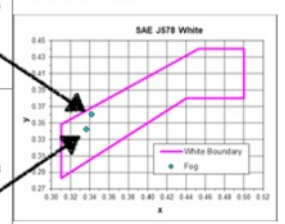
Fog 13.2V 2.5°D/V	#2, t=0	0.3327	0.3448
	#2, t=30	0.3344	0.3477



4: DD SS3 Pro SAE Fog

0.31 ≤ x ≤ 0.50
0.38 ≤ y ≤ 0.44
y ≥ 0.75x + 0.05
y ≤ 0.64x + 0.15

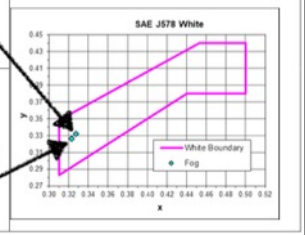
Fog 13.2V 2.5°D/V	#1, t=0	0.3361	0.3427
	#1, t=30	0.3419	0.3603



5: Rigid D-series SAE Fog

0.31 ≤ x ≤ 0.50
0.38 ≤ y ≤ 0.44
y ≥ 0.75x + 0.05
y ≤ 0.64x + 0.15

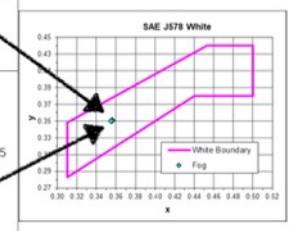
Fog 13.2V 2.5°D/V	#1, t=0	0.3276	0.3320
	#1, t=30	0.3231	0.3263



6: Baja Squadron SAE fog

0.31 ≤ x ≤ 0.50
0.38 ≤ y ≤ 0.44
y ≥ 0.75x + 0.05
y ≤ 0.64x + 0.15

Fog 13.2V 2.5°D/V	#1, t=0	0.3562	0.3506
	#1, t=30	0.3548	0.3505



TEST 3: COLOR-SHIFT (KEY TAKEAWAYS)

1: 4Banger HXB: +136K

- Though the HXB shares the same exact LED chips with the SS3 Max (Osram Oslon HX Boost) and 99% of the power (38.9w vs 39.2w) but the LEDs experienced 64% less color shift. This concludes that, despite their smaller footprint, the 4Banger is a much more effective design from a thermal capability standpoint.

2: 4Banger NCS: +71K

- The NCS shares the same direct-thermal path PCB and heatsink with the HXB model. With roughly half the power requirements of the HXB, the color shift was also reduced to roughly half. Further proof that the thermal design of the 4Banger is highly effective.

3: Rigid D Series: +239K

- Given the low power consumption of the Rigid pod (compared to the likes of the SS3 Max or 4Banger HXB), the resulting color shift was much higher than expected.

4: DD SS3 Max Backlit: +291K

- The SS3 Max consumed the most power in the group and recorded the highest color-shift during testing. These results conclude that, even with the larger heatsink, the thermal design of the SS3 Pod is not as effective at removing the heat from the LED chips when compared to the 4Banger design (which consumes similar power and uses the same LED chips). This could lead to reduced LED lifespan with extended use.

5: DD SS3 Pro: -201K*

- The DD SS3 Pro actually went down in kelvin, which CalCoast cites as an error likely related chromatic aberration and difficulties aiming.

6: Baja Squadron: +49K

- With the second lowest power rating of the group @ 21W, the color-shift results show the LEDs experienced virtually no change, implying that the system was generally unaffected by the heat generated.

TEST CONCLUSION

MODEL RANK		ON ROAD CATEGORIES				OFF ROAD CATEGORY	OVERALL SCORING	
RANK	MODEL	PEAK INTENSITY (K Candela)	ROAD EDGE INTENSITY (R/L K Candela)	SAE SCORE (Peak + R/L K-Candela)	SAE F COMPLIANT (J583 Photometrics)	WIDTH SCORE (35L/R K-Candela)	COLOR SHIFT (CCT % Shift X -1)	FINAL SCORE (ON+OFF ROAD)
1	Morimoto 4Banger HXB SAE Fog	22.6	26.2	48.8	PASSED	2.8	-2.3	51.6
2	Diode SS3 Max ABL SAE Fog	17.6	22.7	40.3	DISQUALIFIED	8.7	-4.9	49
3	Morimoto 4Banger NCS SAE Fog	14.4	17.9	32.3	PASSED	1.3	0	33.6
4	Diode SS3 Pro SAE Fog	13.9	12.3	26.2	DISQUALIFIED	7.3	0	33.5
5	Rigid D-Series SAE Fog	12.5	17.1	29.6	PASSED	0	-4	29.6
6	Baja Designs Squadron SAE Fog	3.3	2.4	5.7	DISQUALIFIED	0	0	5.7

1st Place: 4Banger HXB SAE Fog: Final Score = 51.6 (BEST FOR ON AND OFF-ROAD USE) ($500/Set)

- SAE Compliant Photometrics: Yes
- On-road Performance: Highest peak and road edge intensity while maintaining compliant photometrics.
- Off-Road Performance: Excellent combination of width and foreground light, which aids in overall visibility when used on A-Pillar brackets or a roof rack.

2nd Place: Diode Dynamics SS3 Max with Backlight SAE Fog: Final Score = 49 (GREAT FOR OFF ROAD ONLY) ($539.95/Set)

- SAE Compliant Photometrics: No
- On-road Performance: Would have ranked in second place for peak and road edge intensity but disqualified (failed SAE J583)
- Off-Road Performance: Excellent width will provide great visibility on the far left/right sides of the trail (Best in Class)

3rd Place: 4Banger NCS SAE Fog: Final Score = 33.6 (VERY GOOD FOR ON AND OFF-ROAD USERS) ($300/Set)

- SAE Compliant Photometrics: Yes
- On-road Performance: Second best peak and road edge intensity while maintaining compliant photometrics
- Off-Road Performance: Excellent combination of width and foreground light, which aids in overall visibility when used on A-Pillar brackets or a roof rack.

4th Place: Diode Dynamics SS3 Pro SAE Fog: Final Score = 33.5 (GOOD FOR OFF ROAD ONLY) ($300/Set)

- SAE Compliant Photometrics: No
- On-road Performance: Mediocre peak and road edge intensity, while also disqualified for extreme failure in both J583 photometric tests.
- Off-Road Performance: Excellent width will provide great visibility on the far left/right sides of the trail.

5th Place: Rigid D-Series SAE Fog: Final Score = 29.6 (WORKS WELL STRICTLY USED AS AN SAE FOG) ($299.99/Set)

- SAE Compliant Photometrics: Yes (Best in class)
- On-road Performance: Ranked third for peak and road edge intensity while maintaining compliant photometrics.
- Off-Road Performance: Lacks width compared to SS3 and 4Bangers and no foreground coverage when mounted anywhere but a fog light, making the D-Series SAE a poor choice for use as an off-road light. (doesn't claim to be)

6TH Place: Baja Designs Squadron SAE Fog: Final Score = 5.7 (POOR PERFORMANCE OVERALL) ($294.95/Set)

- SAE Compliant Photometrics: No
- On-road Performance: Lowest peak and road edge intensity, while also disqualified for extreme failure in both J583 photometric tests.
- Off-Road Performance: Regardless of mounting location, narrow beam width provides weak visibility on the far left/right sides of the trail.

APPENDIX: FOG LIGHT MOUNT (ON-ROAD USE) (J583 AIM)

*With Main Low beam = Morimoto XB Bi-LED dual low beam

1: 4Banger HXB SAE Fog

2: DD SS3 Max Back-lit SAE Fog

3: 4Banger NCS SAE Fog

4: DD SS3 Pro SAE Fog

5: Rigid D-series SAE Fog

6: Baja Squadron SAE fog

APPENDIX: A-PILLAR MOUNT (OFF-ROAD USE)

1: 4Banger HXB SAE Fog

2: DD SS3 Max Back-lit SAE Fog

3: 4Banger NCS SAE Fog

4: DD SS3 Pro SAE Fog

5: Rigid D-series SAE Fog

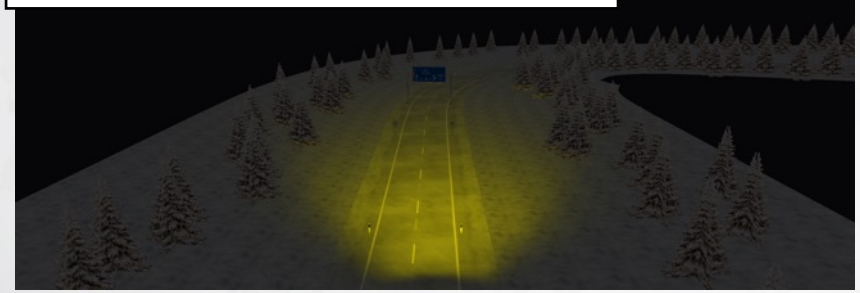
6: Baja Squadron SAE fog

APPENDIX: A-PILLAR MOUNT (OFF-ROAD USE)

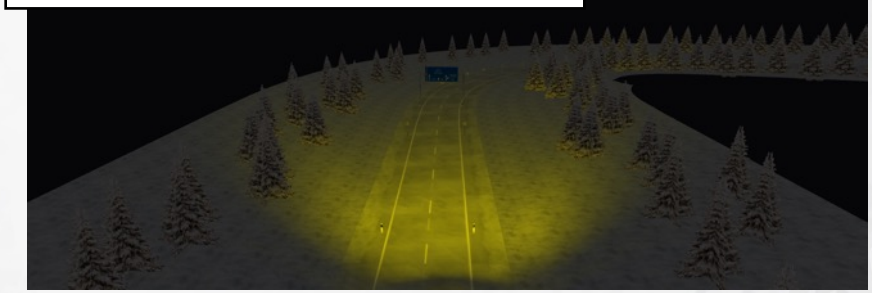
1: 4Banger HXB SAE Fog

2: DD SS3 Max Back-lit SAE Fog

3: 4Banger NCS SAE Fog



4: DD SS3 Pro SAE Fog



5: Rigid D-series SAE Fog

6: Baja Squadron SAE fog

APPENDIX: DD SS3 MAX VS SS3 MAX BACK-LIT

When we informed a representative from Diode Dynamics about this project, they indicated that the SS3 max would soon be discontinued and replaced by the Max with backlight. To ensure the testing was conducted with the 'latest' version, they overnighted a set of the newer backlit SS3 max pods to the Calcoast Lab.

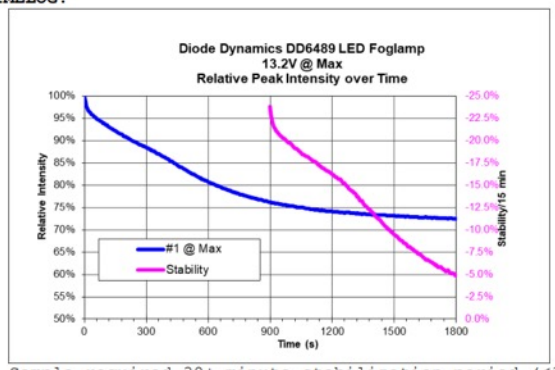
The testing was already complete on the standard SS3. the differences are summarized below:

- **Power consumption increased by**: 20% (32.6w vs 39.2W)
- **peak intensity increased by**: 2.2% (17,236cd vs 17,619cd)
- **T=0 to T=30 intensity stability improved by**: 7% (6% loss vs 11% loss)

Takeaway 1: The output is basically the same, though its consuming 20% more power. This indicates that the capacity of their heat sink was already maxed out, limiting performance.

Takeaway 2: The optics are identical. neither passed J583 photometric tests. the ss3 sport and pro also use the same optic.

SS3 Max Full Report



Stabilized Figures:
Output: 17,236 cd
Power: 32.6W
Stable: 37 min (Est)

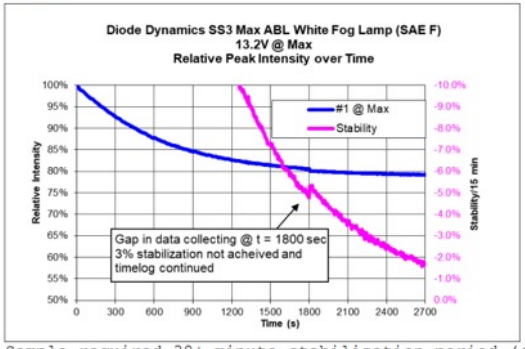
TIMELOG

	-	-
1200		-
2400		12000
2400		12000
1200		-
1200		-
1200		-
	-	150
	-	-

Sample required 30+ minute stabilization period (<3%/15 min).

MAXIMUM 4.5D 0.6L 17236.71

SS3 Max back-lit Full Report



Stabilized Figures:
Output: 17,619 cd
Power: 39.2W
Stable: 37 min (Est)

TIME

	-	-
1200		-
2400		12000
2400		12000
1200		-
1200		-
1200		-
	-	150
	-	-

Sample required 30+ minute stabilization period (<3%/15 min).

MAXIMUM 4.4D 0.2L 17619.93