Transmitted by the expert from SAE

Informal document **GRE-80-34**
(80th GRE, 23 – 26 October 2018,
agenda item 5)

SAE

Standardization of Technical Requirements for Forward Lighting LED Replacement Light Sources

LED Forward Lighting Replacement Sources Market Observations – Performance Concerns

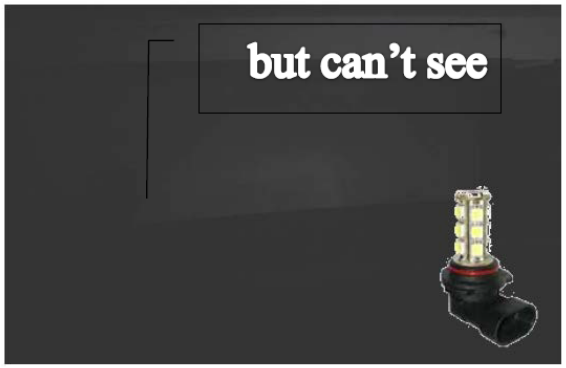
Performance Comparison (From document GRE-69-41)

LED retrofit in front lighting

example

approved halogen light source vs. non-approved LED retrofit

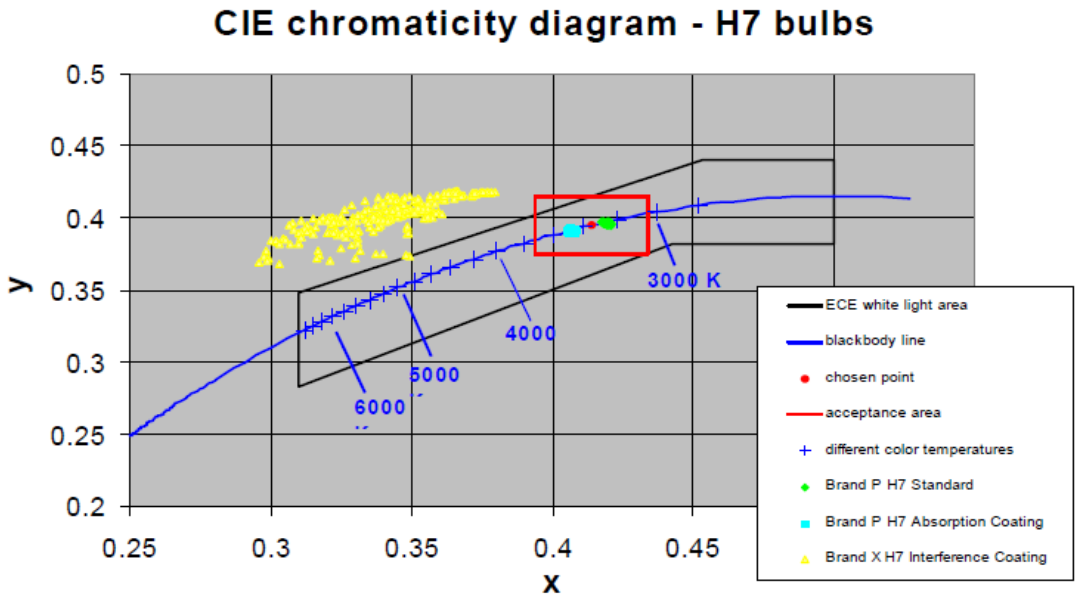
looks cool



➢ Luminous output:	1100lm	vs.	67lm
➢ Color of light:	3200K	vs.	9300K (outside boundaries for white)
➢ Emitter size:	4mm	vs.	20mm
➢ Intensity distribution:	circular	vs.	non-symmetrical

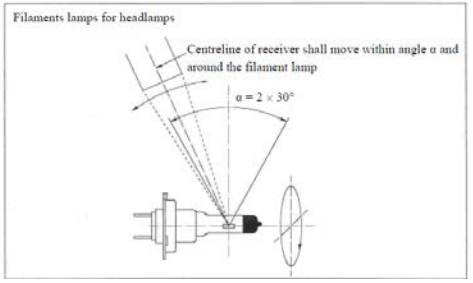
Early 2000's : Coated Halogen Bulbs

- SAE Coated Bulb Task Force
- Round Robin testing



Early 2000's : Coated Halogen Bulbs

- Test method – accepted by industry and regulators
  - ECE Regulation 37
  - SAE J2560
  - Part 564 data sheets for coated light sources
- Full report SAE J2739



SAE International	SURFACE VEHICLE INFORMATION REPORT	SAE J2739 FEB2011
		Issued 2007-01 Stabilized 2011-02 Superseding J2739 JAN2007
Absorptive and Interference Coatings Applied on Replaceable Headlamp Bulbs		

LED Replacement Light Sources

- Signal and Marking light sources
  - Filament types
    - No FMVSS108 light source data sheets
    - Standardized in SAE J573 and ANSI SR25
- Forward Lighting
  - Fog lamps
    - No FMVSS108 light source data sheets
  - Low and high beam (DOT-marked light sources)
    - FMVSS108 Requirements and Part 564 Data sheets

Signal and Marking Lamps in FMVSS108

S14.2.1.6 Bulbs. Except for a lamp having a sealed-in bulb, a lamp must meet the applicable requirements of this standard when tested with a bulb whose filament is positioned within ± .010 in of the nominal design position specified in SAE J573d*, Lamp Bulbs and Sealed Units*, December 1968, (incorporated by reference, see 571.108 S5.2 of this title) or specified by the bulb manufacturer and operated at the bulb's rated mean spherical candela.

S14.2.1.6.1 Each lamp designed to use a type of bulb that has not been assigned a mean spherical candela rating by its manufacturer and is not listed in SAE J573d, *Lamp Bulbs and Sealed Units*, December 1968 (incorporated by reference, see 571.108 S5.2 of this title), must meet the applicable requirements of this standard when used with any bulb of the type specified by the lamp manufacturer, operated at the bulb's design voltage. A lamp that contains a sealed-in bulb must meet these requirements with the bulb operated at the bulb's design voltage.

S14.2.1.6.2 A bulb that is not listed in SAE J573d, *Lamp Bulbs and Sealed Units*, December 1968, (incorporated by reference, see 571.108 S5.2 of this title) is not required to use a socket that conforms to the requirements of SAE J567b*, Bulb Sockets*, April 1964 (incorporated by reference, see 571.108 S5.2 of this title).

Timeline
Forward Lighting LED Replacement Sources

*= estimated

April 2016
Topic introduced in Replaceable Bulb Task Force

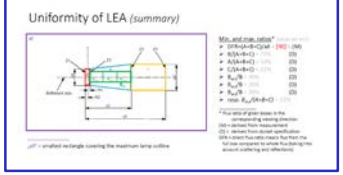
April 2017
Launch of dedicated Task Force

June 2017
Start Work in Progress J3145


SURFACE VEHICLE RECOMMENDED PRACTICE

Sept. 2017
Demonstration

May 2018
Definition of fundamental equivalence criteria



Aug 2018
Document drafting

April 2019*
1st Committee ballot

Demonstration

SAE Replaceable LED Sources Task Force

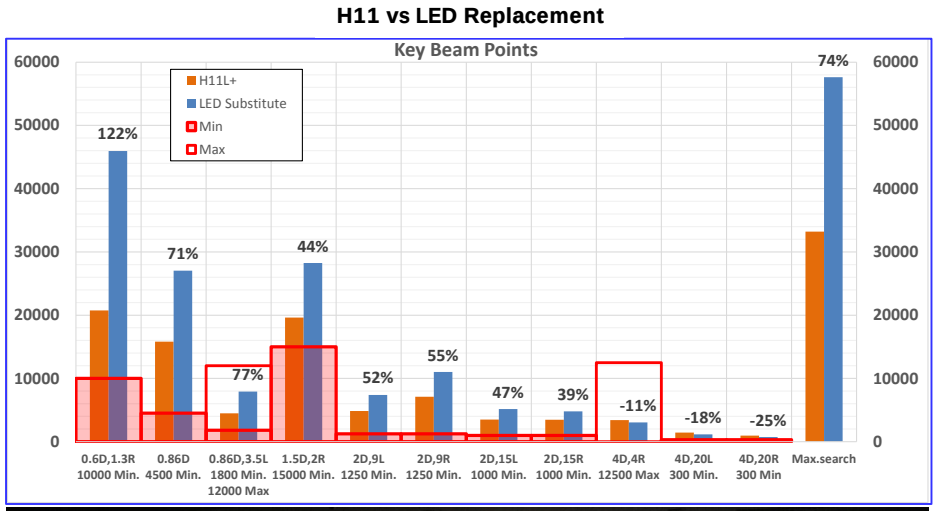
- Alexandria, VA on 13 September 2017
- Demonstration by light source manufacturers
  - H11 Reflector headlamp – SAE beam pattern
  - H11 Projector headlamp – SAE beam pattern
- Presentation of feasibility studies

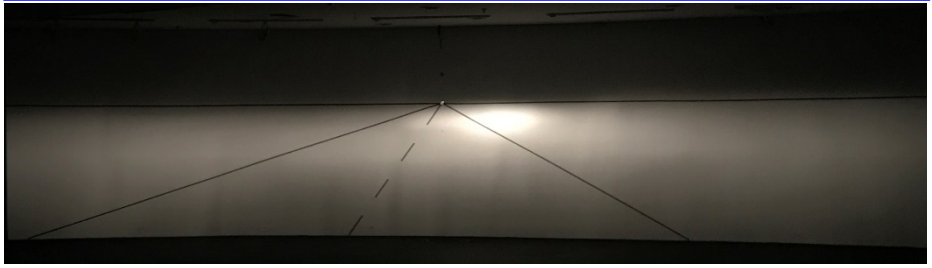
Demonstration – Sept 2017

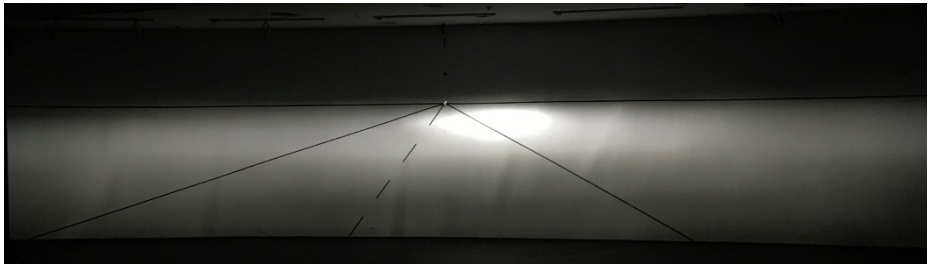
Feasibility Studies – Headlamp Testing
H11 LED Replacement Light Source

Head Lamp / Type	Downroad 0.86D	Max Search	Points Passed	Beam Flux	IIHS Rating	Fit	Comments
Light Truck 1 / Reflector	26569 +44%	31901 +53%	22/22	380 +15%	15.6 +32%	Good	Beam spread drops slightly at edges?
Light Truck 2 / Reflector	27042 +71%	57610 +74%	21/22 2U-4L	438 +14%	12.9 +50%	Very Good	
Minivan / Reflector	49329 +35%	59893 +48%	21/22 0.5U 1-3R	+11%	10.7 +53%	Very Good	
Light Truck 3 / Projector	20079 +59%	21878 +7%	20/22 2U-4L, 0.5U 1-3R	+22%	11.4 +51%	Good	
Sedan 1 / Projector	15637 +142%	18725 +21%	22/22	+21%	24.4 +37%	Good	
Sedan 2 / Reflector	22034 +9%	37898 +55%	22/22	+10%	12.0 +19%	Good	
Sedan 3	12698 +25%	38088 +46%	22/22	-	-	OK	Striations in Beam
Sedan 4 / Reflector	15880 +44%	36843 +44%	21/22 10-90U	-	-	Very Good	

H11 LED Replacement
Beam Performance – Light Truck 2 (Reflector)

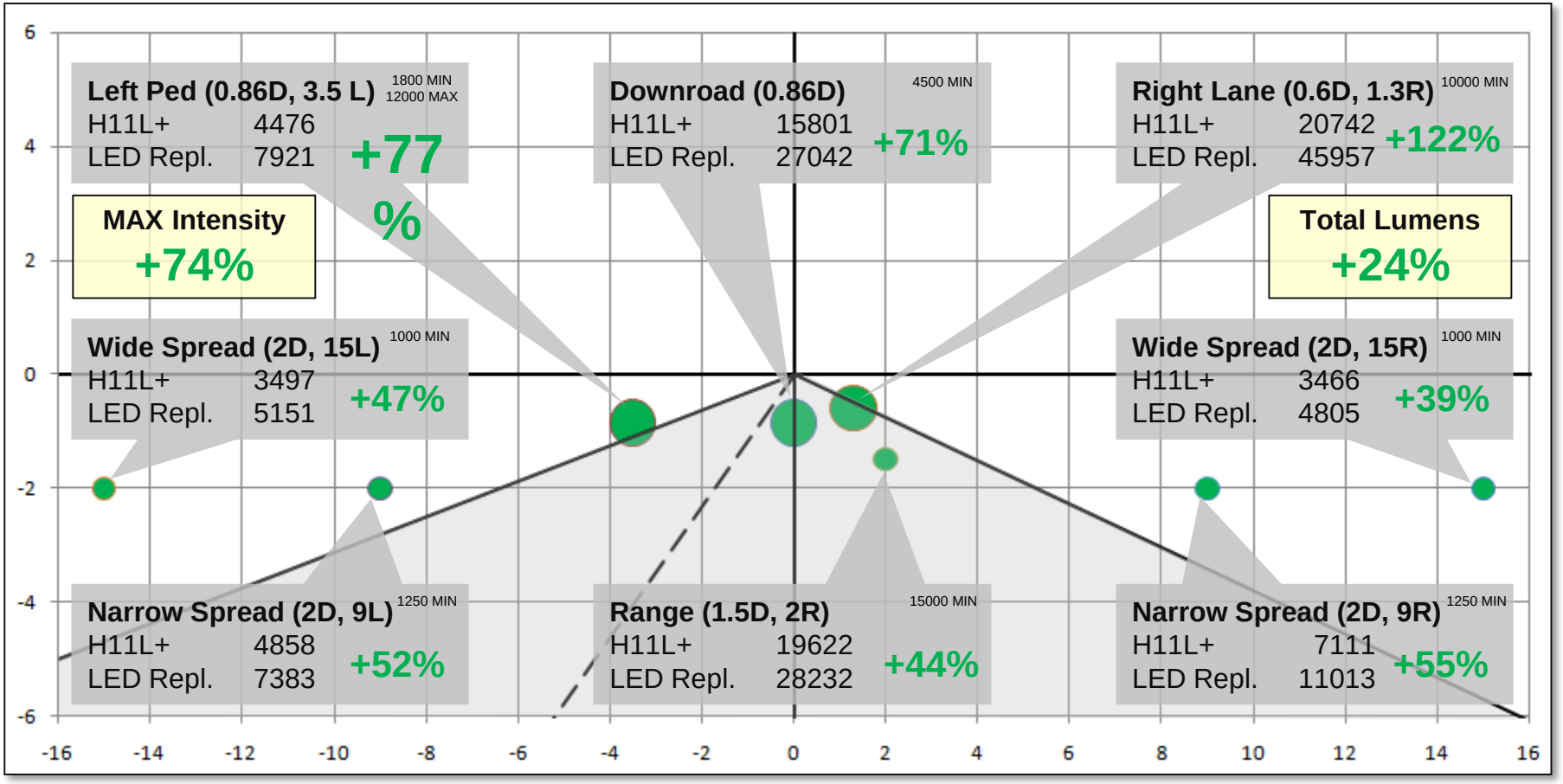






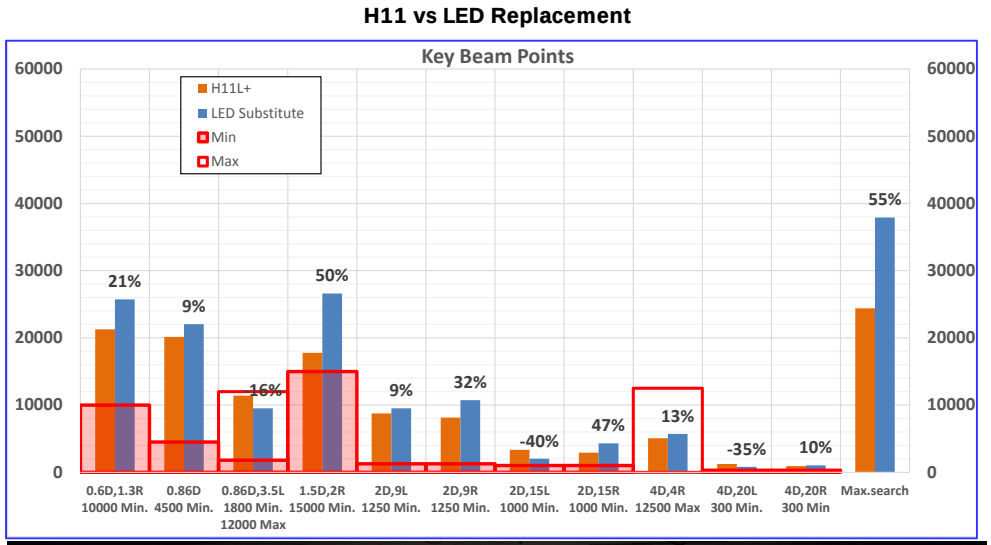
FMVSS 108 TAB17-2 LB, visual aim (Single Filament or HB2)	H11-7	LED-1	LED-2	LED-3	LED-4	LED Average	% Δ
Voltage	12.81	12.81	12.81	12.81	12.81		
Current	4.19	1.06	1.07	1.05	1.07		
10U-90U Max. 125	90	125	129	126	129	127	42%
4U, 8L 64 Min.	106	78	81	75	74	77	-27%
4U, 8R 64 Min.	121	97	100	103	97	99	-18%
2U, 4L 135 Min.	172	127	132	140	131	133	-23%
1.5U,1R-3R Min. 200	254	220	221	227	221	222	-13%
1.5U,1R-R 1400 Max.	287	242	238	249	245	244	-15%
1U, 1.5L-L Max. 700	369	223	215	238	227	226	-39%
.5U, 1.5L-L Max. 1000	544	385	468	499	409	440	-19%
.5U, 1R-3R 500 Min. Max 2700	(504.3) 585.1	(553.2) 873.7	(825) 1252	(879) 1407	(581.7) 859.0	710	-
H,4L 135 Min.	827	1570	1682	2069	1659	1745	111%
H,8L 64 Min.	633	1080	1201	1363	1122	1192	88%
0.6D,1.3R 10000 Min.	20742	45244	45134	46804	46644	45957	122%
0.86D 4500 Min.	15801	28143	25612	26722	27693	27042	71%
0.86D,3.5L 1800 Min. 12000 Max	4476	7852	7706	7969	8158	7921	77%
1.5D,2R 15000 Min.	19622	28433	27933	28413	28173	28238	44%
2D,9L 1250 Min.	4858	7464	7559	7167	7342	7383	52%
2D,9R 1250 Min.	7111	11002	11020	11433	10599	11013	55%
2D,15L 1000 Min.	3497	5389	5210	4737	5271	5151	47%
2D,15R 1000 Min.	3466	4798	4897	4717	4805	4805	39%
4D,4R 12500 Max	3423	3217	3084	2905	3012	3055	-11%
4D,20L 300 Min.	1431	1237	1203	1038	1191	1167	-18%
4D,20R 300 Min	971	700	744	748	709	725	-25%
Max.search	33201	58525	56726	56887	58302	57610	74%
H	2.65	2.5	2.4	2.3	2.4	2.40	
V	-0.85	-0.65	-0.6	-0.6	-0.65	-0.63	
Gradient	0.298	0.298	0.256	0.251	0.26	0.27	-11%

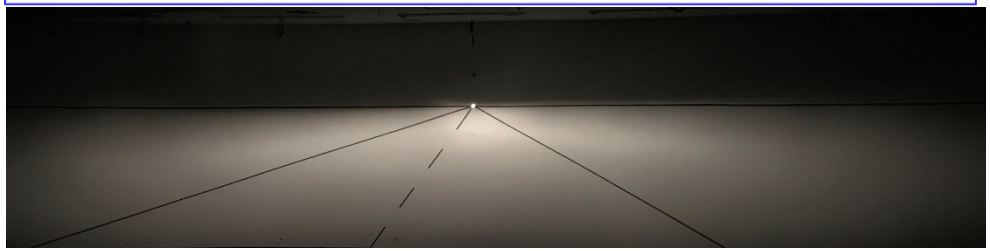
H11 LED Replacement
Beam Performance – Light Truck 2 (Reflector)

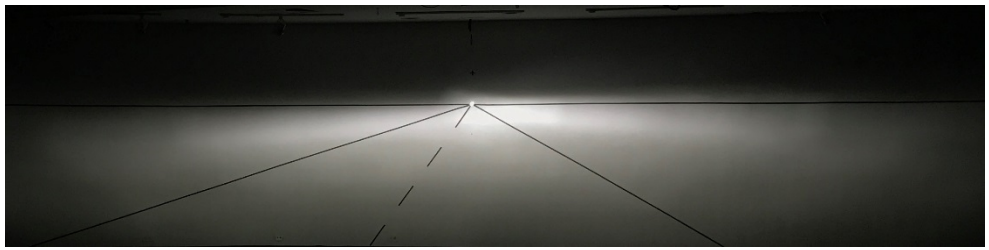


- LED Replacement – 2 failed beam points – 10-90U and 2U, 4L

H11 LED Replacement
Beam Performance – Sedan 2 (Reflector)







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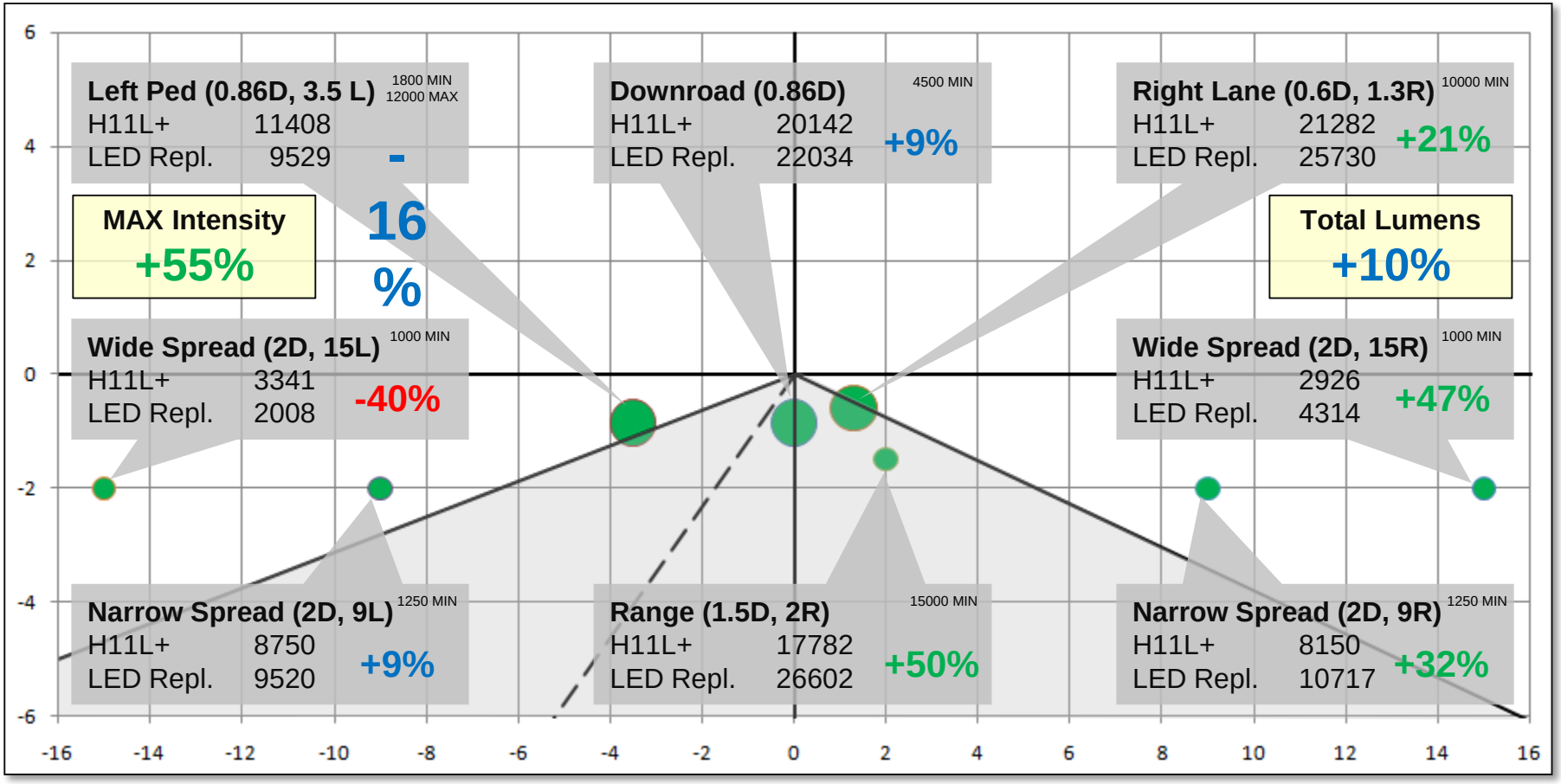
Voltage	12.81	12.81	12.81	12.81	12.81		
Current	4.22	1.05	1.06	1.06	1.06		
10U-90U Max. 125	87	68	74	66	66	68	-22%
4U, 8L 64 Min.	245	141	140	140	135	139	-43%
4U, 8R 64 Min.	173	102	105	97	101	101	-42%
2U, 4L 135 Min.	313	159	149	152	156	154	-51%
1.5U,1R-3R Min. 200	495	200	239	212	211	215	-56%
1.5U,1R-R 1400 Max.	567	447	417	423	381	417	-26%
1U, 1.5L-L Max. 700	453	256	242	228	229	238	-47%
.5U, 1.5L-L Max. 1000	638	431	403	362	349	386	-39%
.5U, 1R-3R 500 Min. Max 2700	(814.3) 899.0	(930) 1280	(833) 1227	(688) 1085	(678) 1047	782	-4%
H,4L 135 Min.	1222	834	778	648	651	728	-40%
H,8L 64 Min.	762	459	434	387	364	411	-46%
0.6D,1.3R 10000 Min.	21282	28213	27773	24142	22792	25730	21%
0.86D 4500 Min.	20142	23482	22722	21512	20422	22034	9%
0.86D,3.5L 1800 Min. 12000 Max	11408	8007	7621	11888	10602	9529	-16%
1.5D,2R 15000 Min.	17782	25812	26772	26412	27412	26602	50%
2D,9L 1250 Min.	8750	9520	9351	9835	9376	9520	9%
2D,9R 1250 Min.	8150	10516	10312	11177	10865	10717	32%
2D,15L 1000 Min.	3341	2075	2097	2005	1853	2008	-40%
2D,15R 1000 Min.	2926	4259	4156	4473	4365	4314	47%
4D,4R 12500 Max	5070	5471	5752	5646	5963	5708	13%
4D,20L 300 Min.	1232	788	810	798	787	796	-35%
4D,20R 300 Min	929	1006	1022	1035	1029	1023	10%
Max.search	24393	37953	39184	37632	36822	37898	55%
H	1.05	2.95	2.9	2.95	3	2.95	
V	-1	-0.85	-0.9	-0.9	-0.95	-0.90	
Gradient	0.298	0.245	0.251	0.27	0.233	0.25	-16%

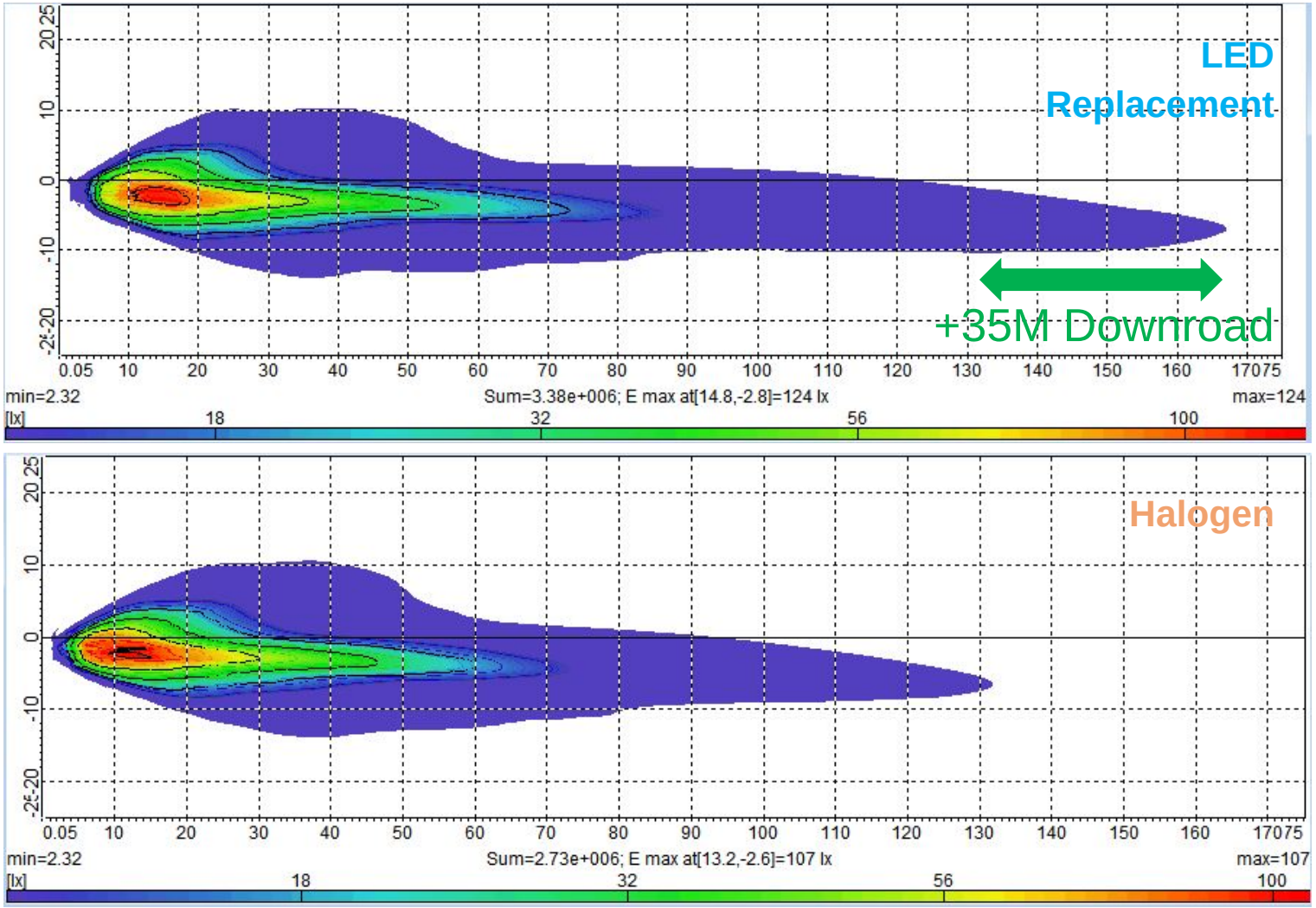
H11 LED Replacement
Beam Performance – Sedan 2 (Reflector)



- LED Replacement – NO failed beam points. 2 reaims.

Feasibility H11 LED Replacement

Light Truck 2 – Halogen vs LED Replacement



Conditions for Equivalent Performance

- Based on light-technical “Equivalency Principle”
- Require LED light source to have same far-field and near-field behavior as filament light source
- Source-level compliance

Conditions for Equivalent Performance

Filament Light Source

Same
- base keying
- electrical connector
- maximum outline
- test voltage
- luminous flux
- color of the emitted light
- light center length
- distortion free zone

Similar
- luminous intensity distribution
- size and position of light emitting area (LEA)
- homogeneity of LEA

Different
- Base dimensions
- Power consumption

Additional
- thermal behavior
- outage behavior

LED Replacement Light Source

Draft SAE J3145

SAE INTERNATIONAL

SURFACE VEHICLE RECOMMENDED PRACTICE

J3145™

PropDft SEP2018

Issued 2018-xx

Forward Lighting LED Replacement Light Sources for Halogen Light Sources

RATIONALE

Apparent light emtting area is apparent because it is the size as seen from the outside (possibly through a lens or primary optics) of the LED light source, not the actual chip-size.

The contrast of the LED light source determines the minimum achievable glare compared to the maximum amount of light on the road in the far field (i.e. close to cut-off).

The size of the light-emitting-area of the LED light source (relative to the size of the nominal-emitter-box defined in the category sheet) is linked to the position accuracy of individual LEDs and impacts the range for re-aiming of the headlamp.

Thank you