

# Luminance and Color report

## Runway and Taxiway Guidance Signs

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**FLAT-Light TGS series 4**



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Attachment: Analysis Report by SGS Intron

## 1. Introduction

Luminance and color of illuminated signs along runway and taxiway are subject to international standards of FAA, ICAO and EASA. In order to ensure conformity with these regulations AAS International initiated a luminance and color test on a production model. This test is commissioned by AAS International and is carried out at and under supervision of testing and certification company SGS Intron BV located in Sittard, The Netherlands. The Analysis Report with the original measurements is attached to this document.

## 2. Applicable standards

### ICAO

Annex 14 – Aerodromes Volume I, 8<sup>th</sup> edition

### EASA

CS-ADR-DSN-Book 1,

Chapter N – Visual Aids for navigation (signs)

CS ADR-DSN.N.775

### FAA

AC 150- 5345-44J, 3.2.5.6 and 3.2.5.4

## 3. Measurement setup

Two LED illuminated signs FLAT-Light TGS series 4 in a darkened room for light measurements.

Physical dimensions:

- Sign A : 950 x 1950mm, face 800 x 1800mm, main color: yellow.
- Sign B : 950 x 2250mm, face 800 x 2100mm, main color red.

The FLAT-Light TGS series 4 has a LED strip at the top over the full length of the sign.

The measurements are carried out according the grid points from ICAO and EASA. Luminance and color measurements are performed using a calibrated Minolta CS-200 chroma meter.



Sign A



Sign B

## 4. Measurement results

### 4.1 General conditions

Room temperature	23°C
Room humidity	52%
Main power	230Vac
Frequency	50Hz
Stabilization time	1 hour

## 4.2 Measurements sign A

### Luminance

Luminance Measurements YELLOW - $L_v$ ( $cd/m^2$ )													
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13
1	278	250	240	258	247	253	244	235	214	205	226	245	198
2	177	195		195	195		196	185	173	168	184	173	143
3	148	156		175	166	165	174	172	169		158	147	136
4	133	144	158	162	160	153	166	168		163	156	147	142
5	129	140	156	160	167	169	170	174	172	169	157	153	146
6	133	147	163	170	176	182	183	185	183	177	164	168	153

### Chromaticity

Chromaticity X - Color Yellow													
x	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0,500	0,501	0,500	0,500	0,501	0,501	0,501	0,501	0,501	0,501	0,501	0,501	0,500
2	0,500	0,500		0,499	0,500		0,500	0,500	0,500	0,500	0,500	0,500	0,500
3	0,500	0,500		0,500	0,499	0,499	0,500	0,500	0,500		0,500	0,500	0,500
4	0,501	0,501	0,501	0,501	0,501	0,500	0,501	0,501		0,501	0,501	0,501	0,501
5	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,501	0,502	0,502	0,502
6	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502	0,502

Chromaticity Y - Color Yellow													
y	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0,494	0,494	0,494	0,494	0,494	0,494	0,494	0,494	0,494	0,494	0,494	0,494	0,494
2	0,494	0,494		0,495	0,494		0,494	0,494	0,494	0,495	0,494	0,494	0,494
3	0,494	0,494		0,494	0,495	0,496	0,494	0,494	0,494		0,494	0,494	0,494
4	0,494	0,493	0,494	0,493	0,494	0,495	0,494	0,494		0,494	0,494	0,493	0,493
5	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493
6	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493	0,493

### 4.3 Measurements sign B

#### Luminance

Luminance Measures RED - $L_v$ ( $cd/m^2$ )														
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1					55	56	57	54	55	51	48	44	47	47
2					45	46	46			42		39	39	39
3					41	43	43	42		41		38	39	35
4					37	39	39		40	42		39	36	35
5					38	41	43	41	41	41	42	41	38	35

Luminance Measures WHITE - $L_v$ ( $cd/m^2$ )														
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2								338	358		338			
3									329		300	321		
4								319	299		325	318		
5														

Luminance Measures YELLOW - $L_v$ ( $cd/m^2$ )														
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2		299	294											
3		245	259											
4		214	223											
5														

**Chromacity**

<b>Chromacity X - Color RED</b>														
x	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1					0,682	0,683	0,683	0,683	0,683	0,683	0,683	0,683	0,683	0,683
2					0,682	0,682	0,682			0,681		0,681	0,682	0,682
3					0,681	0,681	0,682	0,681		0,680		0,680	0,682	0,682
4					0,681	0,681	0,681		0,679	0,671		0,679	0,681	0,681
5					0,680	0,681	0,681	0,681	0,681	0,681	0,681	0,681	0,681	0,681

<b>Chromacity Y - Color RED</b>														
y	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1					0,318	0,317	0,317	0,317	0,317	0,317	0,317	0,317	0,317	0,317
2					0,318	0,318	0,318			0,318		0,318	0,318	0,318
3					0,319	0,318	0,318	0,318		0,318		0,318	0,318	0,318
4					0,320	0,319	0,319		0,319	0,323		0,319	0,319	0,319
5					0,319	0,319	0,319	0,319	0,319	0,319	0,318	0,319	0,318	0,319

<b>Chromacity X - Color WHITE</b>														
x	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2								0,348	0,346		0,344			
3									0,346		0,351	0,344		
4								0,348	0,351		0,348	0,346		
5														

<b>Chromacity Y - Color WHITE</b>														
y	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2								0,353	0,353		0,353			
3									0,355		0,355	0,354		
4								0,358	0,358		0,358	0,356		
5														

Title:  
Issue:  
Date:

Author:



Chromaticity X - Color Yellow														
x	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2		0,500	0,500											
3		0,500	0,501											
4		0,501	0,501											
5														

Chromaticity Y - Color Yellow														
y	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1														
2		0,495	0,494											
3		0,494	0,494											
4		0,494	0,494											
5														

## 5 Review of results according international standards

To determine if the illumination of the sign complies with the international standards the measurement results were plotted against relevant criteria for luminance and chromaticity.

### 5.1 Luminance

The luminance values were compared to the minimum values as specified by ICAO Annex 14 Volume I. The same values are specified by FAA and EASA.

From the table can be concluded that the luminance levels of yellow, red and white comply with ICAO Annex 14 Volume I – Appendix 4, paragraph 4a.

#### Sign A

Average Luminance for RVR < 800m			
Color	L <sub>vAverage</sub> (cd/m <sup>2</sup> )	Parameters	Analysis
Yellow	177	L <sub>vAverage</sub> >= 150cd/m <sup>2</sup>	OK

Relationship between adjacent points YELLOW			
Grid points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters according to the grid	Analysis
1	238	15*15Cm (L <sub>vMax</sub> / L <sub>vMin</sub> <= 1,5)	
2	180		OK
3	160		OK
4	154		OK
5	159		OK
6	168		OK

Relationship between highest and lowest value YELLOW			
Grid Points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters	Analysis
L <sub>vMin</sub>	129	L <sub>vMax</sub> / L <sub>vMin</sub> <= 5	OK
L <sub>vMax</sub>	278		

#### Sign B

Average Luminance for RVR < 800m			
Color	L <sub>vAverage</sub> (cd/m <sup>2</sup> )	Parameters	Analysis
Red	42,8	L <sub>vAverage</sub> >= 30cd/m <sup>2</sup>	OK
Yellow	256	L <sub>vAverage</sub> >= 150cd/m <sup>2</sup>	OK
White	325	L <sub>vAverage</sub> >= 300cd/m <sup>2</sup>	OK

Mandatory Signals Relation between adjacent white and red dots			
Color	L <sub>vAverage</sub> (cd/m <sup>2</sup> )	Parameters	Analysis
White	325	Br 5 to 10x larger than Vm	OK
Red	43		



Relationship between adjacent points RED			
Grid points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters according to the grid	Analysis
1	51	15*15Cm (L <sub>v</sub> Max / L <sub>v</sub> Min <= 1,5)	
2	42		OK
3	40		OK
4	38		OK
5	40		OK

Relationship between highest and lowest value RED			
Grid Points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters	Analysis
L <sub>v</sub> Min	35	L <sub>v</sub> Max / L <sub>v</sub> Min <= 5	OK
L <sub>v</sub> Max	57		

Relationship between adjacent points YELLOW			
Grid points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters according to the grid	Analysis
1		15*15Cm (L <sub>v</sub> Max / L <sub>v</sub> Min <= 1,5)	
2	296		OK
3	252		OK
4	219		OK
5			OK

Relationship between highest and lowest value YELLOW			
Grid Points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters	Analysis
L <sub>v</sub> Min	214	L <sub>v</sub> Max / L <sub>v</sub> Min <= 5	OK
L <sub>v</sub> Max	299		

Relationship between adjacent points WHITE			
Grid points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters according to the grid	Analysis
1		15*15Cm (L <sub>v</sub> Max / L <sub>v</sub> Min <= 1,5)	
2	345		OK
3	317		OK
4	315		OK
5			OK

Relationship between highest and lowest value WHITE			
Grid Points	L <sub>v</sub> (cd/m <sup>2</sup> )	Parameters	Analysis
L <sub>v</sub> Min	299	L <sub>v</sub> Max / L <sub>v</sub> Min <= 5	OK
L <sub>v</sub> Max	358		

### 5.2 Chromaticity

The chromaticity is measured by the color coordinates of each color. The coordinates were compared to the limits as specified by ICAO Annex 14 Volume I – Appendix 1, paragraph 3.4. The same limits apply according FAA and EASA regulations.

#### Sign A

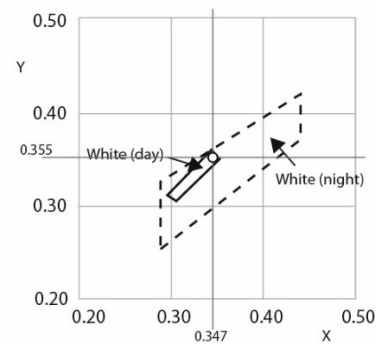
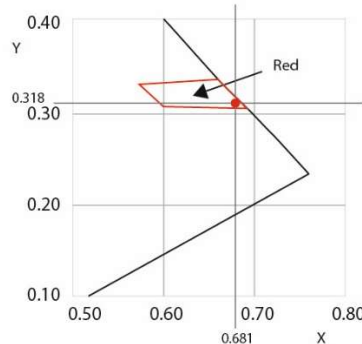
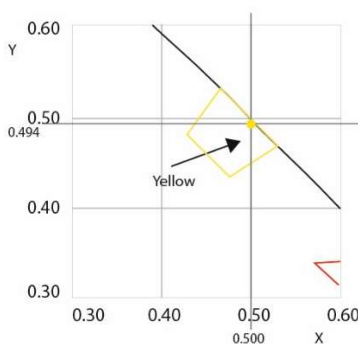
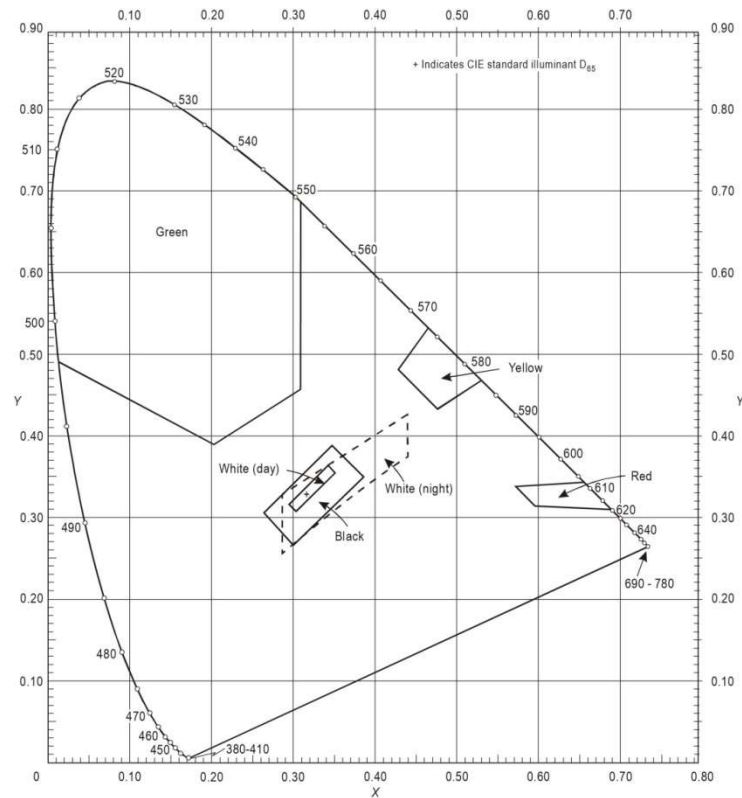
Average values	
x	0,500
y	0,494

#### Sign B

Average values	
x	0,681
y	0,318

Average values	
x	0,347
y	0,355

Average values	
x	0,500
y	0,494



## 6 Conclusion

### AAS International - Runway Sign and Taxiway Guidance Sign

	<i>Complies with limits for luminance</i>	<i>Complies with limits for ratios between points</i>	<i>Complies with limits for color</i>
Red	Yes	Yes	Yes
White	Yes	Yes	Yes
Yellow	Yes	Yes	Yes

Luminance, luminance ratios and color are fully in line with ICAO/FAA/EASA regulations.

## Certificate Of Analysis

AAS International  
Mr. D. Biesmans  
E: db@asinternational.nl  
Achtseweg Zuid 153C  
5651 GW EINDHOVEN, The Netherlands

Date : 04-08-2023  
Subject : Optical tests on runway signs  
Your Code : -  
Laboratory Number : 232812  
Sampling : by customer  
Period of Investigation : 19-07-2023 until 04-08-2023

### SAMPLE DATA

Sample No	Sample Type	Sample Code
1	Runway sign	FLAT-Light TGS series 4, Red display 2100 x 800
2	Runway sign	FLAT-Light TGS series 4, Yellow display 1800 x 800



Photo 1: Samples tested

### METHODS

Analysis	Method	Q s
Luminance	NEN EN 12966-1 + A1, Clause 7.3 & 7.4 & 9.3	Q
Colour	NEN EN 12966-1 + A1, Clause 7.2 & 9.3	Q

Q = ISO 17025 accredited, s = subcontracted, Qs = ISO 17025 accredited subcontractor

Author: ing. M.J.G. Delambo  
Operations Manager

Authorisation: ing. A. Meijs  
Account Manager



## RESULTS

### FLAT-LIGHT TGS SERIES 4, RED DISPLAY 2100 X 800

#### LUMINANCE

Luminance Measures RED - L <sub>v</sub>																		
(cd/m <sup>2</sup> )																		
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1					54,92	55,94	56,58	54,41	54,77	51,41	47,80	44,31	46,89	47,30				
2					45,21	46,45	45,56			42,46		38,72	39,49	39,24				
3					40,88	43,06	42,79	41,63		40,63		38,39	38,73	35,12				
4					36,96	38,92	39,39		39,97	41,71		39,20	36,19	34,60				
5					37,59	40,65	43,33	40,65	40,84	41,39	42,43	41,03	37,50	35,26				

Luminance Measures WHITE - L <sub>v</sub>																		
(cd/m <sup>2</sup> )																		
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2								338,44	357,73		337,65							
3									329,41		300,43		320,82					
4								319,29	299,30		324,63		318,35					
5																		

Luminance Measures YELLOW - L <sub>v</sub>																		
(cd/m <sup>2</sup> )																		
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2		298,81	293,92															
3		245,17	259,32															
4		214,10	223,24															
5																		

#### COLOUR

Color RED																		
x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1					0,6821	0,6827	0,6828	0,6828	0,6827	0,6826	0,6825	0,6825	0,6828	0,6826				
2					0,6818	0,6823	0,6822			0,6813		0,6814	0,6821	0,6821				
3					0,6807	0,6814	0,6817	0,6806		0,6804		0,6804	0,6815	0,6815				
4					0,6805	0,6810	0,6806		0,6789	0,6709		0,6793	0,6809	0,6813				
5					0,6804	0,6812	0,6809	0,6808	0,6805	0,6807	0,6807	0,6809	0,6812	0,6811				

Color RED																		
y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1					0,3177	0,3170	0,3170	0,3169	0,3170	0,3170	0,3170	0,3172	0,3169	0,3170				
2					0,3181	0,3176	0,3175			0,3175		0,3177	0,3177	0,3176				
3					0,3191	0,3182	0,3182	0,3182		0,3180		0,3183	0,3183	0,3181				
4					0,3195	0,3188	0,3188		0,3192	0,3232		0,3190	0,3186	0,3187				
5					0,3193	0,3187	0,3188	0,3186	0,3186	0,3185	0,3184	0,3185	0,3184	0,3185				

Color WHITE																		
x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2								0,3476	0,3456		0,3437							
3									0,3464		0,3514	0,3438						
4								0,3482	0,3505		0,3475	0,3462						
5																		

Color WHITE																		
y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2								0,3533	0,3530		0,3529							
3									0,3552		0,3551	0,3544						
4								0,3576	0,3578		0,3576	0,3563						
5																		

Color Yellow																		
x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2		0,4997	0,5003															
3		0,5002	0,5008															
4		0,5006	0,5009															
5																		

Color Yellow																		
y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		
2		0,4948	0,4943															
3		0,4944	0,4939															
4		0,4940	0,4937															
5																		



**FLAT-LIGHT TGS SERIES 4, YELLOW DISPLAY 1800 X 800**  
**LUMINANCE**

Luminance Measures YELLOW - L <sub>v</sub> (cd/m <sup>2</sup> )																		
Grid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	277,88	250,49	239,52	258,14	247,38	253,19	243,62	235,20	213,70	205,06	226,15	244,54	197,57					
2	176,59	195,46		194,78	194,65		196,28	185,49	173,47	168,46	184,42	172,73	142,72					
3	147,83	155,58		175,19	166,48	164,75	173,60	171,95	168,58		157,92	146,84	136,41					
4	132,73	144,01	158,00	161,82	160,38	152,63	165,74	168,38		163,44	156,07	147,47	141,58					
5	128,80	139,87	155,76	160,46	166,90	169,17	169,81	173,62	172,46	168,63	157,23	152,63	145,96					

**COLOUR**

Color Yellow																		
x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0,5002	0,5006	0,5003	0,5004	0,5005	0,5010	0,5006	0,5006	0,5008	0,5008	0,5010	0,5005	0,5004					
2	0,5001	0,5000		0,4991	0,5001		0,5002	0,5004	0,5002	0,5000	0,5003	0,5002	0,5001					
3	0,5001	0,5002		0,5000	0,4994	0,4985	0,5000	0,5003	0,5000		0,5001	0,5002	0,5001					
4	0,5010	0,5012	0,5008	0,5012	0,5006	0,4996	0,5010	0,5011		0,5010	0,5012	0,5013	0,5012					
5	0,5015	0,5016	0,5016	0,5017	0,5016	0,5015	0,5016	0,5017	0,5015	0,5014	0,5017	0,5017	0,5017					

Color Yellow																		
y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	0,4942	0,4939	0,4941	0,4940	0,4939	0,4936	0,4939	0,4940	0,4937	0,4936	0,4935	0,4940	0,4940					
2	0,4943	0,4944		0,4952	0,4943		0,4943	0,4941	0,4942	0,4945	0,4942	0,4941	0,4942					
3	0,4944	0,4943		0,4944	0,4949	0,4957	0,4944	0,4943	0,4944		0,4944	0,4942	0,4942					
4	0,4936	0,4934	0,4938	0,4934	0,4939	0,4948	0,4936	0,4939		0,4935	0,4935	0,4934	0,4933					
5	0,4931	0,4930	0,4930	0,4930	0,4931	0,4931	0,4931	0,4931	0,4931	0,4932	0,4930	0,4930	0,4929					



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- The results are only related to the investigated samples.
- Unless otherwise specified, the tests have been executed at the address shown above.
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- The uncertainty of measurement of the reported results and other performance data can be requested at SGS INTRON.
- Unless otherwise noted, in conformity assessments, a binary statement (pass, fail) is made based on applicable limits, without taking measurement uncertainty into account.
- On request, a list of accredited analysis methods can be requested, which describes the relationship (compliant, equivalent, own method) with the underlying standard.