



Great One Global Certification Co., Ltd.

9F-2, No. 120, Qiaohe Rd., Zhonghe Dist., New Taipei City 235, Taiwan (R.O.C.)

Website : www.go-safety.com.tw

TEL : +886-2-2248-0810

E-mail : sales@go-safety.com.tw

FAX : +886-2-2248-0811

Lumen Maintenance of LED Light Source Test Report



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

Standard Used :	IESNA LM-80 Approved Method for Measuring Lumen Maintenance of LED Light Sources
Date of test :	September 24, 2014 to June 17, 2015
Date of issue :	June 23, 2015
Report Number :	GO14063007
Total number of pages :	20



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*Joint IAF-ILAC-ISO Communiqué
on the
Management Systems Requirements of ISO/IEC 17025:2005,
General requirements for the competence of testing and calibration
laboratories*

A laboratory's fulfilment of the requirements of ISO/IEC 17025:2005 means the laboratory meets both the technical competence requirements and **management system requirements** that are necessary for it to consistently deliver technically valid test results and calibrations. The **management system requirements** in ISO/IEC 17025:2005 (Section 4) are written in language relevant to laboratory operations and meet the principles of ISO 9001:2008 **Quality Management Systems — Requirements** and are aligned with its pertinent requirements.

IAF Chair

ILAC Chair

ISO Secretary General



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www.ilac.org



International Laboratory Accreditation Cooperation

Joint ISO-ILAC-IAF Communiqué

8 January 2009

ILAC members will be aware that many of their accredited laboratories have been experiencing difficulty convincing their customers they should be asking laboratories to be accredited to ISO/IEC 17025, (prior to 1999 ISO Guide 25) rather than be certified (registered) to ISO 9001. The situation became more acute with the publication of ISO 9001:2008, as some customers continually asked laboratories to be certified, when they really meant accredited. The confusion is caused by the perception that accredited laboratories do not operate a recognised quality management system.

To address this problem the ILAC Laboratory Committee asked that a statement be put on accreditation (attestation) certificates, issued by their accreditation body, stating that an accredited laboratory's management system meets the principles of ISO 9001:2008. The same statement could also be used by accredited laboratories on their calibration certificates and test reports.

Working through the ISO-ILAC-IAF Joint Working Group (JWG), ILAC is pleased to be able to advise its member accreditation bodies that the problem raised by the Laboratory Committee may now be addressed as follows:-

On accreditation (attestation) certificates, accreditation bodies may add the following:

"This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009)"

Accreditation Bodies choosing to use the above statement on their accreditation certificates should either supply, or provide access to (via a website), the Joint ISO-ILAC-IAF Communiqué as part of the package. (It may be convenient for accreditation bodies to do this when they issue new accreditation certificates for ISO/IEC 17025:2005 to their accredited laboratories.)

Accredited laboratories choosing to use the above statement on their test reports and calibration certificates should also either supply, or provide access to (via a website), the Joint ISO-ILAC-IAF Communiqué as part of the package for their laboratory customers.

The Joint Communiqué is available on the ILAC website at www.ilac.org on the publications and resources page.

The ILAC Laboratory Committee thanks the members of the ILAC and IAF Executive Committees and the ISO-ILAC-IAF JWG, for developing a solution to a critical market issue facing some accredited laboratories.

Daniel Pierre, ILAC Chair

Secretariat: PO Box 7507, Silverwater, NSW 2128, Australia
7 Leeds Street, Rhodes, NSW 2138, Australia
ph: + 61 2 9736 8374 fax: + 61 2 9736 8373 email: ilac@nata.asn.au



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ACCREDITED

TEST REPORT Lumen Maintenance of LED Light Sources

Report Number.....: GO14063007

Date of issue: June 23, 2015

Tested by Kevin Wang *Kevin Wang*

(printed name and signature): Matt Hsieh *Matt Hsieh*

Reported by Donald Chang *Donald Chang*

(printed name and signature).....: Donald Chang *Donald Chang*

Approved by David Yuan *David Yuan*

(printed name and signature): David Yuan *David Yuan*

Testing Laboratory.....: Great One Global Certification Co., Ltd.

Address.....: 9F-2, No. 120, Qiaohe Road., Zhonghe Dist., New Taipei City 235, Taiwan (R.O.C.)

Applicant's name.....: Ledder Technologies Co., Ltd.

Address.....: 7F-4, No. 12, Ln. 609, Sec. 5, Chongsin Rd., Sanchong Dist., New Taipei City 24159, Taiwan (R.O.C.)

Manufacturer's name: Ledder Technologies Co., Ltd.

Address.....: 7F-4, No. 12, Ln. 609, Sec. 5, Chongsin Rd., Sanchong Dist., New Taipei City 24159, Taiwan (R.O.C.)

Standard IESNA LM-80 Approved Method for Measuring Lumen

Used.....: Maintenance of LED Light Sources

Brand Name.....: 

Test item description :

Product Name: LED Package

Model/Type reference: BIC1921-60-1-STAR

Classification.....: Package

Ratings.....: 350 mA, 3 Vdc, 1 W

1. The test results of this report relate only to the tested sample identified in this report.
2. This report shall not be reproduced, in full or in portion, except for having written approval from Great One Global Certification Co., Ltd.
3. The data in report cannot be used for advertisement, publication and promotion.



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Summary of testing:

Tests performed

The test samples were configured for continuous emission and powered by 350 mA constant current.

The LED output power was measured under normal conditions noted in details of measurement procedure and measurement results.

Measurement results: **See Appendix A.**

Testing location:

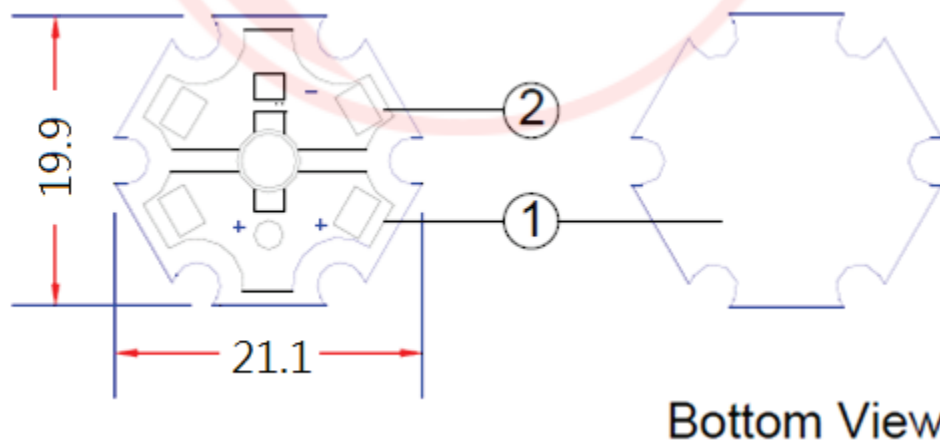
Great One Global Certification Co., Ltd.

Address:

9F-2, No. 120, Qiaohu Rd., Zhonghe Dist., New Taipei City 235, Taiwan (R.O.C.)

Testing.....	:	
Date of receipt of test item	:	September 24, 2014
Date(s) of performance of tests	:	September 24, 2014 to June 17, 2015
Number of LED light sources tested.....	:	10 pcs per case temperature
Test duration	:	6,000 hrs
Operating cycle.....	:	Constant direct current
Air flow.....	:	< 0.1 m/s
Relative humidity	:	< 45%
Photometric measurement uncertainty		
Flux measurement	:	2.2 % (k=2)
CCT measurement.....	:	0.48 % (k=2)

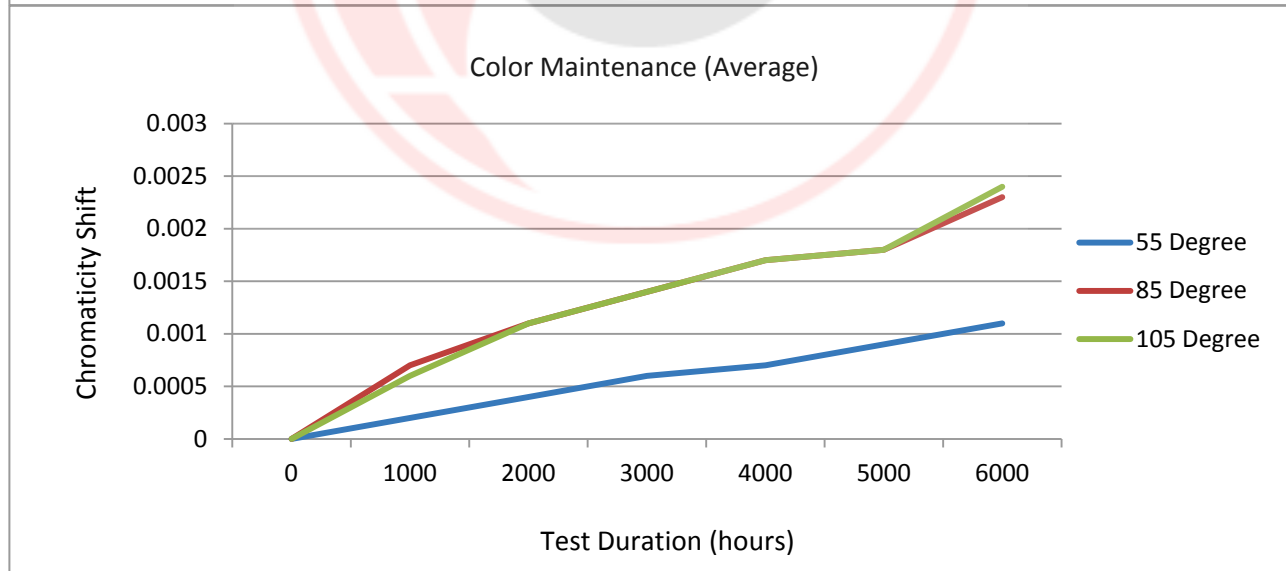
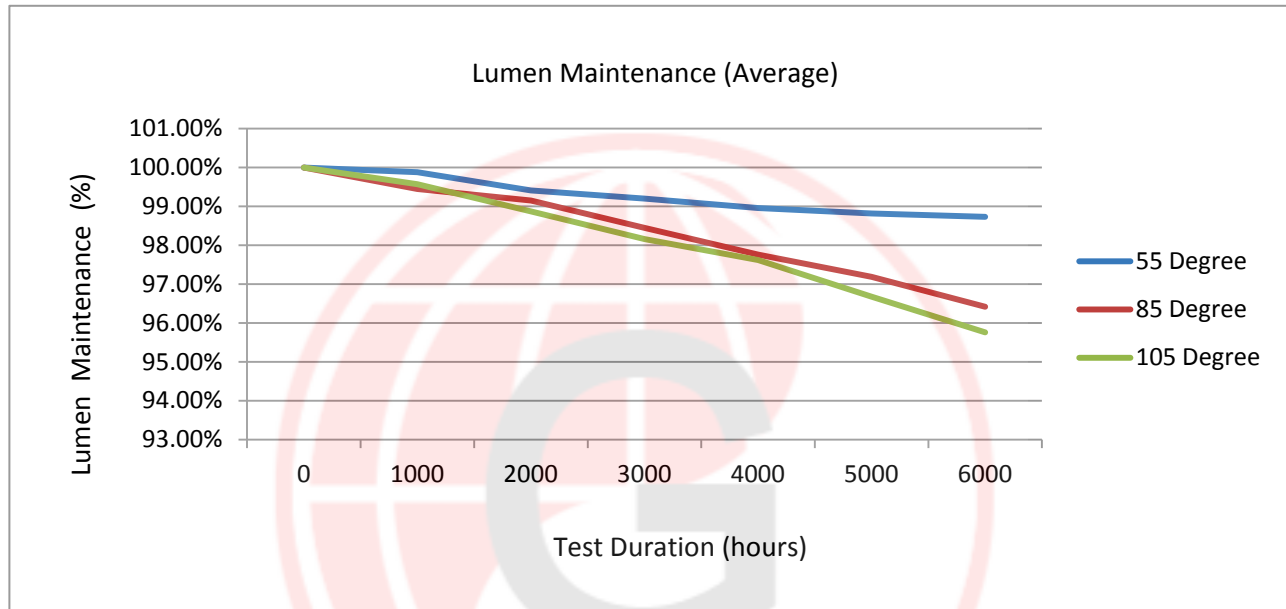
General product information:





Summary of results

Data Set	Case Temperature [Ts] °C	Ambient Temperature [Ta] °C	Drive Current [IF] mA	Lumen Maintenance at 6000 hrs	Chromaticity Shift ($\Delta u'v'$) at 6000 hrs	TM-21 Projection L70 (6K)
1	55	>50	350	98.73%	0.0011	$\geq 33,000$
2	85	>80	350	96.42%	0.0023	$\geq 33,000$
3	105	>100	350	95.76%	0.0024	$\geq 33,000$



Observation of LED light sources failures, including the failure conditions and time of failure:
No failure observed

~ End of Report ~



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Appendix A

LM-80-08

Approved Method for Measuring Lumen Maintenance of LED Light Sources

Report No. :	GO14063007	Test Initiation Date :	2014-09-24
Model No. :	BIC1921-60-1-STAR	Test Completion Date :	2015-06-17
Tested By : Kevin Wang, Matt Hsieh			
Manufacturer's Name : Ledder Technologies Limited			
Rated Voltage :	<u>3</u> V	Temperature Selected by manufacturer:	<u>105</u> °C
Rated Current :	<u>350</u> mA	Number of LED Light Sources tested:	<u>10</u>
Rated CCT	5000 K		

EQUIPMENT USED:				
Inst. ID No.	Instrument Type	Function /Range	Cal. Date	Due Date
L401	LED current source 1 (16 channel)	0~48 V dc, 0~5 A	2015/03/13	2016/03/12
L402	LED current source 2 (8 channel)	0~48 V dc, 0~5 A	2015/03/13	2016/03/12
L403	Thermal Plate Controller	0°C to 95°C	-	-
L404	Environment Oven	-	-	-
L405	PC Controller	-	-	-
L406 to L411	Temperature Data Recorder	0°C to 300°C	2015/02/26	2016/02/25
L412 to L418	Temperature Controller	0°C to 300°C	2015/02/26	2016/02/25
L419 to L420	Auxiliary Thermal Plate Controller 1 to 2	0°C to 95°C	-	-
L238	Thermal Plate Cooler	0°C to 95°C	-	-
L240	Integrating Sphere	0.5 M	-	-
L244	Standard Lamp	-	2015/01/03	2016/01/02
L225	Digital CC & CV DC Power Supply	V : 0~50Vdc, A : 0~10A	2014/07/25	2015/07/24

TEST SAMPLE IDENTIFICATION		
Date Received	Data Set No.	Sample No.
2014-09-24	1	14063007-1 to 14063007-16
2014-09-24	2	14063007-17 to 14063007-32
2014-09-24	3	14063007-33 to 14063007-48



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Appendix A

TEST METHOD

The samples were tested according to the IES LM-80-2008. Lumen maintenance data for each individual LED light source along with median value, standard deviation, minimum and maximum lumen maintenance value for all of the LED light sources were recorded in the following table.

Temperature and Humidity

The three case temperatures, T_s , were 55°C and 85°C with a third temperatures 105°C selected by the manufacturer. The case temperature and drive current selected by the manufacturer represented their expectation for customers applications and was within the recommended operating temperature range. Case temperatures were controlled to - 2°C during life testing. The temperature of the surrounding air was maintained to within -5°C of the case temperature during testing.

Humidity was maintained to less the 65 RH throughout the life test.

Airflow was minimized (Air flow : < 0.1m/s) for proper light source starting and operation.

Photometry Measurement

For information on the photometry of the LED light source, see Reference 2.1.2, LM-79.

A Spectroradiometer and Integrating Sphere were used to measure correlated color temperature, chromaticity coordinates, and the luminous flux for each LED light sources. Chromaticity coordinates, correlated color temperature and color rendering index were calculated from the spectral radiant flux measurements taken at 5 nm intervals over the range of 380 to 780 nm.

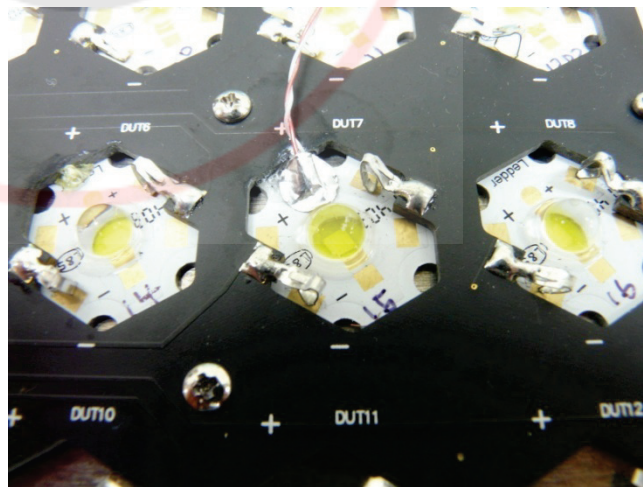
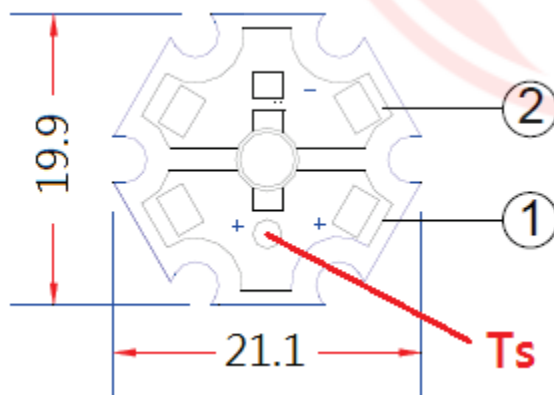
Luminous flux was measured at the drive current used during life testing.

The ambient temperature during lumen and chromaticity measurements was set to 25C +/- 2C.

Recording failures

Checking for LED light source failures either by visual observation or automatic monitoring was done at every measurement interval.

CASE TEMPERATURE, (T_s) ATTACMENT POINT, CASE SIZE





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Appendix A

Data Set 1	
Case Temperature	55 °C
Measurement Current	350 mA

Table 1-1
Initial Characteristics

Sample No.	Luminous Flux (lm)	Forward Voltage	CCT(K)	CIE-1931		CIE-1976	
14063007-2	137.5	2.902	5037	0.3496	0.4171	0.1914	0.5138
14063007-3	133.1	3.298	4976	0.3524	0.4233	0.1912	0.5166
14063007-5	139.1	3.094	5184	0.3437	0.4081	0.1907	0.5094
14063007-7	136.7	3.059	5006	0.3510	0.4200	0.1913	0.5151
14063007-8	139.6	2.971	5064	0.3486	0.4171	0.1908	0.5137
14063007-10	141.0	2.869	4925	0.3549	0.4288	0.1910	0.5190
14063007-11	136.4	2.908	5125	0.3459	0.4101	0.1914	0.5105
14063007-13	135.2	2.862	5200	0.3429	0.4044	0.1914	0.5078
14063007-15	140.4	2.861	4969	0.3528	0.4239	0.1912	0.5169
14063007-16	136.4	2.871	5098	0.3471	0.4141	0.1909	0.5123
Avg.	137.5	2.970	5058	0.3489	0.4167	0.1911	0.5135
Med.	137.1	2.905	5051	0.3491	0.4171	0.1912	0.5138
σ	2.48	0.14	92.88	0.0040	0.0077	0.0003	0.0036
Min.	133.1	2.861	4925	0.3429	0.4044	0.1907	0.5078
Max.	141.0	3.298	5200	0.3549	0.4288	0.1914	0.5190

Appendix A

**Table 1-2
Lumen Maintenance**

Sample No.	Lumen Maintenance% (Normalized to 100% at Initial)						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-2	100.0%	99.9%	99.4%	99.1%	99.0%	99.0%	98.9%
14063007-3	100.0%	100.0%	99.9%	99.5%	99.5%	99.2%	99.2%
14063007-5	100.0%	99.9%	99.4%	99.2%	98.7%	98.6%	98.6%
14063007-7	100.0%	99.9%	99.6%	99.3%	99.0%	98.8%	98.6%
14063007-8	100.0%	99.9%	99.2%	98.8%	98.5%	98.4%	98.3%
14063007-10	100.0%	99.8%	99.1%	99.1%	98.8%	98.7%	98.7%
14063007-11	100.0%	99.8%	99.7%	99.7%	99.6%	99.4%	99.3%
14063007-13	100.0%	99.8%	99.0%	98.9%	98.4%	98.3%	98.3%
14063007-15	100.0%	99.9%	99.4%	99.1%	98.8%	98.8%	98.6%
14063007-16	100.0%	99.9%	99.4%	99.3%	99.3%	99.0%	98.8%
Avg.	100.00%	99.88%	99.41%	99.20%	98.96%	98.82%	98.73%
Med.	100.00%	99.90%	99.40%	99.15%	98.90%	98.80%	98.65%
σ	0.0000	0.0006	0.0027	0.0027	0.0040	0.0034	0.0033
Min.	100.00%	99.80%	99.00%	98.80%	98.40%	98.30%	98.30%
Max.	100.00%	100.00%	99.90%	99.70%	99.60%	99.40%	99.30%

TM-21 Projection

Time	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
ln (Avg.)	0.0000	-0.0012	-0.0059	-0.0080	-0.0105	-0.0119	-0.0128

Test duration used	6,000 hrs	Calculated L70 (6K)	159,000 hrs
B	0.999	Report L70 (6K)	$\geq 33,000$ hrs
α	2.234E-06		



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Appendix A

**Table 1-3
Forward Voltage**

Sample No.	Relative Forward Voltage % (Normalized to 100% at Initial)						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-2	100.0%	100.0%	100.0%	99.9%	100.0%	100.0%	100.0%
14063007-3	100.0%	100.0%	100.0%	99.9%	100.0%	100.1%	100.0%
14063007-5	100.0%	100.0%	99.9%	99.9%	99.9%	100.0%	99.9%
14063007-7	100.0%	100.0%	100.0%	100.0%	100.1%	100.1%	100.0%
14063007-8	100.0%	100.0%	99.9%	99.9%	99.9%	100.0%	99.9%
14063007-10	100.0%	100.1%	100.0%	99.9%	100.0%	100.0%	100.0%
14063007-11	100.0%	100.0%	99.9%	99.9%	100.0%	100.1%	100.0%
14063007-13	100.0%	100.1%	100.0%	100.0%	100.0%	100.1%	100.0%
14063007-15	100.0%	100.1%	100.0%	100.0%	100.1%	100.1%	100.0%
14063007-16	100.0%	100.1%	100.1%	100.1%	100.1%	100.1%	100.0%
Avg.	100.00%	100.05%	100.01%	99.97%	100.02%	100.09%	100.01%
Med.	100.00%	100.05%	100.00%	99.95%	100.00%	100.10%	100.00%
σ	0.0000	0.0005	0.0009	0.0008	0.0008	0.0007	0.0007
Min.	100.00%	100.00%	99.90%	99.90%	99.90%	100.00%	99.90%
Max.	100.00%	100.10%	100.10%	100.10%	100.10%	100.20%	100.10%

Appendix A

**Table 1-4
Chromaticity Shift**

Sample No.	Chromaticity Shift $\Delta u'v'$						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-2	0.0000	0.0003	0.0005	0.0007	0.0007	0.0009	0.0009
14063007-3	0.0000	0.0002	0.0005	0.0007	0.0008	0.0011	0.0012
14063007-5	0.0000	0.0002	0.0005	0.0006	0.0008	0.0009	0.0010
14063007-7	0.0000	0.0002	0.0004	0.0006	0.0006	0.0009	0.0011
14063007-8	0.0000	0.0001	0.0002	0.0004	0.0006	0.0008	0.0009
14063007-10	0.0000	0.0003	0.0005	0.0007	0.0009	0.0011	0.0013
14063007-11	0.0000	0.0002	0.0003	0.0005	0.0007	0.0007	0.0010
14063007-13	0.0000	0.0002	0.0003	0.0005	0.0006	0.0009	0.0011
14063007-15	0.0000	0.0003	0.0004	0.0007	0.0009	0.0010	0.0012
14063007-16	0.0000	0.0001	0.0002	0.0004	0.0006	0.0008	0.0010
Avg.	0.0000	0.0002	0.0004	0.0006	0.0007	0.0009	0.0011
Med.	0.0000	0.0002	0.0004	0.0006	0.0007	0.0009	0.0011
σ	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.0000	0.0001	0.0002	0.0004	0.0006	0.0007	0.0009
Max.	0.0000	0.0003	0.0005	0.0007	0.0009	0.0011	0.0013



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Appendix A

Data Set 2	
Case Temperature	85 °C
Measurement Current	350 mA

Table 2-1
Initial Characteristics

Sample No.	Luminous Flux (lm)	Forward Voltage	CCT(K)	CIE-1931		CIE-1976	
14063007-17	139.1	2.889	4956	0.3533	0.4251	0.1911	0.5174
14063007-19	134.5	2.881	5115	0.3465	0.4129	0.1908	0.5117
14063007-20	138.2	2.867	5142	0.3453	0.4107	0.1909	0.5107
14063007-21	139.1	2.894	4976	0.3523	0.4227	0.1913	0.5163
14063007-22	136.6	2.860	5082	0.3478	0.4142	0.1912	0.5124
14063007-24	136.1	2.893	5105	0.3468	0.4129	0.1911	0.5118
14063007-25	136.0	2.895	5233	0.3417	0.4031	0.1911	0.5071
14063007-26	135.6	2.860	5105	0.3467	0.4115	0.1914	0.5112
14063007-27	136.3	2.875	5169	0.3443	0.4086	0.1909	0.5097
14063007-32	133.2	2.895	5257	0.3408	0.4008	0.1912	0.5061
Avg.	136.5	2.881	5114	0.3466	0.4123	0.1911	0.5114
Med.	136.2	2.885	5110	0.3466	0.4122	0.1911	0.5115
σ	1.90	0.01	96.39	0.0040	0.0075	0.0002	0.0035
Min.	133.2	2.860	4956	0.3408	0.4008	0.1908	0.5061
Max.	139.1	2.895	5257	0.3533	0.4251	0.1914	0.5174

Appendix A

**Table 2-2
Lumen Maintenance**

Sample No.	Lumen Maintenance% (Normalized to 100% at Initial)						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-17	100.0%	99.2%	98.8%	98.7%	98.5%	97.6%	97.1%
14063007-19	100.0%	99.6%	99.0%	97.8%	97.6%	97.5%	96.4%
14063007-20	100.0%	99.5%	99.3%	98.2%	97.0%	96.5%	95.4%
14063007-21	100.0%	99.5%	99.5%	99.1%	98.3%	97.2%	96.2%
14063007-22	100.0%	99.5%	99.0%	98.8%	97.6%	97.1%	96.8%
14063007-24	100.0%	99.5%	99.5%	99.0%	98.0%	98.0%	97.4%
14063007-25	100.0%	99.2%	99.0%	98.2%	98.1%	97.6%	97.3%
14063007-26	100.0%	99.8%	99.6%	98.5%	97.9%	96.9%	95.9%
14063007-27	100.0%	99.5%	98.9%	98.3%	97.4%	96.7%	95.8%
14063007-32	100.0%	99.2%	98.9%	97.9%	97.2%	96.8%	95.9%
Avg.	100.00%	99.45%	99.15%	98.45%	97.76%	97.19%	96.42%
Med.	100.00%	99.50%	99.00%	98.40%	97.75%	97.15%	96.30%
σ	0.0000	0.0020	0.0030	0.0045	0.0048	0.0048	0.0070
Min.	100.00%	99.20%	98.80%	97.80%	97.00%	96.50%	95.40%
Max.	100.00%	99.80%	99.60%	99.10%	98.50%	98.00%	97.40%

TM-21 Projection

Time	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
ln (Avg.)	0.0000	-0.0055	-0.0085	-0.0156	-0.0227	-0.0285	-0.0365

Test duration used	6,000 hrs	Calculated L ₇₀ (6K)	57,000 hrs
B	1.003	Report L ₇₀ (6K)	≥ 33,000 hrs
α	6.333E-06		



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Appendix A

Table 2-3
Forward Voltage

Sample No.	Relative Forward Voltage % (Normalized to 100% at Initial)						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-17	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
14063007-19	100.0%	99.9%	99.9%	99.9%	100.0%	99.9%	100.0%
14063007-20	100.0%	100.0%	100.0%	99.9%	100.0%	99.9%	100.0%
14063007-21	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.1%
14063007-22	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
14063007-24	100.0%	100.0%	100.0%	100.0%	100.1%	100.0%	100.1%
14063007-25	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	100.0%
14063007-26	100.0%	100.0%	100.1%	100.0%	100.1%	100.0%	100.0%
14063007-27	100.0%	99.9%	99.9%	99.9%	99.9%	99.8%	99.9%
14063007-32	100.0%	100.0%	100.0%	99.9%	100.0%	99.9%	100.0%
Avg.	100.00%	99.98%	99.99%	99.96%	100.01%	99.95%	100.00%
Med.	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
σ	0.0000	0.0004	0.0006	0.0005	0.0007	0.0007	0.0007
Min.	100.00%	99.90%	99.90%	99.90%	99.90%	99.80%	99.90%
Max.	100.00%	100.00%	100.10%	100.00%	100.10%	100.00%	100.10%



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Appendix A

Table 2-4
Chromaticity Shift

Sample No.	Chromaticity Shift $\Delta u'v'$						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-17	0.0000	0.0004	0.0010	0.0013	0.0017	0.0018	0.0028
14063007-19	0.0000	0.0002	0.0008	0.0011	0.0013	0.0014	0.0020
14063007-20	0.0000	0.0011	0.0019	0.0021	0.0023	0.0023	0.0027
14063007-21	0.0000	0.0010	0.0011	0.0013	0.0014	0.0016	0.0021
14063007-22	0.0000	0.0001	0.0002	0.0005	0.0008	0.0011	0.0013
14063007-24	0.0000	0.0009	0.0012	0.0017	0.0020	0.0022	0.0026
14063007-25	0.0000	0.0005	0.0011	0.0012	0.0013	0.0014	0.0021
14063007-26	0.0000	0.0007	0.0010	0.0013	0.0017	0.0018	0.0021
14063007-27	0.0000	0.0008	0.0011	0.0016	0.0019	0.0022	0.0026
14063007-32	0.0000	0.0010	0.0014	0.0019	0.0021	0.0022	0.0028
Avg.	0.0000	0.0007	0.0011	0.0014	0.0017	0.0018	0.0023
Med.	0.0000	0.0008	0.0011	0.0013	0.0017	0.0018	0.0024
σ	0.0000	0.0004	0.0004	0.0005	0.0005	0.0004	0.0005
Min.	0.0000	0.0001	0.0002	0.0005	0.0008	0.0011	0.0013
Max.	0.0000	0.0011	0.0019	0.0021	0.0023	0.0023	0.0028



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Data Set 3	
Case Temperature	105 °C
Measurement Current	350 mA

Table 3-1
Initial Characteristics

Sample No.	Luminous Flux (lm)	Forward Voltage	CCT(K)	CIE-1931		CIE-1976	
14063007-33	131.6	2.864	5010	0.3486	0.3943	0.1982	0.5045
14063007-34	132.3	2.857	5240	0.3403	0.3782	0.1985	0.4964
14063007-35	131.2	2.884	5070	0.3463	0.3902	0.1982	0.5024
14063007-36	132.4	2.872	5033	0.3477	0.3932	0.1981	0.5039
14063007-37	132.7	2.878	4860	0.3548	0.4048	0.1985	0.5097
14063007-38	130.0	2.897	5016	0.3481	0.3921	0.1987	0.5035
14063007-39	132.0	2.879	5110	0.3448	0.3875	0.1982	0.5010
14063007-40	129.9	2.857	5238	0.3403	0.3782	0.1985	0.4963
14063007-41	132.6	2.895	5287	0.3398	0.3992	0.1911	0.5053
14063007-45	129.5	2.883	5257	0.3409	0.4025	0.1908	0.5068
Avg.	131.4	2.877	5112	0.3452	0.3920	0.1969	0.5030
Med.	131.8	2.879	5090	0.3456	0.3927	0.1982	0.5037
σ	1.21	0.01	139.46	0.0049	0.0090	0.0031	0.0042
Min.	129.5	2.857	4860	0.3398	0.3782	0.1908	0.4963
Max.	132.7	2.897	5287	0.3548	0.4048	0.1987	0.5097



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**Table 3-2
Lumen Maintenance**

Sample No.	Lumen Maintenance% (Normalized to 100% at Initial)						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-33	100.0%	99.5%	98.4%	97.2%	97.1%	96.3%	95.6%
14063007-34	100.0%	99.9%	99.8%	99.5%	99.5%	98.1%	97.4%
14063007-35	100.0%	99.0%	98.2%	97.5%	97.4%	96.0%	94.7%
14063007-36	100.0%	99.2%	99.2%	98.4%	97.1%	96.8%	95.5%
14063007-37	100.0%	99.7%	98.9%	98.1%	97.3%	96.2%	95.6%
14063007-38	100.0%	99.4%	98.8%	98.0%	97.3%	96.8%	95.5%
14063007-39	100.0%	99.9%	98.8%	97.7%	97.0%	96.5%	95.2%
14063007-40	100.0%	99.9%	99.6%	99.0%	98.1%	96.8%	95.4%
14063007-41	100.0%	100.0%	98.9%	98.4%	98.0%	96.7%	96.3%
14063007-45	100.0%	99.2%	98.1%	97.8%	97.4%	96.6%	96.4%
Avg.	100.00%	99.57%	98.87%	98.16%	97.62%	96.68%	95.76%
Med.	100.00%	99.60%	98.85%	98.05%	97.35%	96.65%	95.55%
σ	0.0000	0.0036	0.0056	0.0069	0.0076	0.0057	0.0076
Min.	100.00%	99.00%	98.10%	97.20%	97.00%	96.00%	94.70%
Max.	100.00%	100.00%	99.80%	99.50%	99.50%	98.10%	97.40%

TM-21 Projection

Time	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
ln (Avg.)	0.0000	-0.0043	-0.0114	-0.0186	-0.0241	-0.0338	-0.0433

Test duration used	6,000 hrs	Calculated L ₇₀ (6K)	47,000 hrs
B	1.004	Report L ₇₀ (6K)	≥ 33,000 hrs
α	7.651E-06		



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**Table 3-3
Forward Voltage**

Sample No.	Relative Forward Voltage % (Normalized to 100% at Initial)						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-33	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
14063007-34	100.0%	99.9%	100.0%	99.9%	99.9%	99.9%	99.9%
14063007-35	100.0%	100.0%	100.0%	99.9%	99.9%	99.9%	99.9%
14063007-36	100.0%	100.0%	100.1%	100.1%	100.2%	100.1%	100.2%
14063007-37	100.0%	100.0%	100.0%	99.9%	100.0%	100.0%	100.0%
14063007-38	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.1%
14063007-39	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
14063007-40	100.0%	100.0%	100.0%	99.9%	99.9%	99.9%	99.9%
14063007-41	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.9%
14063007-45	100.0%	99.9%	100.0%	99.9%	100.0%	100.0%	100.0%
Avg.	100.00%	99.98%	100.01%	99.97%	100.00%	99.97%	100.00%
Med.	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
σ	0.0000	0.0004	0.0003	0.0007	0.0009	0.0007	0.0011
Min.	100.00%	99.90%	100.00%	99.90%	99.90%	99.90%	99.90%
Max.	100.00%	100.00%	100.10%	100.10%	100.20%	100.10%	100.20%



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Table 3-4
Chromaticity Shift

Sample No.	Chromaticity Shift $\Delta u'v'$						
	0 h	1000 h	2000 h	3000 h	4000 h	5000 h	6000 h
14063007-33	0.0000	0.0004	0.0010	0.0013	0.0017	0.0018	0.0028
14063007-34	0.0000	0.0002	0.0008	0.0011	0.0013	0.0014	0.0020
14063007-35	0.0000	0.0011	0.0019	0.0021	0.0023	0.0023	0.0027
14063007-36	0.0000	0.0010	0.0011	0.0013	0.0014	0.0016	0.0021
14063007-37	0.0000	0.0001	0.0002	0.0005	0.0008	0.0011	0.0013
14063007-38	0.0000	0.0009	0.0012	0.0017	0.0020	0.0022	0.0026
14063007-39	0.0000	0.0005	0.0011	0.0012	0.0013	0.0014	0.0021
14063007-40	0.0000	0.0007	0.0010	0.0013	0.0017	0.0018	0.0021
14063007-41	0.0000	0.0008	0.0011	0.0016	0.0019	0.0022	0.0026
14063007-45	0.0000	0.0002	0.0008	0.0011	0.0014	0.0017	0.0025
Avg.	0.0000	0.0006	0.0011	0.0014	0.0017	0.0018	0.0024
Med.	0.0000	0.0006	0.0011	0.0014	0.0017	0.0018	0.0026
σ	0.0000	0.0003	0.0003	0.0004	0.0004	0.0004	0.0005
Min.	0.0000	0.0001	0.0002	0.0005	0.0008	0.0011	0.0013
Max.	0.0000	0.0011	0.0019	0.0021	0.0023	0.0023	0.0031