

DATE OF ISSUE : **2012. 06. 20**

SPECIFICATION

MODEL : SPMWHT325AD5YBT0S0



Approved rank :

 $V_F(A1, A2, A3, A4, A5),$
 $CIE(T1, T2, T3, T4, T5, T6, T7, T8, T9, TA, TB, TC, TD, TE, TF, TG),$
 $I_V(S1, S2, S3)$

3623 WHITE LED T0 RANK

CUSTOMER :

CHECKED	APPROVED

SAMSUNG ELECTRONICS

DRAWN	CHECKED		APPROVED
	SALES	QUALITY	

SAMSUNG ELECTRONICS

95, Samsung 2-ro, Giheung-Gu

Yongin-City, Gyeonggi-Do 446-711, KOREA

Contents

1. Product Outline	3
2. Absolute Maximum Rating	3
3. Characteristics	3
4. Chromaticity Diagram	4
5. Typical Characteristic Graph	5
6. Outline Drawing & Dimension	6
7. Reliability Test Items & Conditions	7
8. Solder Conditions	8
9. Taping Dimension	9
10. Label Structure	10
11. Lot Number	10
12. Reel Packing Structure	11
13. Aluminum Packing Bag	12
14. Precaution For Use	13
15. Hazard Substance Analysis (SGS)	15
16. Hazard Substance Analysis (SVHC)	20
17. Revision History	29

1. Product Outline

1) Feature

- . Lead Frame Type LED Package (3.6 * 2.3 * t 0.6 mm)
- . Beam Angle ($\Delta\theta$: 120 °)
- . GaN/Al₂O₃ Chip & Long Time Reliability

2) Applications

- . Indoor, Outdoor Display and etc.

2. Absolute Maximum Rating

Parameter	Symbol	Rating	Condition
Operating temperature range	T _{op}	-40 ~ +85℃	
Storage temperature range	T _{stg}	-40 ~ +100℃	
Junction Temperature	T _j	125℃	
Forward current	I _F	200 mA	
Peak Pulsed Forward Current	I _{FP}	400 mA	Duty 1/10 Pulse Width 10 ms
Reverse Voltage	V _R	0.7 ~ 1.2 V	I _R = 5 mA
Thermal resistance, Junction to Solder Point	R _{th, JS}	< 15℃/W	
Assembly Process Temp.		260℃, < 10 sec	
ESD		5 kV	HBM

3. Characteristics

Electrical / Optical Characteristics

(T_s : 25℃)

Item	Symbol	Conditions	Rank	Min.	Typ.	Max.	Unit
Forward Voltage (*)	V _F	I _F = 100 mA	YB	A1	5.6	-	5.8
				A2	5.8	-	6.0
				A3	6.0	-	6.2
				A4	6.2	-	6.4
				A5	6.4	-	6.6
Reverse Voltage	V _R	I _F = 5 mA	-	0.7	-	1.2	V
Color Rendering	R _a	I _F = 100 mA	3	80	-	-	-

Luminous Intensity / Luminous Flux

(T_s : 25℃)

Symbol	Conditions	Model Name	Rank	Min.	Typ.	Max.	Unit
I _v	I _F = 100 mA	SPMWHT325AD5YBT0S0	S0	S1	19	-	22
				S2	22	-	25
				S3	25	-	28
Φ _v	I _F = 100 mA	SPMWHT325AD5YBT0S0	S0	S1	55	-	60
				S2	60	-	70
				S3	70	-	80

* Luminous Intensity (I_v) : Only reference data.

Electro-Optical Characteristics

I _F (mA)	V _f (V)	Power(W)	Flux(lm)	Lm/W
50	5.7	0.28	39	139
100	6.0	0.60	66	110
150	6.2	0.93	95	100

* All values are representative references only

Chromaticity Coordinate

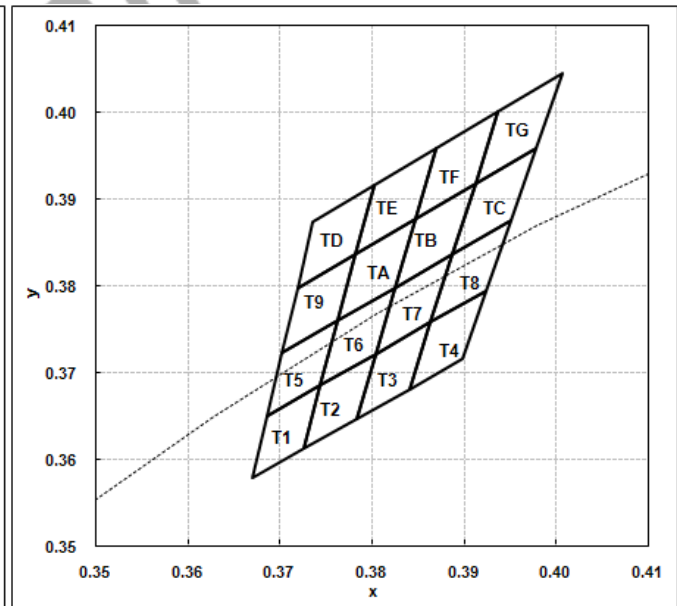
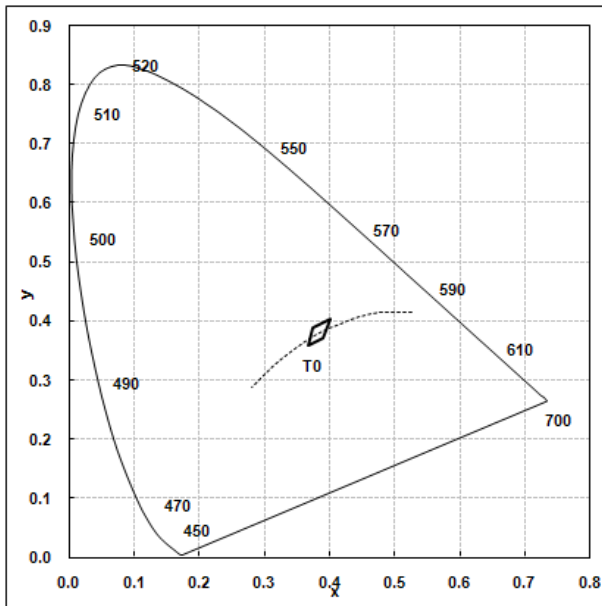
(Ts : 25 °C)

Condition	Rank	x				y			
I _F = 100 mA	T0	T1	0.3670	0.3726	0.3744	0.3686	0.3578	0.3612	0.3685
		T2	0.3726	0.3783	0.3804	0.3744	0.3612	0.3646	0.3721
		T3	0.3783	0.3840	0.3863	0.3804	0.3646	0.3681	0.3758
		T4	0.3840	0.3898	0.3924	0.3863	0.3681	0.3716	0.3794
		T5	0.3686	0.3744	0.3763	0.3702	0.3649	0.3685	0.3760
		T6	0.3744	0.3804	0.3825	0.3763	0.3685	0.3721	0.3798
		T7	0.3804	0.3863	0.3887	0.3825	0.3721	0.3758	0.3836
		T8	0.3863	0.3924	0.3950	0.3887	0.3758	0.3794	0.3875
		T9	0.3702	0.3763	0.3782	0.3719	0.3722	0.3760	0.3837
		TA	0.3763	0.3825	0.3847	0.3782	0.3760	0.3798	0.3877
		TB	0.3825	0.3887	0.3912	0.3847	0.3798	0.3836	0.3917
		TC	0.3887	0.3950	0.3978	0.3912	0.3837	0.3875	0.3958
		TD	0.3719	0.3782	0.3802	0.3736	0.3797	0.3837	0.3916
		TE	0.3782	0.3847	0.3869	0.3802	0.3837	0.3877	0.3958
		TF	0.3847	0.3912	0.3937	0.3869	0.3877	0.3917	0.4001
		TG	0.3912	0.3978	0.4006	0.3937	0.3917	0.3958	0.4044

* Tolerance : V_F:±0.1 V, I_V:±5 %, x,y:±0.01, R_a :±3.0

* Luminous Intensity measuring equipment : CAS140CT

4. Chromaticity Diagram



* T0 = T1, T2, T3, T4, T5, T6, T7, T8, T9, TA, TB, TC, TD, TE, TF, TG

V _F	CIE	I _V (°Φ _V)
A1, A2, A3, A4, A5	T1, T2, T3, T4, T5, T6, T7, T8, T9, TA, TB, TC, TD, TE, TF, TG	S1, S2, S3

* Each reel contains only one of the A1, A2, A3, A4 or A5 a segment (1/5) of the V_F rank.

* Each reel contains only one of the T1, T2, T3, T4, T5, T6, T7, T8, T9, TA, TB, TC, TD, TE, TF or TG a segment (1/16) of the CIE rank.

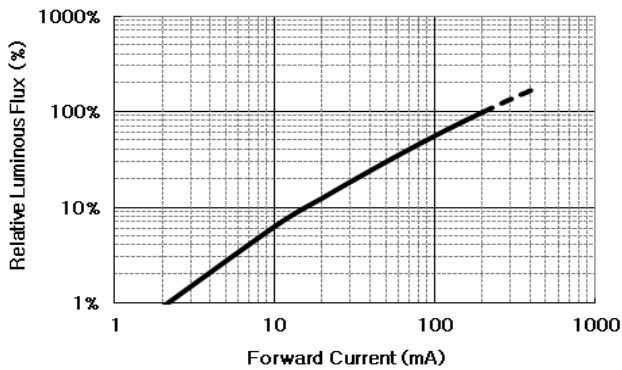
* Each reel contains only one of the S1, S2 or S3 a segment (1/3) of the I_V rank.

5. Typical Characteristics Graph

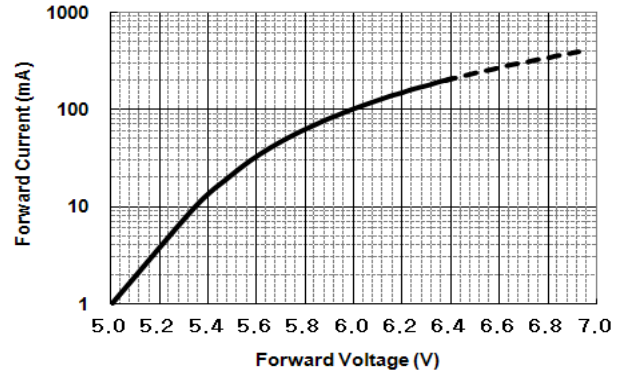
* These graphs show typical values.

($T_s : 25^\circ\text{C}$)

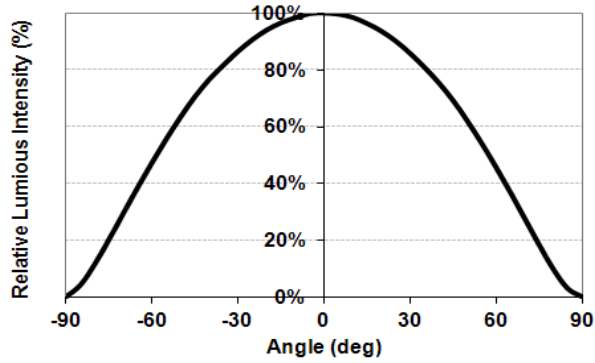
Relative Luminous Flux vs. Forward Current



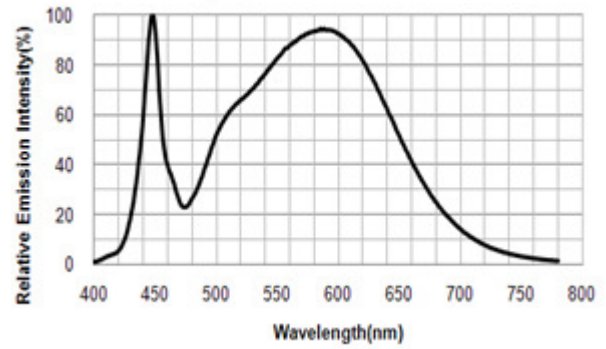
Forward Current vs. Forward Voltage



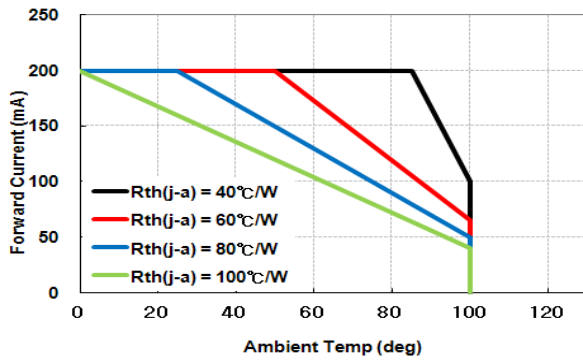
Radiation Diagram



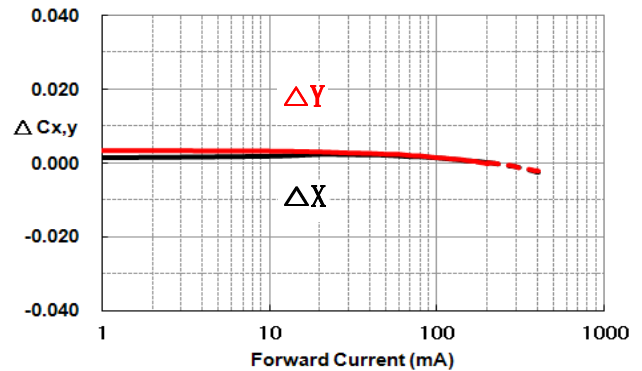
Spectrum Distribution



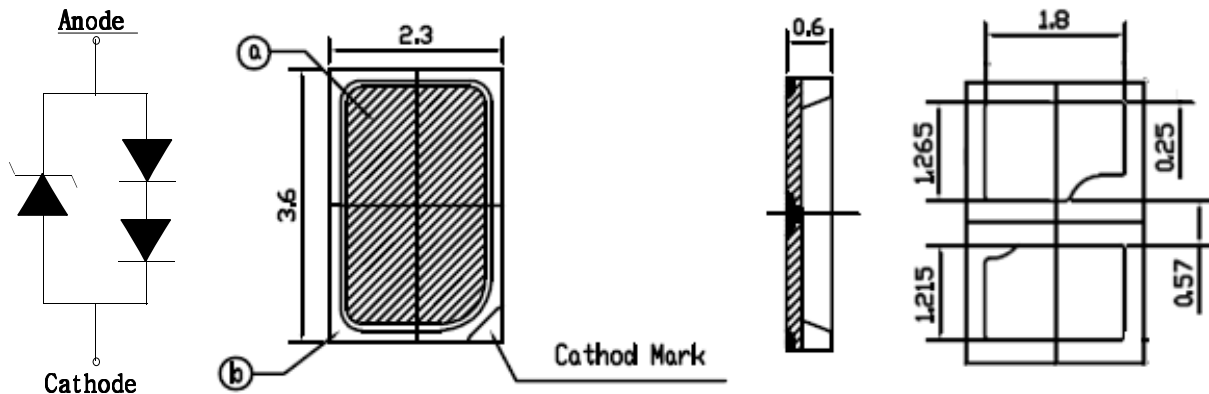
Derating Curve



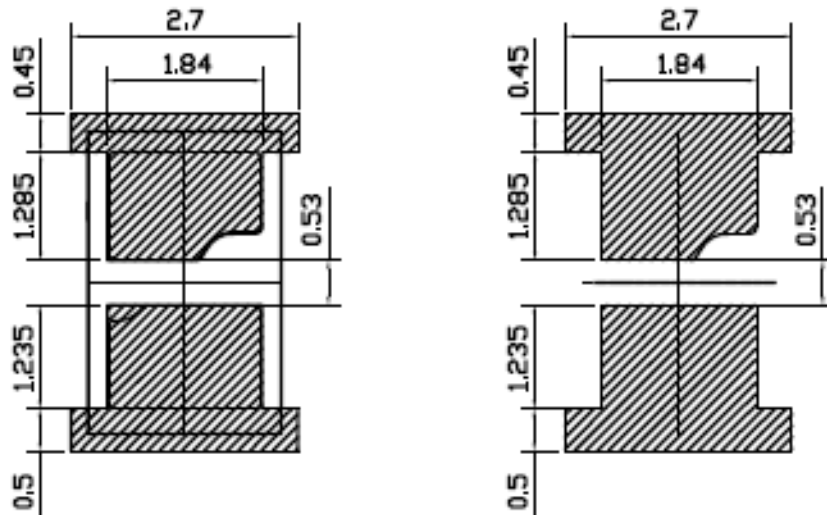
Chromaticity Coordinate Shift



6. LED Package Outline Dimensions



1. Tolerance is ± 0.1 mm
2. The maximum compressing force is 15N on the silicone ①
3. Do not place pressure on the encapsulation resin ②



Recommend Land Pattern

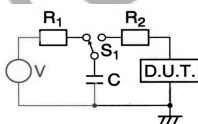
* This LED has built-in ESD protection device(s) connected in parallel to LED chip(s).

Precautions

- ① The pressure on the LEDs will influence to the reliability of the LEDs. Precautions should be taken to avoid the strong pressure on the LEDs. Do not put stress on the LEDs during heating.
- ② Re-soldering should not be done after the LEDs have been soldered. If re-soldering is unavoidable, LED's characteristics should be carefully checked before and after such repair.
- ③ Do not stack assembled PCBs together. Since materials of LEDs is soft, abrasion between two PCB assembled with LED might cause catastrophic failure of the LEDs.

7. Reliability Test Items and Conditions

1) Test Items

Test Item	Test Conditions	Test Hours/Cycles	Sample No	
MSL Test	125 ℃ 24hrs drying → 60 ℃, 60 %RH 120hrs → 260 ℃ 10sec 3 cycles	1 cycle	11	
Room Temperature life test	25 ℃±3 ℃, DC150 mA	1,000 hrs	22	
High Temperature life test	85 ℃±3 ℃, DC150 mA	1,000 hrs	22	
High Temperature humidity life test	60 ℃±3 ℃, 95 %±2 %RH, DC150 mA	1,000 hrs	22	
Low Temperature life test	-40 ℃±3 ℃, DC150 mA	1,000 hrs	22	
Power Temperature Cycle	-40 ℃/20min ~ 85 ℃/20min Temp. change within 100min Power On:5min, Off:5min, 100 cyc	10 cycles	50	
Thermal Shock	-45 ℃/15 min ↔ 125 ℃/15 min, Temp. change within 5min => Reflow 260 ℃ → Hot plate 180 ℃	200 cycle	100	
High Temperature Storage	Ta=120 ℃±3 ℃	1000 hrs	11	
Low Temperature Storage	Ta=-40 ℃±3 ℃	1000 hrs	11	
ESD(HBM)		R1:10 MΩ, R2:1.5 kΩ, C:100 pF, V = ±5 kV	5 times	5
ESD(MM)		-R1:10 MΩ, R2:0, C:200 pF, V = ±0.5 kV	5 times	5
Vibration Test	20~80Hz(Displacement:0.06inch, Max 20G) 80~2kHz (Max 20G) Min. Frequency ↔ Max. Frequency 4min transfer	4 cycles	11	
Mechanical Shock Test	1500G, 0.5ms, Every 6faces (3axis X 2faces)	5 cycles	11	

2) Criteria for Judging the Damage

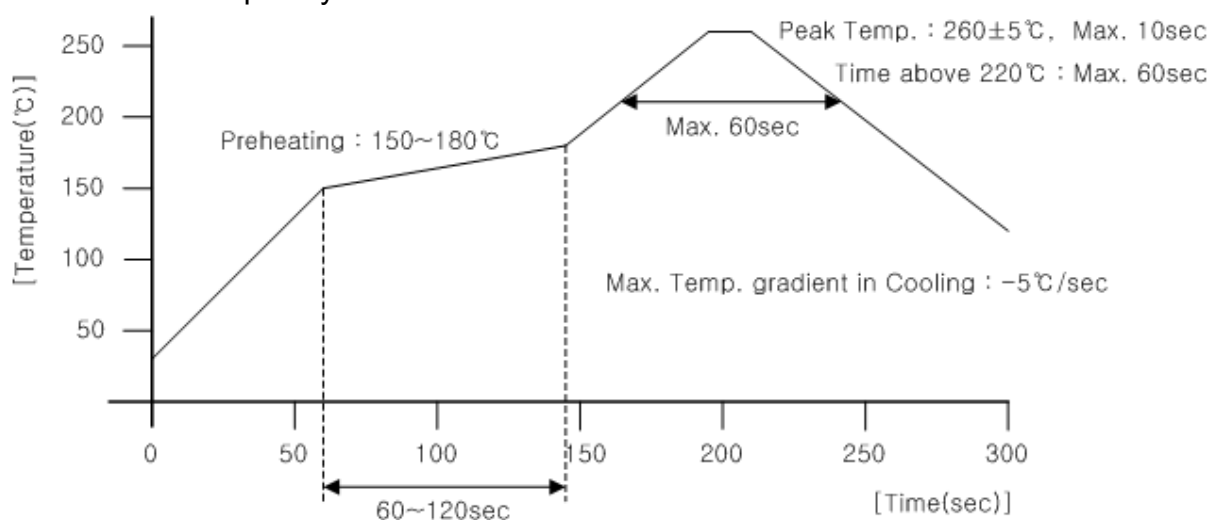
Item	Symbol	Test Condition	Limit	
			Min	Max
Forward Voltage	V_F	$I_F = 100 \text{ mA}$	Init. Value*0.9	Init. Value*1.1
Luminous Intensity	I_V	$I_F = 100 \text{ mA}$	Init. Value*0.8	Init. Value*1.2

* USL : Upper Standard Level LSL : Lower Standard Level

8. Solder Conditions

1) Reflow Conditions (Pb Free)

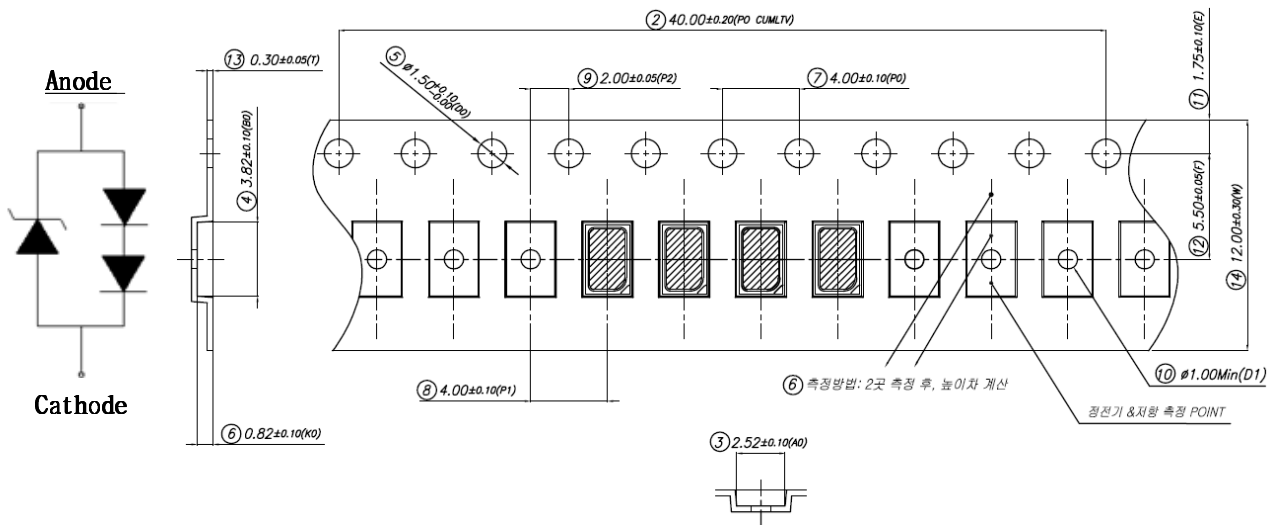
Reflow Frequency : 2 times max.



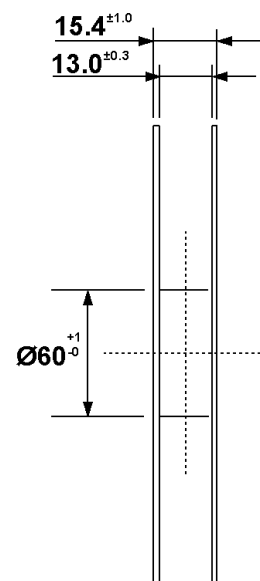
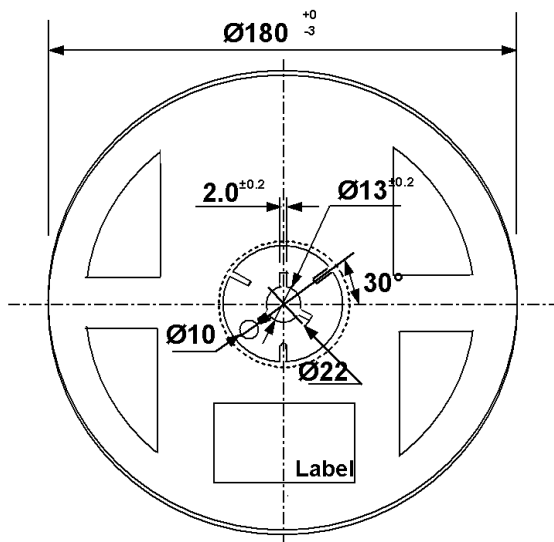
2) For Manual Soldering

Not more than 5 seconds @MAX300 °C, under soldering iron.

9. Taping Dimension



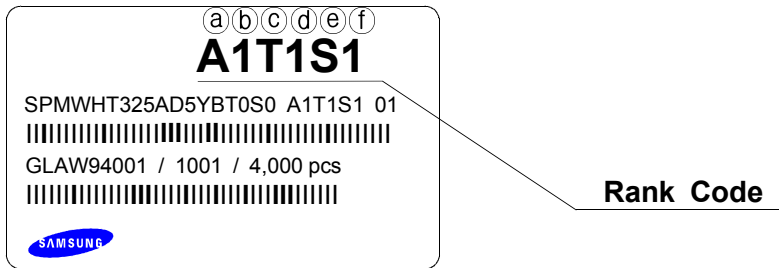
End			Start
More than 40 mm Unloaded tape	Mounted with Flash LED	More than (100~200)mm Unloaded tape	Leading part more than (200~400)mm



Tolerance ± 0.2 , Unit:mm

- (1) Quantity : The quantity/reel to be 4,000 pcs.
- (2) Cumulative Tolerance : Cumulative tolerance/10 pitches to be ± 0.2 mm
- (3) Adhesion Strength of Cover Tape : Adhesion strength to be 0.1-0.7 N when the cover tape is turned off from the carrier tape at 10 °C angle to be the carrier tape.
- (4) Packaging : P/N, Manufacturing data code no. and quantity to be indicated on a damp proof package.

10. Label Structure



N.B) Denoted rank is the only example.

Rank Code

- (a)(b) : Forward Voltage(V_F) Rank (refer to page. 3)
- (c)(d) : Chromaticity Coordinate Rank (refer to page. 4)
- (e)(f) : Luminous Intensity(cd) Rank (refer to page. 3)

11. Lot Number

The Lot number is composed of the following characters



①②③④⑤⑥⑦⑧⑨ / 1(a)(b)(c) / 4,000 PCS

- ① : Production Site (S:SAMSUNG LED, G:GOSIN CHINA)
- ② : L (LED)
- ③ : Product State (A:Normality, B:Bulk, C:First Production, R:Reproduction, S:Sample)
- ④ : Year (V:2011, W:2012, X:2013...)
- ⑤ : Month (1 ~ 9, A, B)
- ⑥ : Day (1 ~ 9, A, B ~ V)
- ⑦⑧⑨ : SAMSUNG LED Product number (1 ~ 999)
- (a)(b)(c) : Reel Number (1 ~ 999)

13. Aluminum Vinyl Bag



CAUTION

This bag contains
MOISTURE SENSITIVE DEVICES

LEVEL
2a

- Shelf life in sealed bag: 12 months at $<40^{\circ}\text{C}$ and $<90\%$ relative humidity (RH)
 - Peak package body temperature: 240°C
 - After this bag is opened, devices that will be subjected to reflow solder or other high temperature processes must be:
 - Mounted within 672 hours at factory conditions of equal to or less than 30°C / 60% RH, or
 - Stored at $<10\%$ RH
 - Devices require bake, before mounting, if:
 - Humidity Indicator Card is $>65\%$ when read at $23\pm5^{\circ}\text{C}$, or
 - 2a is not met.
 - If baking is required, devices must be baked for 1 hours at $60\pm5^{\circ}\text{C}$
- Note: if device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure,
- Bag seal due date: _____

(if blank, see code label)

Note: Level and body temperature by IPC/JEDEC J-STD-020

A1T1S1

SPMWHT325AD5YBT0S0 A1T1S1 01

|||||

GLAW94001 / 1001 / 4,000 pcs

|||||

SAMSUNG



주의 사항

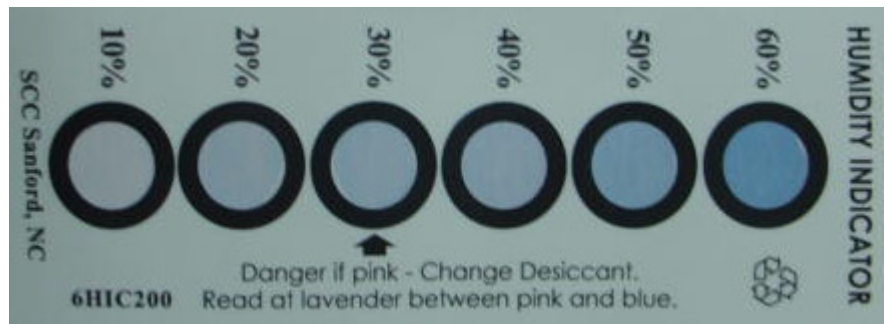
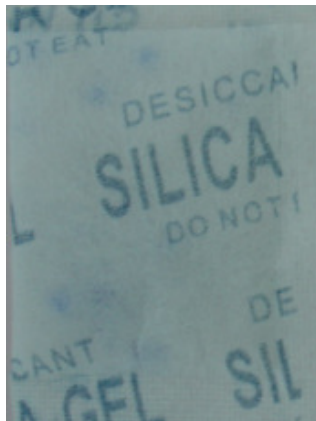
이 알루미늄 지퍼 백은 습기 및 정전기로부터 제품을 보호하기 위하여 제작되었습니다. 개봉 후에는 즉시 솔더 작업을 실시하는 것을 권장합니다.

습기 및 정전기로부터 제품을 보호 하기 위해서 개봉 후 사용하지 않는 자재는 본 팩에 넣어 보관 하시기 바랍니다. 사용하지 않는 자재를 본 팩에 넣을 때는 반드시 동봉된 드라이 팩과 함께 넣고 지퍼부분을 완전하게 밀봉하여 주시기 바랍니다.

Important

This Al Zipper bag is designed to protect the enclosed products from moisture and ESD. Once opened, the products should be soldered onto the printed circuit board immediately. When not in use, please do not leave the products unprotected by the Al Zipper Bag. To repack unused products, please ensure the zip-lock is completely sealed with the dry pack left inside.

Silica gel & Humidity Indicator Card in Aluminum Vinyl Bag



14. Precaution for Use (취급상 주의사항)

- 1) For over-current-proof function, customers are recommended to apply resistors to prevent sudden change of the current caused by slight shift of the voltage.

과전류 방지를 위해 전압의 미세한 이동에 의해 야기되는 전류의 순간 변화를 방지하기 위해 저항 등의 설치를 권장함.

- 2) This device should not be used in any type of fluid such as water, oil, organic solvent, etc. When washing is required, IPA is recommended to use.

제품은 물, 오일, 유기물과 같은 액체 타입에서의 사용은 제한되며, 세정이 필요할 시에는 IPA 사용을 권장함.

- 3) When the LEDs illuminate, operating current should be decided after considering the ambient maximum temperature.

LED의 발광 시, 동작 전류는 주변 최고온도를 고려하여 결정되어야 함.

- 4) LEDs must be stored in a clean environment.

If the LEDs are to be stored for 3 months or more after being shipped from SLED, they should be packed by a sealed container with nitrogen gas injected.

(Shelf life of sealed bags: 12 months, temp. $\sim 40^{\circ}\text{C}$, $\sim 90\% \text{RH}$)

LED의 보관은 청정한 환경에서 보존되어야 하며, 만약 삼성LED로부터 공급받는 후 3개월 또는 그 이상 보관이 필요하다면 질소 가스를 동봉한 보존용기에 보관되어야 함.

(보존 bag의 수명 : 12 개월, 보존 온도 $\sim 40^{\circ}\text{C}$, 습도 $\sim 90\% \text{RH}$)

- 5) After storage bag is open, device subjected to soldering, solder reflow, or other high temperature processes must be:

보존 Bag이 개봉된 후에, 납땜이나 reflow등의 높은 온도에 노출되는 제품은 다음의 사항에 부합되어야 함.

- a. Mounted within 672 hours (28 days) at an assembly line with a condition of no more than $30^{\circ}\text{C}/60\% \text{RH}$,

- a. 제품은 $30^{\circ}\text{C}/60\% \text{RH}$ 보다 같거나 낮은 조립조건에서 672시간 (28일)이내에 조립해야 함.

- b. Stored at $<10\% \text{RH}$.

- b. 10 % 이하의 상대습도에서 보관되어야 함.

- 6) Repack unused Products with anti-moisture packing, fold to close any opening and then store in a dry place.

사용하지 않은 제품은 방습팩에 넣어 개봉 부위를 닫아서 다시 포장한 후, 건조한 장소에서 보관할 것을 권장함.

- 7) Devices require baking before mounting, if humidity card reading is $>65\%$ at $23\pm 5^{\circ}\text{C}$.

만약 습도표시카드의 수치가 $23\pm 5^{\circ}\text{C}$ 에서 65 % 이상이라면, 제품 실장 전에 baking하여야 함.

8) Devices must be baked for 1 hour at $65\pm5\text{ }^{\circ}\text{C}$, if baking is required.

만약 baking이 필요하다면, 제품은 $65\pm5\text{ }^{\circ}\text{C}$ 에서 1시간 정도 baking 되어야 함.

9) The LEDs are sensitive to the static electricity and surge. It is recommended to use a wrist band or anti-electrostatic glove when handling the LEDs.

LED는 정전기 및 서지에 민감한 제품이므로, LED 제품을 다룰 시에는 정전기 방지장갑이나 손목밴드를 사용하기를 권장함.

If voltage exceeding the absolute maximum rating is applied to LEDs, it may cause damage or even destruction to LED devices.

만약 절대 허용치를 초과하는 전압이 LED에 가해지면, LED 소자는 파괴되거나 손상될 수 있음.

Damaged LEDs may show some unusual characteristics such as increase in leak current, lowered turn-on voltage, or abnormal lighting of LEDs at low current.

손상된 제품은 누설전류의 증가, Turn on 전압의 저하, 저 전류에서의 점등불량 등의 이상 거동을 보일 수 있음.

10) Risk of Sulfurization (or Tarnishing)

Samsung LED's lead frame based package products (such as mid power and HV AC) contain silver (Ag) plated lead frames. Silver may turn black (or tarnish) when exposed to substances such as sulfur, chlorine, or other halogen compounds.

삼성LED의 리드 프레임은 Ag(은)을 도금한 Package 제품입니다.

황(S), 염소(Cl), 또는 다른 할로겐 화합물들에 노출시 Ag(은)은 검정(또는 어두운색)으로 바뀔 수 있으니 주의바랍니다.

Sulfurization of the lead frame may result in reduction of lumen output, color shift and an open circuit in some extreme cases.

리드 프레임의 황화(Sulfurization)는 광량 저하, 색좌표 변화 및 심한 경우 회로내의 LED 무등(Open) 불량을 일으킬 수도 있습니다.

Do not store or use such lead frame LED's together with oxidizing substances listed above. The following examples could be sources of such substances: rubber, corrugate paper, solder cream etc.

LED를 아래의 목록으로 만들어진 산화성 물질들과 함께 리드 프레임을 저장하거나 사용하지 마십시오. 황화(Sulfurization)의 근원일 수 있습니다.

: 고무, 일반 종이, 납땜 크림 등

15. Hazard Substance Analysis - SGS



Test Report No. F690101/LF-CTSAYAA12-09116

Issued Date: 2012. 03. 07 Page 1 of 5

To: SAMSUNG LED
95 Samsung2ro
Giheug-gu
Yongin-si
Gyeonggi-do
Korea

The following merchandise was submitted and identified by the client as :

SGS File No. : AYAA12-09116
Product Name : 3623
Item No./Part No. : N/A
Received Date : 2012. 03. 02
Test Period : 2012. 03. 05 to 2012. 03. 07
Test Results : For further details, please refer to following page(s)
Test Performed : SGS Korea tested the sample(s) selected by applicant with following results.
Test Comments : By the applicant's specific request, the sampling and testing was performed only for the part indicated in the photo without disassembly.

SGS Korea Co. Ltd.

Jeff Jang / Chemical Lab Mgr

Timothy Jeon
Jinhee Kim
Cindy Park
Jerry Jung/ Testing Person

This document is issued by the Company subject to its General Conditions of Service printed hereon, available on request or accessible at www.sgs.com/terms_and_conditions.htm and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute parties to a transaction from asserting all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is an offence and, if detected, may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 180 days only.

SGS Korea Co., Ltd.

322, The O valley, 555-B, Hoge-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080
t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/greenlab

F052 Version4

Member of the SGS Group (Société Générale de Surveillance)


Test Report No. F690101/LF-CTSAYAA12-09116

Issued Date: 2012. 03. 07 Page 2 of 5

Sample No. : AYAA12-09116.001

Sample Description : 3623

Item No./Part No. : N/A

Materials : N/A

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2008, ICP	0.5	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321:2008, ICP	5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2008, ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	With reference to IEC 62321:2008, UV-VIS	1	N.D.

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

NOTE: (1) N.D. = Not detected.(<MDL)
 (2) mg/kg = ppm
 (3) MDL = Method Detection Limit
 (4) - = No regulation
 (5) Negative = Undetectable / Positive = Detectable
 (6) ** = Qualitative analysis (No Unit)
 (7) * = Boiling-water-extraction:
 Negative = Absence of CrVI coating
 Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at www.sgs.com/terms_and_conditions and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions. If any. The Company's sole responsibility is to its Client and this document does not constitute part of a transaction thus assuming all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document in any way and/or use may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 180 days only.

SGS Korea Co., Ltd.

 322, The O valley, 555-9, Hoge-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080
 T +82 (0)31 4608 000 F +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/greenlab

F052 Version4

Member of the SGS Group (Société Générale de Surveillance)


Test Report No. F690101/LF-CTSAYAA12-09116

Issued Date: 2012. 03. 07 Page 3 of 5

Sample No. : AYAA12-09116.001

Sample Description : 3623

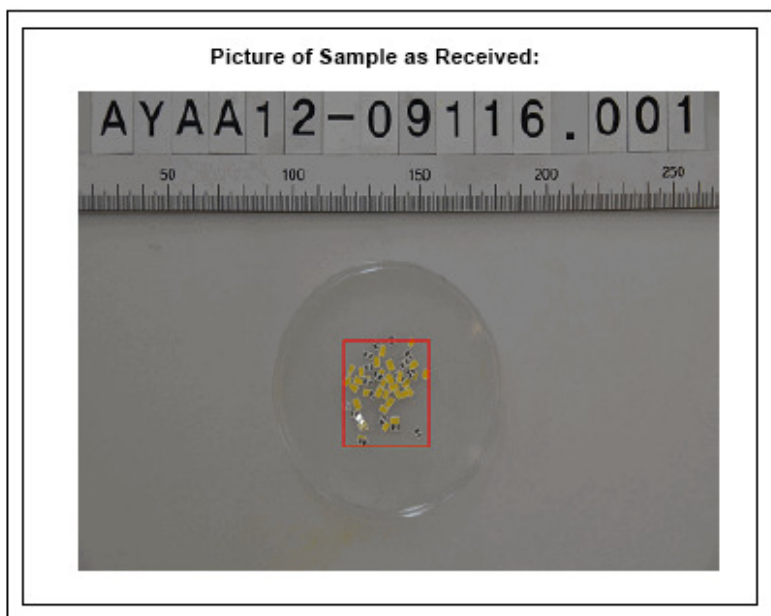
Item No./Part No. : N/A

Materials : N/A

Halogen Contents

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	With reference to ASTM D 7359-08 , IC	30	N.D.
Chlorine(Cl)	mg/kg	With reference to ASTM D 7359-08 , IC	30	N.D.
Fluorine(F)	mg/kg	With reference to ASTM D 7359-08 , IC	30	N.D.
Iodine(I)	mg/kg	With reference to ASTM D 7359-08 , IC	50	N.D.

Picture of Sample as Received:



- NOTE: (1) N.D. = Not detected.(<MDL)
 (2) mg/kg = ppm
 (3) MDL = Method Detection Limit
 (4) - = No regulation
 (5) Negative = Undetectable / Positive = Detectable
 (6) ** = Qualitative analysis (No Unit)
 (7) * = Boiling-water-extraction:
 Negative = Absence of CrVI coating
 Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm2 sample surface area.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at www.sgs.com/terms_and_conditions.htm, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions. If any, the Company's sole responsibility is to its Client and this document does not constitute a contract. The information contained herein is confidential and its disclosure to third parties without prior written approval of the Company is strictly prohibited. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 180 days only.

SGS Korea Co., Ltd.

 322, The O valley, 555-5, Hoggae-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080
 t+82 (0)31 4608 000 f+82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/greentab

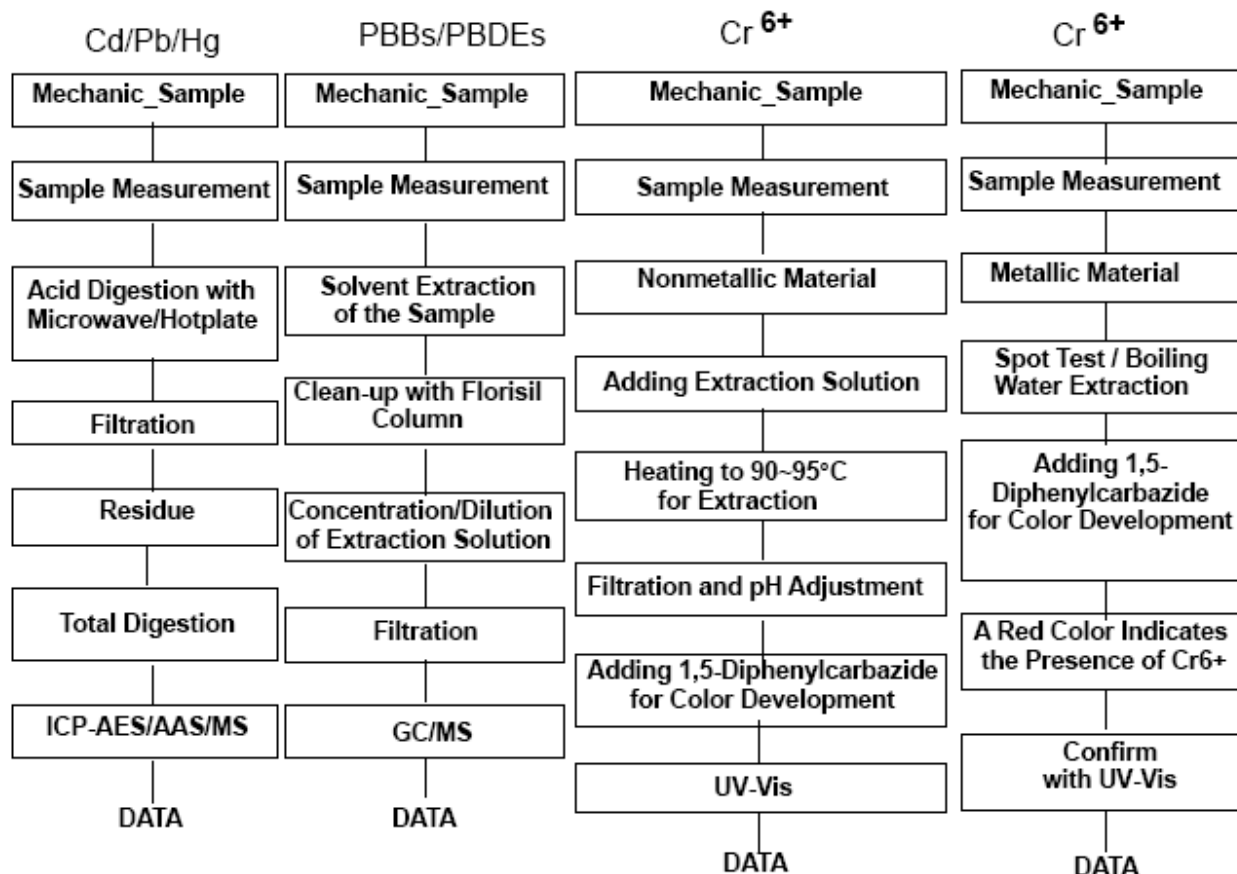
F052 Version4

Member of the SGS Group (Société Générale de Surveillance)



Test Report No. F690101/LF-CTSAYAA12-09116

Issued Date: 2012. 03. 07 Page 4 of 5

Testing Flow Chart for RoHS: Cd/Pb/Hg/Cr⁶⁺ /PBBs&PBDEs Testing

The samples were dissolved totally by pre-conditioning method according to above flow chart for Cd,Pb,Hg.

Section Chief : Gilsae Yi

- NOTE: (1) N.D. = Not detected.(<MDL)
 (2) mg/kg = ppm
 (3) MDL = Method Detection Limit
 (4) - = No regulation
 (5) Negative = Undetectable / Positive = Detectable
 (6) ** = Qualitative analysis (No Unit)
 (7) * = Boiling-water-extraction:
 Negative = Absence of CrVI coating
 Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at www.sgs.com/terms_and_conditions and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions. If any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 180 days only.

SGS Korea Co., Ltd.

322, The O valley, 555-9, Hoge-dong, Daejeon-gu, Anyang-si, Gyeonggi-do, Korea 431-080
t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/greenlab

F052 Version4

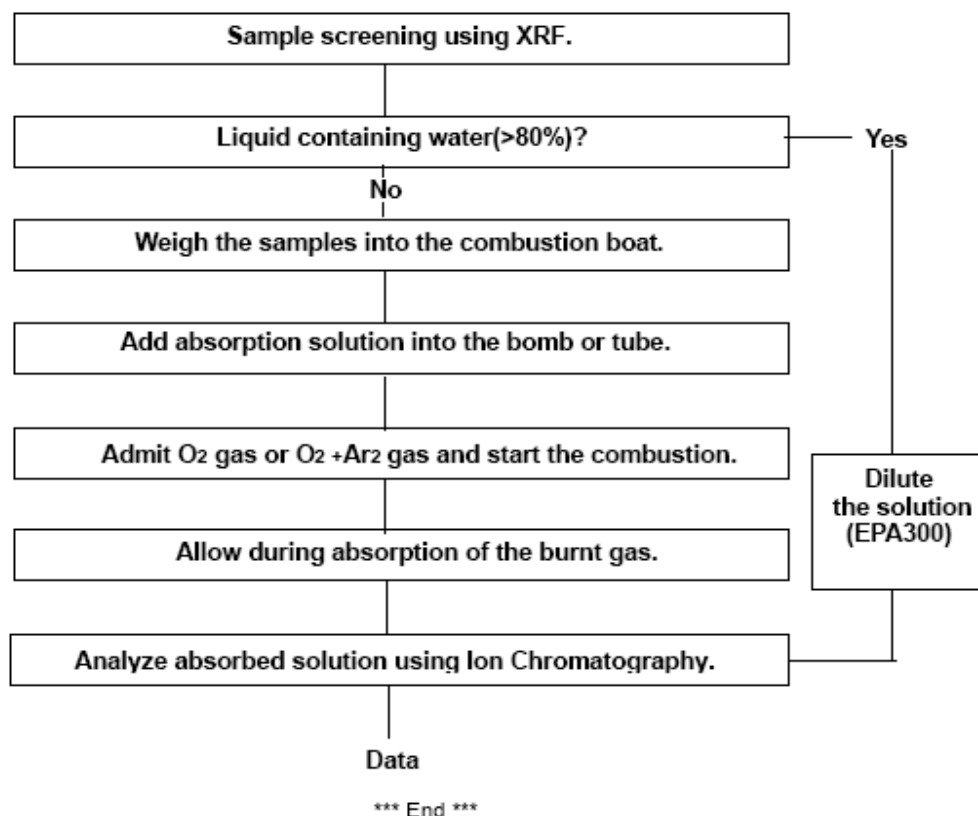
Member of the SGS Group (Société Générale de Surveillance)



Test Report No. F690101/LF-CTSAYAA12-09116

Issued Date: 2012. 03. 07 Page 5 of 5

Flow Chart for Halogen Test



NOTE: (1) N.D. = Not detected.(<MDL)
 (2) mg/kg = ppm
 (3) MDL = Method Detection Limit
 (4) - = No regulation
 (5) Negative = Undetectable / Positive = Detectable
 (6) ** = Qualitative analysis (No Unit)
 (7) * = Boiling-water-extraction:
 Negative = Absence of CrVI coating
 Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at www.sgs.com/terms_and_conditions.htm and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is notified that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions. If any, the Company's sole responsibility is to its Client and this document does not constitute proof for a transaction other than verifying all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 180 days only.

F052 Version4

SGS Korea Co.,Ltd.

 322, The O valley, 555-9, Hoge-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080
 t+82 (0)31 4608 000 f+82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/greenlab

Member of the SGS Group (Société Générale de Surveillance)

16. Hazard Substance Analysis - SVHC(REACH)



Test Report No. F690101/LF-CTSAYAA12-09117 Issued Date: March 09, 2012 Page 1 of 9

To **SAMSUNG LED Co.,Ltd.**
95 Samsung2ro
Giheug-gu
Yongin-city
Gyeonggi-do
Korea

The following sample(s) was/were submitted and identified by/on behalf of the client as:-

Product Name : 3623
Item/Part Name : N/A
SGS File No. : AYAA12-09117
Received Date : March 02, 2012
Test Period : March 05, 2012 ~ March 09, 2012
Test Performed : SGS Korea tested the sample(s) selected by applicant with following results
Test Requested : Seventy-three (73) substances in the Candidate List of Substances of Very High Concern (SVHC) for authorization published by European Chemicals Agency (ECHA) on and before December 19, 2011 regarding Regulation (EC) No 1907/2006 concerning the REACH.
Test Method : Please refer to next page(s).
Test Result(s) : Please refer to next page(s).
Summary : According to the specified scope and analytical technique, concentrations of all SVHC are <0.1% in the submitted sample(s).

Timothy Jeon
Cindy park
Jinhee Kim
Sophia Kim
/Testing Person

SGS Korea Co., Ltd

Jeff Jang / Chemical Lab Mgr

The document is issued by the Company, subject to its General Conditions of Service (printed or e-mailed), available on request or accessible at www.sgs.com/terms_and_conditions.htm, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company is not responsible to its Client and this document does not constitute a warranty or a transaction from waiving all their rights and obligations under the transaction documents. This document cannot be reproduced or copied in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 100 days only.

F052 Version4

SGS Korea Co., Ltd.

322, The O valley, 555-9, Hoge-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-090
t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgalab.co.kr> www.kr.sgs.com/sgslab

Member of the SGS Group (Société Générale de Surveillance)



Test Report No. F690101/LF-CTSAYAA12-09117 Issued Date: March 09, 2012 Page 2 of 9

Test Method:

SGS In-House method - Analyzed by ICP-OES, PLM, UV/VIS, LC/MS, GC/MS and colorimetric method

Remarks:

1. The chemical analysis of specified SVHC is performed by means of currently available analytical techniques against the following SVHC related documents published by ECHA:
<http://echa.europa.eu/web/guest/candidate-list-table> (Candidate list)
 These lists are under evaluation by ECHA and may subject to change in the future.
2. In accordance with Regulation (EC) No 1907/2006, any producer or importer of articles shall notify ECHA, in accordance with paragraph 2 of Article 7, if a substance meets the criteria in Article 57 and is identified in accordance with Article 59(1) of the Regulation, if (a) the substance is present in those articles in quantities totaling over one tonne per producer or importer per year; and (b) the substance is present in those articles above a concentration of 0.1% weight by weight (w/w).
3. Article 33 of Regulation (EC) No 1907/2006 requires supplier of an article containing a substance meeting the criteria in Article 57 and identified in accordance with Article 59(1) in a concentration above 0.1% weight by weight (w/w) shall provide the recipient of the article with sufficient information, available to the supplier, to allow safe use of the article including, as a minimum, the name of that substance in the Candidate List.
4. SGS adopts the interpretation of ECHA for SVHC in article unless indicated otherwise. Detail explanation is available at the following link:
 - http://webstage.contribute.sgs.net/corpreach/documents/SGS-CTS_SVHC-paper-EN-11.pdf
5. Test results in this report are based on the tested sample. This report refers to testing result of composite material group by equal weight proportion. The material in each composite test group may come from more than one article.
6. If a SVHC is found over the reporting limit, client is suggested to identify the component which contains the SVHC and the exact concentration of the SVHC by requesting further quantitative analysis from the laboratory.

The document is issued by the Company, subject to its General Conditions of Service printed on the reverse, available on request or accessible at www.sgs.com/terms-and-conditions.htm and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms-and-conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of the document is advised that information contained therein reflects the Company's findings as the sole of its intervention only and without the intent of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute parties to a transaction from waiving all their rights and obligations under the transaction documents. This document cannot be reproduced or kept in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report relate only to the sample(s) tested and such sample(s) are retained for 100 days only.

F052 Version4

SGS Korea Co., Ltd.

322, The O valley, 555-9, Hoge-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080

t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com www.kr.sgs.com/sgslab

Member of the SGS Group (Société Générale de Surveillance)

Page 3 of 9

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
Alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins)	85535-84-8	287-476-5	N.D.	0.05	PBT
Anthracene	120-12-7	204-371-1	N.D.	0.05	PBT
Benzyl butyl phthalate (BBP)	85-68-7	201-622-7	N.D.	0.05	Toxic for Reproduction
Bis (2-ethylhexylphthalate) (DEHP)	117-81-7	204-211-0	N.D.	0.05	Toxic for Reproduction
Bis(tributyltin)oxide	56-35-9	200-268-0	N.D.	0.05	PBT
Cobalt dichloride*	7646-79-9	231-589-4	N.D.	0.005	Carcinogen Toxic for Reproduction
4,4-Diaminodiphenylmethane	101-77-9	202-974-4	N.D.	0.05	Carcinogen
Diarsenic pentaoxide*	1303-28-2	215-116-9	N.D.	0.005	Carcinogen
Diarsenic trioxide*	1327-53-3	215-481-4	N.D.	0.005	Carcinogen
Dibutyl phthalate (DBP)	84-74-2	201-557-4	N.D.	0.05	Toxic for Reproduction
Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (α -HBCDD, β -HBCDD, γ -HBCDD)	25637-99-4 and 3194-55-6 (134237-51-7, 134237-50-6, 134237-52-8)	247-148-4 and 221-695-9	N.D.	0.05	PBT
Lead hydrogen arsenate*	7784-40-9	232-064-2	N.D.	0.005	Carcinogen Toxic for Reproduction
Sodium dichromate (Sodium dichromate, dehydrate)	10588-01-9 (7789-12-0)	234-190-3	N.D.	0.005	Carcinogen Mutagen Toxic for Reproduction
5-tert-butyl-2,4,6-trinitro-m-xylene (musk xylene)	81-15-2	201-329-4	N.D.	0.05	vPvB
Triethyl arsenate*	15606-95-8	427-700-2	N.D.	0.005	Carcinogen

The document is provided by the Company subject to the General Conditions of Service printed on, available on request or accessible at www.bentley.com/terms_and_conditions/, and for electronic hosted documents, subject to Terms and Conditions for Electronic Documents on the same website. Attention is drawn to the limitations, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that the information contained herein does not reflect the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to the Client and the document does not constitute part to a transaction from asserting all its rights and obligations under the transaction documents. Any unauthorised alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

322, The O valley, 555-9, Hoge-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080
t +82 (0)31 4608 000 f +82 (0)31 4608 050 <http://www.sqslab.co.kr> www.kr.sqs.com/greenlab

Member of the SGS Group (Société Générale de Surveillance)


Test Report No. F690101/LF-CTSAAYAA 12-09117 Issued Date: March 09, 2012 Page 4 of 9

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
Di-isobutyl phthalate(DIBP)	84-69-5	201-553-2	N.D.	0.05	Toxic for Reproduction
2,4-Dinitrotoluene	121-14-2	204-450-0	N.D.	0.05	Carcinogen
Tris(2-chloroethyl) phosphate	115-96-8	204-118-5	N.D.	0.05	Toxic for Reproduction
Anthracene oil	90640-80-5	292-602-7	N.D.	0.05	PBT; vPvB Carcinogen
Anthracene oil, anthracene paste; distn. Lights	91995-17-4	295-278-5	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Anthracene oil, anthracene paste, anthracene fraction	91995-15-2	295-275-9	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Anthracene oil, anthracene-low	90640-82-7	292-604-8	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Anthracene oil, anthracene paste	90640-81-6	292-603-2	N.D.	0.05	PBT; vPvB Carcinogen Mutagen
Coal tar pitch, high temperature	65996-93-2	266-028-2	N.D.	0.05	PBT; vPvB Carcinogen
Aluminosilicate, Refractory Ceramic Fibres*	650-017-00-8 (Index no.)	-	N.D.	0.005	Carcinogen
Zirconia Aluminosilicate, Refractory Ceramic Fibres*	650-017-00-8 (Index no.)	-	N.D.	0.005	Carcinogen
Lead sulfochromate yellow (C.I. Pigment Yellow 34)*	1344-37-2	215-693-7	N.D.	0.005	Carcinogen Toxic for Reproduction
Lead chromate molybdate sulfate red (C.I. Pigment Red 104)*	12656-85-8	235-759-9	N.D.	0.005	Carcinogen Toxic for Reproduction
Lead chromate*	7758-97-6	231-846-0	N.D.	0.005	Carcinogen Toxic for Reproduction
Acrylamide	79-06-01	201-173-7	N.D.	0.05	Carcinogen Mutagen

The document is issued by the Company, subject to its General Conditions of Service printed on sheet, available on request or accessible at www.sgs.com/terms_and_conditions.htm and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of its client's instructions. In any case, the Company is not responsible as to be Client and the document does not constitute parties to a transaction from absolving all their rights and obligations under the transaction documents. This document cannot be reproduced in any form, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated, the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 100 days only.

F052 Version4

SGS Korea Co., Ltd.

322, The O valley, 555-9, Hoge-dong, Dongam-gu, Anyang-si, Gyeonggi-do, Korea 431-080
t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/sgsclab

Member of the SGS Group (Société Générale de Surveillance)


Test Report No. F690101/LF-CTSAYAA 12-09117 Issued Date: March 09, 2012 Page 5 of 9

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
Boric acid*	10043-35-3 11113-50-1	233-139-2 234-343-4	N.D.	0.005	Toxic for Reproduction
Disodium tetraborate, anhydrous*	1330-43-4 12179-04-3 1303-96-4	215-540-4	N.D.	0.005	Toxic for Reproduction
Tetraboron disodium heptaoxide, hydrate*	12267-73-1	235-541-3	N.D.	0.005	Toxic for Reproduction
Trichloroethylene	79-01-6	201-167-4	N.D.	0.05	Carcinogen
Sodium chromate*	7775-11-3	231-889-5	N.D.	0.005	Carcinogen Mutagen Toxic for Reproduction
Ammonium dichromate*	7789-09-5	232-143-1	N.D.	0.005	Carcinogen Mutagen Toxic for Reproduction
Potassium dichromate*	7778-50-9	231-906-6	N.D.	0.005	Carcinogen Mutagen Toxic for Reproduction
Potassium chromate*	7789-00-6	232-140-5	N.D.	0.005	Carcinogen Mutagen

The document is issued by the Company, subject to its General Conditions of Service printed overleaf, available on request or accessible at www.sgs.com/terms_and_conditions.htm and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any notice of this document is subject to the information contained herein reflects the Company's findings at the time of its intervention only and within the limits of its client's instructions, if any. The Company is not responsible to its Client and this document does not constitute parties to a transaction from absolving all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated, the results shown in this test report relate only to the sample(s) tested and such sample(s) are retained for 168 days only.

F052 Version4

SGS Korea Co., Ltd.

 322, The O valley, 555-9, Hoga-dong, Dongam-gu, Anyang-si, Gyeonggi-do, Korea 431-080
 t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/sgslab

Member of the SGS Group (Sociétés Générales de Surveillance)


Test Report No. F690101/LF-CTSAYAA 12-09117 Issued Date: March 09, 2012 Page 6 of 9

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
Cobalt(II) sulphate*	10124-43-3	233-334-2	N.D.	0.005	Carcinogen Toxic for Reproduction
Cobalt(II) dinitrate*	10141-05-6	233-402-1	N.D.	0.005	Carcinogen Toxic for Reproduction
Cobalt(II) carbonate*	513-79-1	208-169-4	N.D.	0.005	Carcinogen Toxic for Reproduction
Cobalt(II) diacetate*	71-48-7	200-755-8	N.D.	0.005	Carcinogen Toxic for Reproduction
2-Methoxyethanol	109-86-4	203-713-7	N.D.	0.05	Toxic for Reproduction
2-Ethoxyethanol	110-80-5	203-804-1	N.D.	0.05	Toxic for Reproduction
Chromium trioxide*	1333-82-0	215-607-8	N.D.	0.005	Carcinogen Mutagen
Acids generated from chromium trioxide and their oligomers: Chromic acid Dichromic acid Oligomers of chromic acid and dichromic acid	7738-94-5 13530-68-2 -	231-801-5 236-881-5 -	N.D.	0.005	Carcinogen
1-methyl-2-pyrrolidone	872-50-4	212-828-1	N.D.	0.05	Toxic for Reproduction
2-ethoxyethyl acetate	111-15-9	203-839-2	N.D.	0.05	Toxic for Reproduction
1,2-benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich	71888-89-6	276-158-1	N.D.	0.05	Toxic for Reproduction
1,2-benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters	68515-42-4	271-084-6	N.D.	0.05	Toxic for Reproduction
1,2,3-trichloropropane	96-18-4	202-486-1	N.D.	0.05	Carcinogen Toxic for Reproduction
Hydrazine	7803-57-8 302-01-2	206-114-9	N.D.	0.05	Carcinogen
Strontium chromate*	7789-06-2	232-142-6	N.D.	0.005	Carcinogen

This document is issued by the Company, subject to its General Conditions of Service printed on sheet, available on request or accessible at www.sgs.com/lab and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/lab. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 100 days only.

F052 Version4

SGS Korea Co., Ltd.

 322, The O valley, 555-9, Hoggae-dong, Dongam-gu, Anyang-si, Gyeonggi-do, Korea 431-080
 t +82 (0)31 4608 000 f +82 (0)31 4608 050 <http://www.sgslab.co.kr> www.kr.sgs.com/sgslab

Member of the SGS Group (Société Générale de Surveillance)


Test Report No. F690101/LF-CTSAYAA 12-09117 Issued Date: March 09, 2012 Page 7 of 9

Substance Name	CAS number	EC number	Concentration (%)	Reporting Limit (%)	Classification
1,2-Dichloroethane	107-06-2	203-458-1	N.D.	0.05	Carcinogenic
2,2'-dichloro-4,4'-methylenedianiline (MOCA)	101-14-4	202-918-9	N.D.	0.05	Carcinogenic
2-Methoxyaniline o-Anisidine	90-04-0	201-963-1	N.D.	0.05	Carcinogenic
4-(1,1,3,3-tetramethylbutyl)phenol, (4-tert-Octylphenol)	140-66-9	205-426-2	N.D.	0.05	Equivalent level of concern having probable serious effects to the environment
Aluminosilicate Refractory Ceramic Fibres* (RCF)	650-017-00-8 (Index no.)	-	N.D.	0.005	Carcinogenic
Arsenic acid*	7778-39-4	231-901-9	N.D.	0.005	Carcinogenic
Bis(2-methoxyethyl) ether	111-96-6	203-924-4	N.D.	0.05	Toxic for reproduction
Bis(2-methoxyethyl) phthalate	117-82-8	204-212-6-	N.D.	0.05	Toxic for reproduction
Calcium arsenate*	7778-44-1	231-904-5	N.D.	0.005	Carcinogenic
Dichromium tris(chromate)*	24613-89-6	246-356-2	N.D.	0.005	Carcinogenic
Formaldehyde, oligomeric reaction products with aniline (technical MDA)	25214-70-4	500-036-1	N.D.	0.05	Carcinogenic
Lead diazide*	13424-46-9	236-542-1	N.D.	0.005	Toxic for reproduction
Lead dipicrate*	6477-64-1	229-335-2	N.D.	0.005	Toxic for reproduction
Lead styphnate*	15245-44-0	239-290-2	N.D.	0.005	Toxic for reproduction
N,N-dimethylacetamide (DMAC)	127-19-5	204-826-4	N.D.	0.05	Toxic for reproduction
Pentazinc chromate octahydroxide*	49663-84-5	256-418-0	N.D.	0.005	Carcinogenic
Phenolphthalein	77-09-8	201-004-7	N.D.	0.05	Carcinogenic
Potassium hydroxyoctaoxodizincatedichromate*	11103-86-9	234-329-8	N.D.	0.005	Carcinogenic
Trilead arsenate*	3687-31-8	222-979-5	N.D.	0.005	Carcinogenic Toxic for reproduction
Zirconia Aluminosilicate Refractory Ceramic Fibres (Zr-RCF)*	650-017-00-8 (Index no.)	-	N.D.	0.005	Carcinogenic

This document is issued by the Company, subject to its General Conditions of Service printed on file, available on request or accessible at www.sgs.com/terms_and_conditions, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings as the sole result of its intervention only and within the limits of its Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report relate only to the sample(s) tested and such sample(s) are retained for 100 days only.

F052 Version4

SGS Korea Co., Ltd.

322, The O valley, 555-9, Hoggae-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080
t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/sgslab

Member of the SGS Group (Société Générale de Surveillance)

SGS

Test Report No. F690101/LF-CTSAYAA12-09117 Issued Date: March 09, 2012 Page 8 of 9**Note:**

1. RL = Reporting Limit
2. N.D. = Not detected (lower than RL)
N.A. = Not applicable for respective material type.

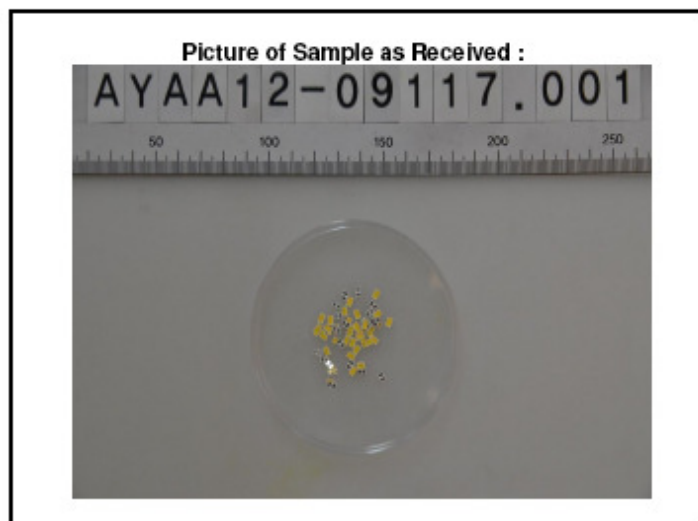
The submitted sample was found to contain significant amount of specific element(s) of SVHC. Upon further test verification and also information provided from client, the possibility that the element(s) content originate from SVHC is very unlikely, even though their presence cannot be exclude entirely. It may be assumed that the detected element(s) have a non-SVHC source.

3. Definition of classification is listed in Appendix A of this report in accordance with 67/548/EEC and Regulation (EC) No 1907/2006. For detail information, Detail explanation is available at the following link:
<http://echa.europa.eu/web/guest/candidate-list-table> (Candidate list)
- 4.. *.The test result is based on the calculation of selected element(s) / marker(s) and to the worst-case scenario. For detail information, please refer to the SGS REACH website: www.reach.sgs.com/substance-of-very-high-concern-analysis-information-page.htm

The client is advised to review the chemical formulation to ascertain above metal substances present in the article.

RL = 0.005% is evaluated for element (i.e. cobalt, arsenic, lead, sodium, chromium, chromium(VI), silicon, aluminum, zirconium, boron, and potassium respectively), except molybdenum RL=0.0005%

0.1% (w/w) = 1,000 ppm = 1,000 mg/kg



*** End of Report ***

The document is issued by the Company subject to its General Conditions of Service printed on request or accessible at www.sgs.com/terms_and_conditions and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of the document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not constitute a warranty or a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced in full, without prior written approval of the Company. Any consultation, alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 100 days only.

F052 Version4

SGS Korea Co., Ltd.

322, The O valley, 555-9, Hoge-dong, Dongam-gu, Anyang-si, Gyeonggi-do, Korea 431-090

t +82 (0)31 4608 000 f +82 (0)31 4608 050 <http://www.sgalab.co.kr> www.kr.sgs.com/sgs-lab

Member of the SGS Group (Société Générale de Surveillance)



Test Report No. F690101/LF-CTSAYAA12-09117 Issued Date: March 09, 2012 Page 9 of 9

Appendix A

Classification Definition under 67/548/EEC and Regulation (EC) No 1907/2006

Carcinogen Category 1: Substances known to be carcinogenic to man. There is sufficient evidence to establish a causal association between human exposure to a substance and the development of cancer.

Carcinogen Category 2: Substances which should be regarded as if they are carcinogenic to man. There is sufficient evidence to provide a strong presumption that human exposure to a substance may result in the development of cancer.
Generally on the basis of:
- appropriate long-term animal studies
- other relevant information.

Mutagen Category 1: Substances known to be mutagenic to man. There is sufficient evidence to establish a causal association between human exposure to a substance and heritable genetic damage.

Mutagen Category 2: Substances which should be regarded as if they are mutagenic to man. There is sufficient evidence to provide a strong presumption that human exposure to the substance may result in the development of heritable genetic damage, generally on the basis of:
- appropriate animal studies,
- other relevant information.

Toxic to Reproduction Category 1: Substances known to impair fertility in humans. There is sufficient evidence to establish a causal relationship between human exposure to the substance and impaired fertility.
Substances known to cause developmental toxicity in humans. There is sufficient evidence to establish a causal relationship between human exposure to the substance and subsequent developmental toxic effects in the progeny.

Toxic to Reproduction Category 2: Substances which should be regarded as if they impair fertility in humans. There is sufficient evidence to provide a strong presumption that human exposure to the substance may result in impaired fertility on the basis of:
- clear evidence in animal studies of impaired fertility in the absence of toxic effects, or, evidence of impaired fertility occurring at around the same dose levels as other toxic effects but which is not a secondary nonspecific consequence of the other toxic effects,
- other relevant information.
Substances which should be regarded as if they cause developmental toxicity to humans. There is sufficient evidence to provide a strong presumption that human exposure to the substance may result in developmental toxicity, generally on the basis of:
- clear results in appropriate animal studies where effects have been observed in the absence of signs of marked maternal toxicity, or at around the same dose levels as other toxic effects but which are not a secondary non-specific consequence of the other toxic effects,
- other relevant information.

PBT & vPvB: Substances which are persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB) pose a particular challenge to the chemicals safety management. For these substances a "safe" concentration in the environment cannot be established with sufficient reliability.

This document is issued by the Company, subject to its General Conditions of Service printed on file, available on request or accessible at www.sgs.com/terms_and_conditions.htm, and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_and_conditions.htm. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained herein reflects the Company's findings at the time of its intervention only and within the limits of its own instructions, if any. The Company is sole responsible to its Client and the document does not constitute parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 168 days only.

F052 Version4

SGS Korea Co., Ltd.

322, The O valley, 555-9, Hoge-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-080
t +82 (0)31 4608 000 f +82 (0)31 4608 059 <http://www.sgslab.co.kr> www.kr.sgs.com/sgslab

Member of the SGS Group (Société Générale de Surveillance)

