

# LM561B – 5630 Middle Power LED for High CRI



## Introduction

### Features

- Beam Angle: 120°
- Precondition : JEDEC Level 2a
- Dimension : 5.6 x 3.0 x 0.8 mm
- ESD withstand Voltage : up to  $\pm 5\text{KV}$  [HBM]

### Applications

- INDOOR LIGHTING : Ambient Light, LED tube, Down light, LED bulb and Ceiling Light

## SAMSUNG ELECTRONICS

95, Samsung2-Ro, Giheung-Gu,  
Yongin-City, Gyeonggi-Do 446-711, KOREA

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# 1. Product Code Information

## 1) Luminous Flux Bins ( $T_s = 25^\circ\text{C}$ )

| Nominal CCT | Product Code       | Flux Rank | Sorting Condition $I_m$ @65mA   |
|-------------|--------------------|-----------|---------------------------------|
|             |                    |           | Flux Range ( $\Phi_v$ , $I_m$ ) |
| 2700K       | SPMWHT541MD7WAW☆S0 | SY        | 20.0 ~ 22.0                     |
|             |                    | SZ        | 22.0 ~ 24.0                     |
|             |                    | S1        | 24.0 ~ 26.0                     |
| 3000K       | SPMWHT541MD7WAV☆S0 | SY        | 20.5 ~ 22.5                     |
|             |                    | SZ        | 22.5 ~ 24.5                     |
|             |                    | S1        | 24.5 ~ 26.5                     |
| 3500K       | SPMWHT541MD7WAU☆S0 | SY        | 22.0 ~ 24.0                     |
|             |                    | SZ        | 24.0 ~ 26.0                     |
|             |                    | S1        | 26.0 ~ 28.0                     |
| 4000K       | SPMWHT541MD7WAT☆S0 | SY        | 23.0 ~ 25.0                     |
|             |                    | SZ        | 25.0 ~ 27.0                     |
|             |                    | S1        | 27.0 ~ 29.0                     |

### Notes:

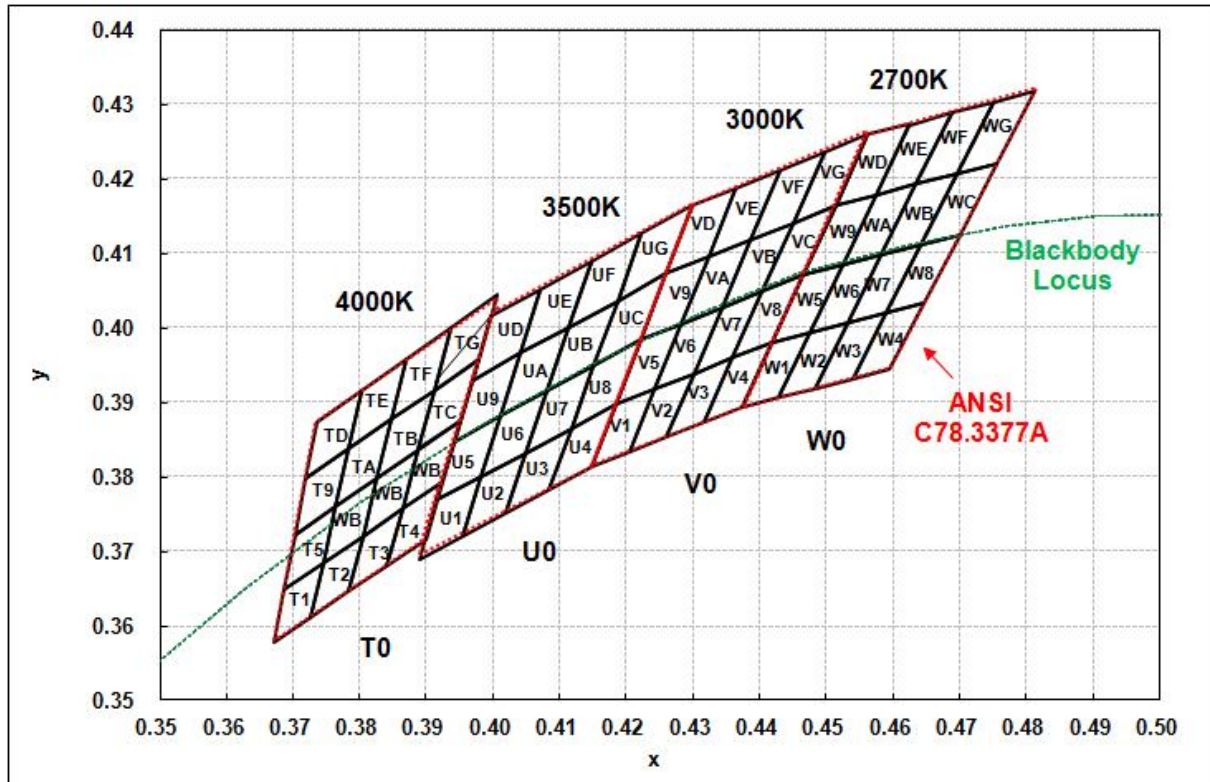
- 1)SAMSUNG ELECTRONICS maintains a tolerance of  $\pm 5\%$  on Luminous Flux measurements.
- 2)Warm white : "☆" can be "0"(Whole Bin), "H"(Half Bin) or "M"(Quarter Bin) of the color binning.

## 2) Color Bins ( $T_s = 25^\circ\text{C}$ )

### 2-1) Color Binning

| Nominal CCT | Product Code       | Color Rank      | Chromaticity Bins                                              |
|-------------|--------------------|-----------------|----------------------------------------------------------------|
| 2700K       | SPMWHT541MD7WAW0S0 | W0(Whole bin)   | W1, W2, W3, W4, W5, W6, W7, W8, W9, WA, WB, WC, WD, WE, WF, WG |
|             | SPMWHT541MD7WAWHS0 | WH(Half bin)    | W5, W6, W7, W8<br>W9, WA, WB, WC                               |
|             | SPMWHT541MD7WAWMS0 | WM(Quarter bin) | W6, W7, WA, WB                                                 |
| 3000K       | SPMWHT541MD7WAV0S0 | V0(Whole bin)   | V1, V2, V3, V4, V5, V6, V7, V8, V9, VA, VB, VC, VD, VE, VF, VG |
|             | SPMWHT541MD7WAVHS0 | VH(Half bin)    | V5, V6, V7, V8<br>V9, VA, VB, VC                               |
|             | SPMWHT541MD7WAVMS0 | VM(Quarter bin) | V6, V7, VA, VB                                                 |
| 3500K       | SPMWHT541MD7WAV0S0 | U0(Whole bin)   | U1, U2, U3, U4, U5, U6, U7, U8, U9, UA, UB, UC, UD, UE, UF, UG |
|             | SPMWHT541MD7WAVHS0 | UH(Half bin)    | U5, U6, U7, U8<br>U9, UA, UB, UC                               |
|             | SPMWHT541MD7WAVMS0 | UM(Quarter bin) | U6, U7, UA, UB                                                 |
| 4000K       | SPMWHT541MD7WAT0S0 | T0(Whole bin)   | T1, T2, T3, T4, T5, T6, T7, T8, T9, TA, TB, TC, TD, TE, TF, TG |
|             | SPMWHT541MD7WATHS0 | TH(Half bin)    | T5, T6, T7, T8, T9, TA, TB, TC                                 |
|             | SPMWHT541MD7WATMS0 | TM(Quarter bin) | T6, T7, TA, TB                                                 |

## 2-2) Chromaticity Region & Coordinates



## 2-3) Chromaticity Region & Coordinates

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| W rank (2700K) |        |        |        |        |        |
| W1             | 0.4373 | 0.3893 | W9     | 0.4465 | 0.4071 |
|                | 0.4418 | 0.3981 |        | 0.4513 | 0.4164 |
|                | 0.4475 | 0.3994 |        | 0.4573 | 0.4178 |
|                | 0.4428 | 0.3906 |        | 0.4523 | 0.4085 |
| W2             | 0.4428 | 0.3906 | WA     | 0.4523 | 0.4085 |
|                | 0.4475 | 0.3994 |        | 0.4573 | 0.4178 |
|                | 0.4532 | 0.4008 |        | 0.4634 | 0.4193 |
|                | 0.4483 | 0.3919 |        | 0.4582 | 0.4099 |
| W3             | 0.4483 | 0.3919 | WB     | 0.4582 | 0.4099 |
|                | 0.4532 | 0.4008 |        | 0.4634 | 0.4193 |
|                | 0.4589 | 0.4021 |        | 0.4695 | 0.4207 |
|                | 0.4538 | 0.3931 |        | 0.4641 | 0.4112 |
| W4             | 0.4538 | 0.3931 | WC     | 0.4641 | 0.4112 |
|                | 0.4589 | 0.4021 |        | 0.4695 | 0.4207 |
|                | 0.4646 | 0.4034 |        | 0.4756 | 0.4221 |
|                | 0.4593 | 0.3944 |        | 0.4700 | 0.4126 |
| W5             | 0.4418 | 0.3981 | WD     | 0.4513 | 0.4164 |
|                | 0.4465 | 0.4071 |        | 0.4562 | 0.4260 |
|                | 0.4523 | 0.4085 |        | 0.4624 | 0.4274 |
|                | 0.4475 | 0.3994 |        | 0.4573 | 0.4178 |
| W6             | 0.4475 | 0.3994 | WE     | 0.4573 | 0.4178 |
|                | 0.4523 | 0.4085 |        | 0.4624 | 0.4274 |
|                | 0.4582 | 0.4099 |        | 0.4687 | 0.4289 |
|                | 0.4532 | 0.4008 |        | 0.4634 | 0.4193 |
| W7             | 0.4532 | 0.4008 | WF     | 0.4634 | 0.4193 |
|                | 0.4582 | 0.4099 |        | 0.4687 | 0.4289 |
|                | 0.4641 | 0.4112 |        | 0.4750 | 0.4304 |
|                | 0.4589 | 0.4021 |        | 0.4695 | 0.4207 |
| W8             | 0.4589 | 0.4021 | WG     | 0.4695 | 0.4207 |
|                | 0.4641 | 0.4112 |        | 0.4750 | 0.4304 |
|                | 0.4700 | 0.4126 |        | 0.4813 | 0.4319 |
|                | 0.4646 | 0.4034 |        | 0.4756 | 0.4221 |

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| V rank (3000K) |        |        |        |        |        |
| V1             | 0.4147 | 0.3814 | V9     | 0.4221 | 0.3984 |
|                | 0.4183 | 0.3898 |        | 0.4259 | 0.4073 |
|                | 0.4242 | 0.3919 |        | 0.4322 | 0.4096 |
|                | 0.4203 | 0.3833 |        | 0.4281 | 0.4006 |
| V2             | 0.4203 | 0.3833 | VA     | 0.4281 | 0.4006 |
|                | 0.4242 | 0.3919 |        | 0.4322 | 0.4096 |
|                | 0.4300 | 0.3939 |        | 0.4385 | 0.4119 |
|                | 0.4259 | 0.3853 |        | 0.4342 | 0.4028 |
| V3             | 0.4259 | 0.3853 | VB     | 0.4342 | 0.4028 |
|                | 0.4300 | 0.3939 |        | 0.4385 | 0.4119 |
|                | 0.4359 | 0.3960 |        | 0.4449 | 0.4141 |
|                | 0.4316 | 0.3873 |        | 0.4403 | 0.4049 |
| V4             | 0.4316 | 0.3873 | VC     | 0.4403 | 0.4049 |
|                | 0.4359 | 0.3960 |        | 0.4449 | 0.4141 |
|                | 0.4418 | 0.3981 |        | 0.4513 | 0.4164 |
|                | 0.4373 | 0.3893 |        | 0.4465 | 0.4071 |
| V5             | 0.4183 | 0.3898 | VD     | 0.4259 | 0.4073 |
|                | 0.4221 | 0.3984 |        | 0.4299 | 0.4165 |
|                | 0.4281 | 0.4006 |        | 0.4364 | 0.4188 |
|                | 0.4242 | 0.3919 |        | 0.4322 | 0.4096 |
| V6             | 0.4242 | 0.3919 | VE     | 0.4322 | 0.4096 |
|                | 0.4281 | 0.4006 |        | 0.4364 | 0.4188 |
|                | 0.4342 | 0.4028 |        | 0.4430 | 0.4212 |
|                | 0.4300 | 0.3939 |        | 0.4385 | 0.4119 |
| V7             | 0.4300 | 0.3939 | VF     | 0.4385 | 0.4119 |
|                | 0.4342 | 0.4028 |        | 0.4430 | 0.4212 |
|                | 0.4403 | 0.4049 |        | 0.4496 | 0.4236 |
|                | 0.4359 | 0.3960 |        | 0.4449 | 0.4141 |
| V8             | 0.4359 | 0.3960 | VG     | 0.4449 | 0.4141 |
|                | 0.4403 | 0.4049 |        | 0.4496 | 0.4236 |
|                | 0.4465 | 0.4071 |        | 0.4562 | 0.4260 |
|                | 0.4418 | 0.3981 |        | 0.4513 | 0.4164 |

## 2) Chromaticity Region & Coordinates (Continued)

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| U rank (3500K) |        |        |        |        |        |
| U1             | 0.3889 | 0.3690 | U9     | 0.3941 | 0.3848 |
|                | 0.3915 | 0.3768 |        | 0.3968 | 0.3930 |
|                | 0.3981 | 0.3800 |        | 0.4040 | 0.3966 |
|                | 0.3953 | 0.3720 |        | 0.4010 | 0.3882 |
| U2             | 0.3953 | 0.3720 | UA     | 0.4010 | 0.3882 |
|                | 0.3981 | 0.3800 |        | 0.4040 | 0.3966 |
|                | 0.4048 | 0.3832 |        | 0.4113 | 0.4001 |
|                | 0.4017 | 0.3751 |        | 0.4080 | 0.3916 |
| U3             | 0.4017 | 0.3751 | UB     | 0.4080 | 0.3916 |
|                | 0.4048 | 0.3832 |        | 0.4113 | 0.4001 |
|                | 0.4116 | 0.3865 |        | 0.4186 | 0.4037 |
|                | 0.4082 | 0.3782 |        | 0.4150 | 0.3950 |
| U4             | 0.4082 | 0.3782 | UC     | 0.4150 | 0.3950 |
|                | 0.4116 | 0.3865 |        | 0.4186 | 0.4037 |
|                | 0.4183 | 0.3898 |        | 0.4259 | 0.4073 |
|                | 0.4147 | 0.3814 |        | 0.4221 | 0.3984 |
| U5             | 0.3915 | 0.3768 | UD     | 0.3968 | 0.3930 |
|                | 0.3941 | 0.3848 |        | 0.3996 | 0.4015 |
|                | 0.4010 | 0.3882 |        | 0.4071 | 0.4052 |
|                | 0.3981 | 0.3800 |        | 0.4040 | 0.3966 |
| U6             | 0.3981 | 0.3800 | UE     | 0.4040 | 0.3966 |
|                | 0.4010 | 0.3882 |        | 0.4071 | 0.4052 |
|                | 0.4080 | 0.3916 |        | 0.4146 | 0.4089 |
|                | 0.4048 | 0.3832 |        | 0.4113 | 0.4001 |
| U7             | 0.4048 | 0.3832 | UF     | 0.4113 | 0.4001 |
|                | 0.4080 | 0.3916 |        | 0.4146 | 0.4089 |
|                | 0.4150 | 0.3950 |        | 0.4222 | 0.4127 |
|                | 0.4116 | 0.3865 |        | 0.4186 | 0.4037 |
| U8             | 0.4116 | 0.3865 | UG     | 0.4186 | 0.4037 |
|                | 0.4150 | 0.3950 |        | 0.4222 | 0.4127 |
|                | 0.4221 | 0.3984 |        | 0.4299 | 0.4165 |
|                | 0.4183 | 0.3898 |        | 0.4259 | 0.4073 |

| Region         | CIE X  | CIE Y  | Region | CIE X  | CIE Y  |
|----------------|--------|--------|--------|--------|--------|
| T rank (4000K) |        |        |        |        |        |
| T1             | 0.367  | 0.3578 | T9     | 0.3702 | 0.3722 |
|                | 0.3726 | 0.3612 |        | 0.3763 | 0.376  |
|                | 0.3744 | 0.3685 |        | 0.3782 | 0.3837 |
|                | 0.3686 | 0.3649 |        | 0.3719 | 0.3797 |
| T2             | 0.3726 | 0.3612 | TA     | 0.3763 | 0.3760 |
|                | 0.3783 | 0.3646 |        | 0.3825 | 0.3798 |
|                | 0.3804 | 0.3721 |        | 0.3847 | 0.3877 |
|                | 0.3744 | 0.3685 |        | 0.3782 | 0.3837 |
| T3             | 0.3783 | 0.3646 | TB     | 0.3825 | 0.3798 |
|                | 0.3840 | 0.3681 |        | 0.3887 | 0.3836 |
|                | 0.3863 | 0.3758 |        | 0.3912 | 0.3917 |
|                | 0.3804 | 0.3721 |        | 0.3847 | 0.3877 |
| T4             | 0.384  | 0.3681 | TC     | 0.3887 | 0.3837 |
|                | 0.3898 | 0.3716 |        | 0.395  | 0.3875 |
|                | 0.3924 | 0.3794 |        | 0.3978 | 0.3958 |
|                | 0.3863 | 0.3758 |        | 0.3912 | 0.3917 |
| T5             | 0.3686 | 0.3649 | TD     | 0.3719 | 0.3797 |
|                | 0.3744 | 0.3685 |        | 0.3782 | 0.3837 |
|                | 0.3763 | 0.376  |        | 0.3802 | 0.3916 |
|                | 0.3702 | 0.3722 |        | 0.3736 | 0.3874 |
| T6             | 0.3744 | 0.3685 | TE     | 0.3782 | 0.3837 |
|                | 0.3804 | 0.3721 |        | 0.3847 | 0.3877 |
|                | 0.3825 | 0.3798 |        | 0.3869 | 0.3958 |
|                | 0.3763 | 0.376  |        | 0.3802 | 0.3916 |
| T7             | 0.3804 | 0.3721 | TF     | 0.3847 | 0.3877 |
|                | 0.3863 | 0.3758 |        | 0.3912 | 0.3917 |
|                | 0.3887 | 0.3836 |        | 0.3937 | 0.4001 |
|                | 0.3825 | 0.3798 |        | 0.3869 | 0.3958 |
| T8             | 0.3863 | 0.3758 | TG     | 0.3912 | 0.3917 |
|                | 0.3924 | 0.3794 |        | 0.3978 | 0.3958 |
|                | 0.395  | 0.3875 |        | 0.4006 | 0.4044 |
|                | 0.3887 | 0.3836 |        | 0.3937 | 0.4001 |

**Notes:** SAMSUNG ELECTRONICS maintains  $\pm 0.005$  tolerance of Cx, Cy

## 2. Characteristics

### 1) Absolute Maximum Rating

| Item                         | Symbol        | Rating        | Condition                  |
|------------------------------|---------------|---------------|----------------------------|
| Operating temperature range  | $T_{op}$      | -40℃ ~ +85℃   | –                          |
| Storage temperature range    | $T_{stg}$     | -40℃ ~ +120℃  | –                          |
| LED junction temperature     | $T_J$         | 110℃          | –                          |
| Forward Current              | $I_F$         | 150 mA        | –                          |
| Peak Pulsed Forward Current  | $I_{FP}$      | 300 mA        | Duty 1/10 pulse width 10ms |
| Thermal resistance           | $R_{th, j-s}$ | 16℃/W         | Junction to solder point   |
| Assembly Process Temperature | –             | 260℃, < 10sec | –                          |
| ESD                          | –             | 5kV           | HBM                        |

### 2) Electro-optical Characteristics

| Item                                                    | Unit | Nominal CCT   | Product Code | Rank |      | Min  | Typ  | Max  |
|---------------------------------------------------------|------|---------------|--------------|------|------|------|------|------|
| Forward Voltage (V <sub>F</sub> )<br>(@65 mA, Ts = 25℃) | V    | –             | –            | WA   | AZ   | 2.70 | –    | 2.80 |
|                                                         |      |               |              |      | A1   | 2.80 | –    | 2.90 |
|                                                         |      |               |              |      | A2   | 2.90 | –    | 3.00 |
|                                                         |      |               |              |      | A3   | 3.00 | –    | 3.10 |
|                                                         |      |               |              |      | A4   | 3.10 | –    | 3.20 |
| Luminous Flux (Φ <sub>v</sub> )<br>(@65 mA, Ts = 25℃)   | lm   | 2700K<br>(W☆) | *WAW☆S0      | SY   | 20.0 | –    | 22.0 |      |
|                                                         |      |               |              | SZ   | 22.0 | –    | 24.0 |      |
|                                                         |      |               |              | S1   | 24.0 | –    | 26.0 |      |
|                                                         |      | 3000K<br>(V☆) | *WAV☆S0      | SY   | 20.5 | –    | 22.5 |      |
|                                                         |      |               |              | SZ   | 22.5 | –    | 24.5 |      |
|                                                         |      |               |              | S1   | 24.5 | –    | 26.5 |      |
|                                                         |      | 3500K<br>(U☆) | *WAU☆S0      | SY   | 22.0 | –    | 24.0 |      |
|                                                         |      |               |              | SZ   | 24.0 | –    | 26.0 |      |
|                                                         |      |               |              | S1   | 26.0 | –    | 28.0 |      |
|                                                         |      | 4000K<br>(T☆) | *WAT☆S0      | SY   | 23.0 | –    | 25.0 |      |
|                                                         |      |               |              | SZ   | 25.0 | –    | 27.0 |      |
|                                                         |      |               |              | S1   | 27.0 | –    | 29.0 |      |
| Reverse Voltage<br>(@5 mA, Ts = 25℃)                    | V    | –             | –            | –    | 0.7  | –    | 1.2  |      |
| Color Rendering Index(R <sub>a</sub> )                  | –    | –             | –            | 7    | 90   | –    | –    |      |
| Special CRI (R9)                                        | –    | –             | –            | –    | 50   | –    | –    |      |

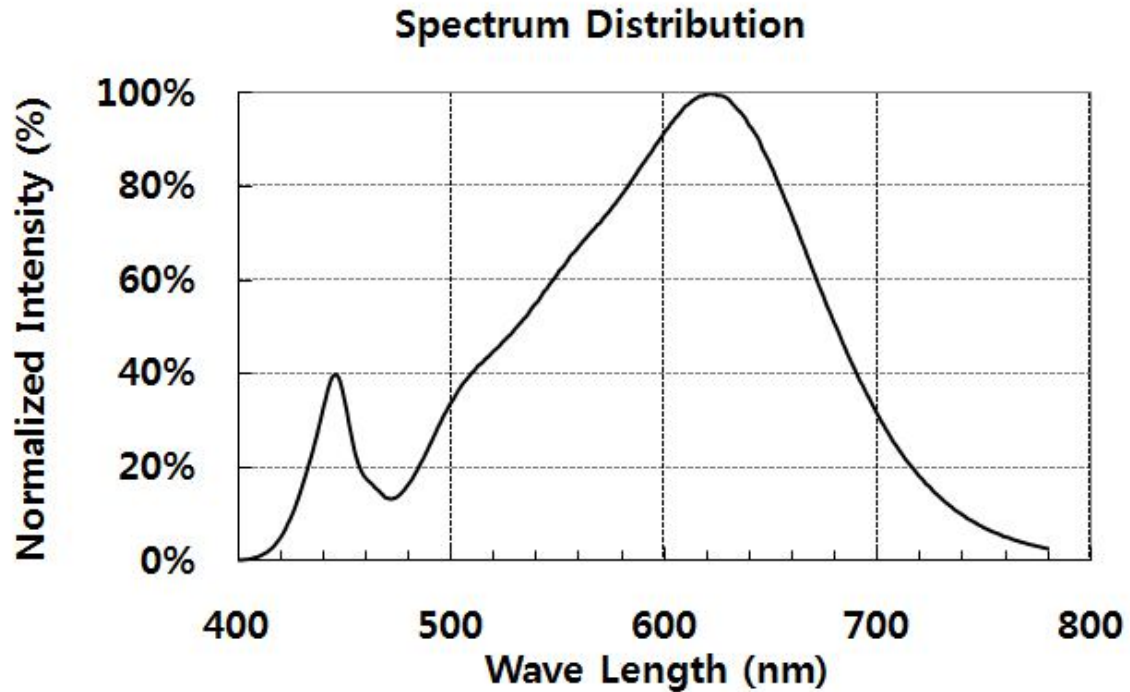
#### Notes:

- 1) SAMSUNG ELECTRONICS maintains a tolerance of  $V_F: \pm 0.1$  V,  $\Phi_v: \pm 5$  %,  $R_a: \pm 3.0$ ,  $R9: \pm 6.5$  on measurements
- 2) " \* " is Product Code of "SPMWH◆541MD7".

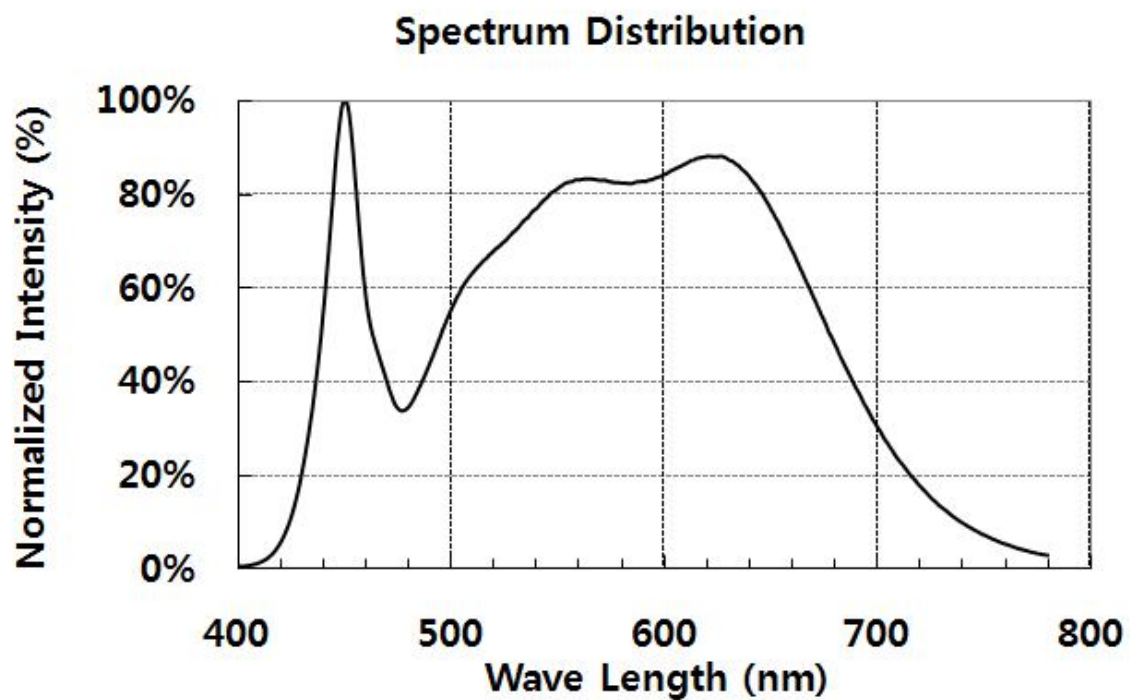
### 3. Typical Characteristics Graph ( $T_s = 25^\circ\text{C}$ )

#### 1) Spectrum Distribution

[CCT : 2700K & 3000K]



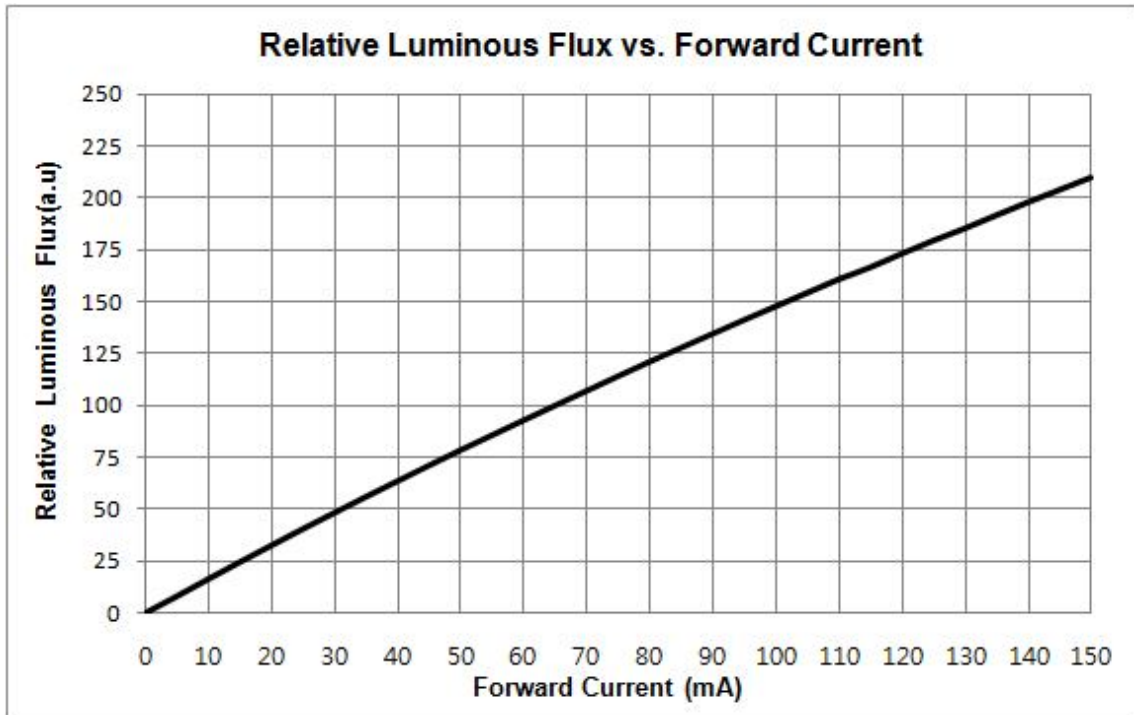
[CCT : 3500K & 4000K]



## 2) Forward Current Characteristics

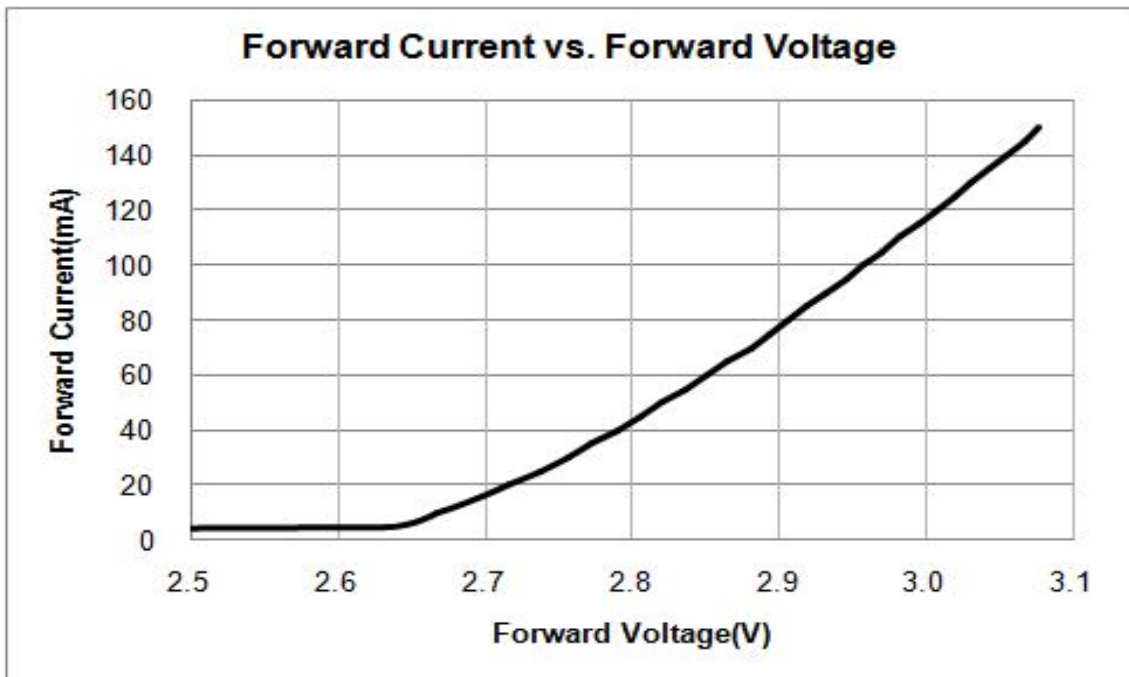
[Relative Luminous Flux vs. Forward Current]

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



[Forward Current vs. Forward Voltage]

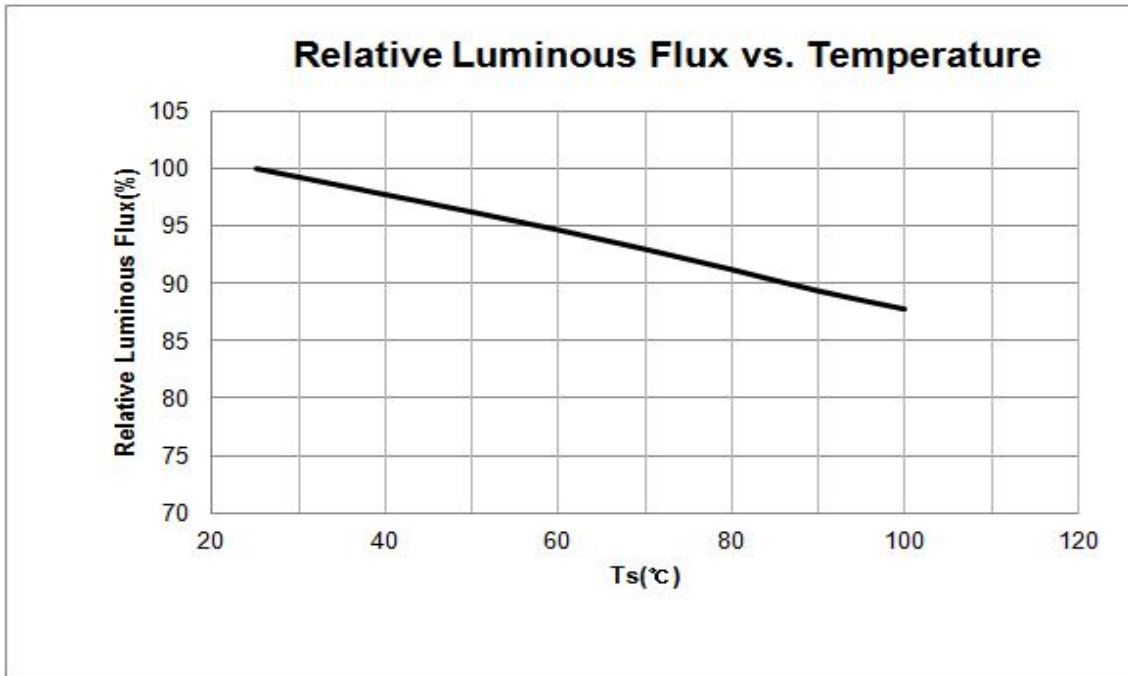
( $T_s = 25^\circ\text{C}$ )



### 3) Temperature Characteristics

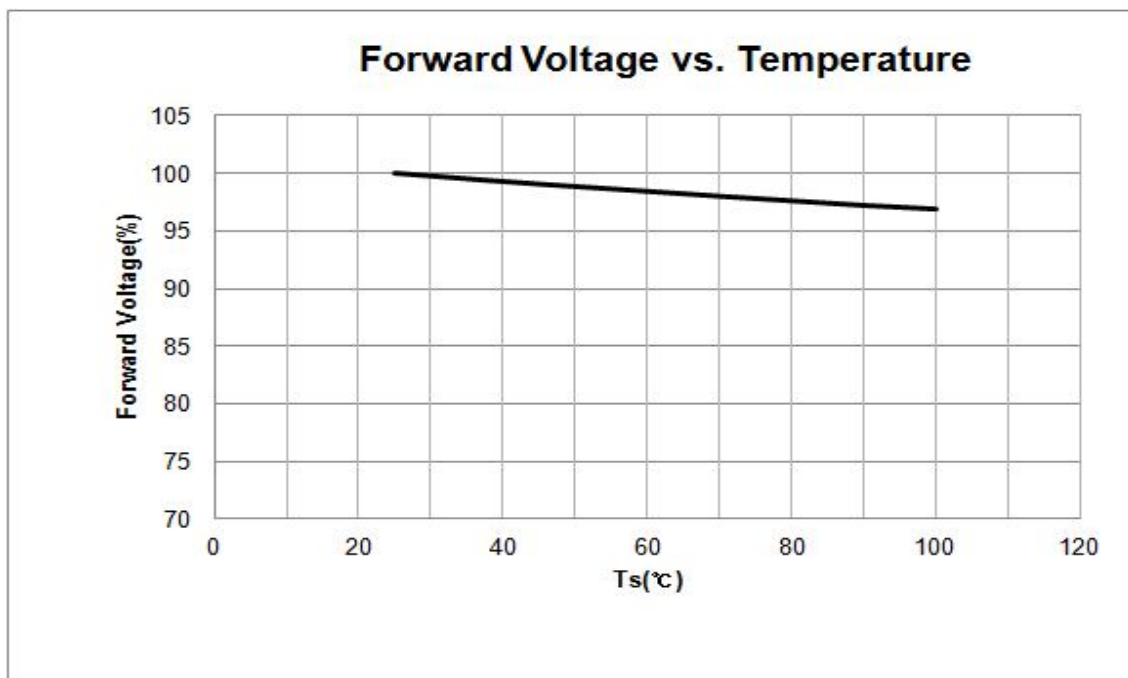
[Relative Luminous Flux vs.  $T_s$ ]

( $I_F = 65\text{mA}$ )



[Forward Voltage vs.  $T_s$ ]

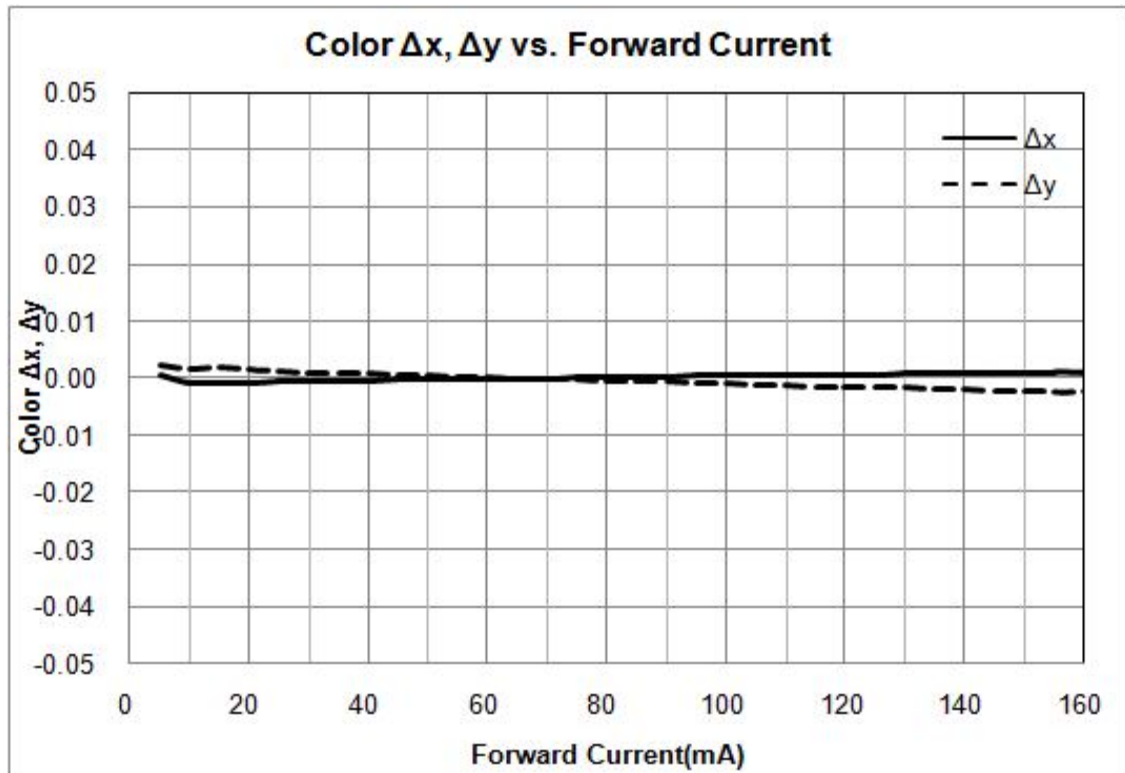
( $I_F = 65\text{mA}$ )



#### 4) Color shift Characteristics

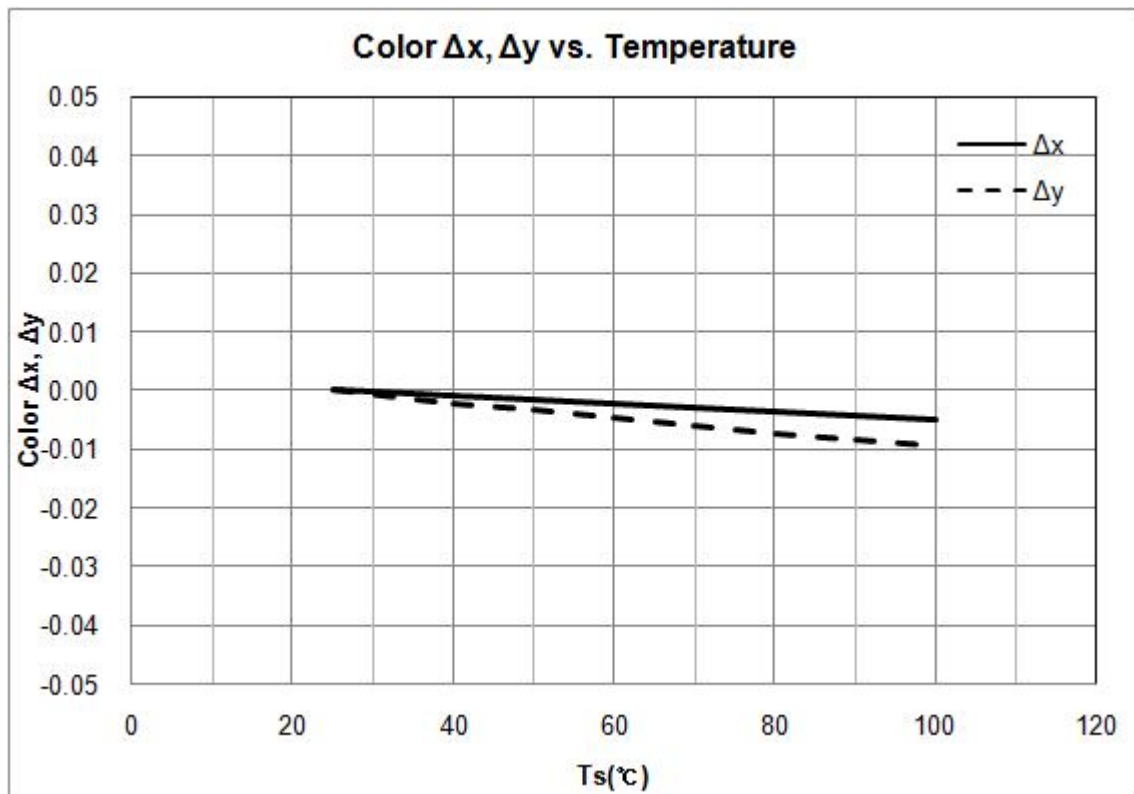
[Color  $\Delta x$ ,  $\Delta y$  vs. Forward Current]

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

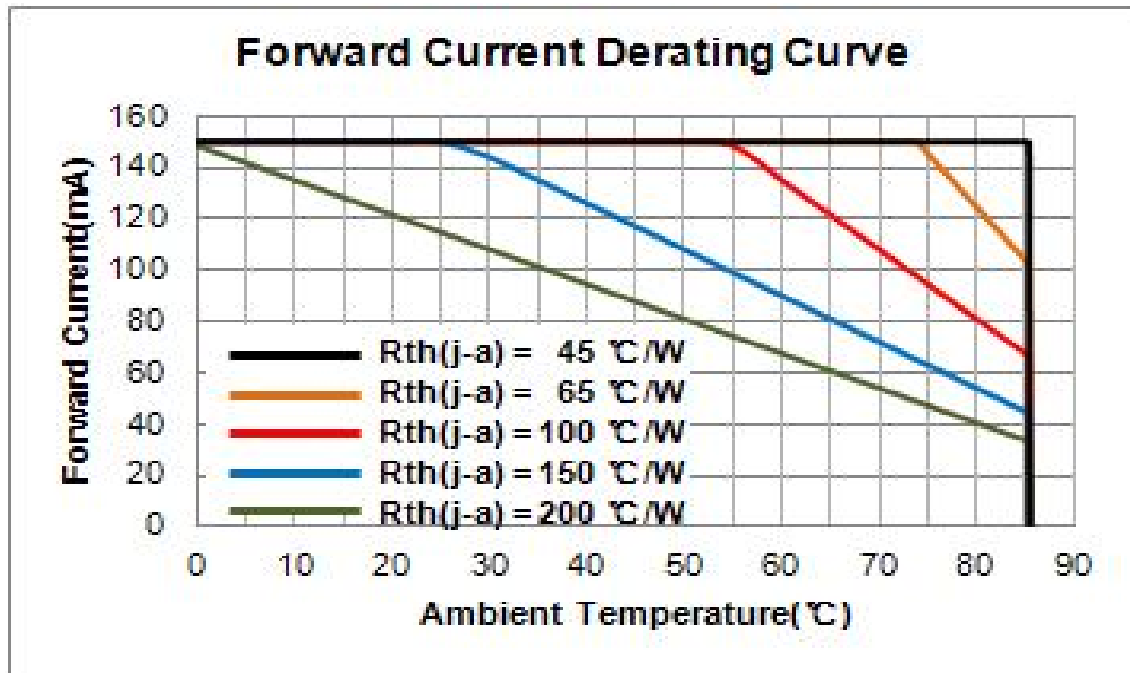


[Color  $\Delta x$ ,  $\Delta y$  vs.  $T_s$ ]

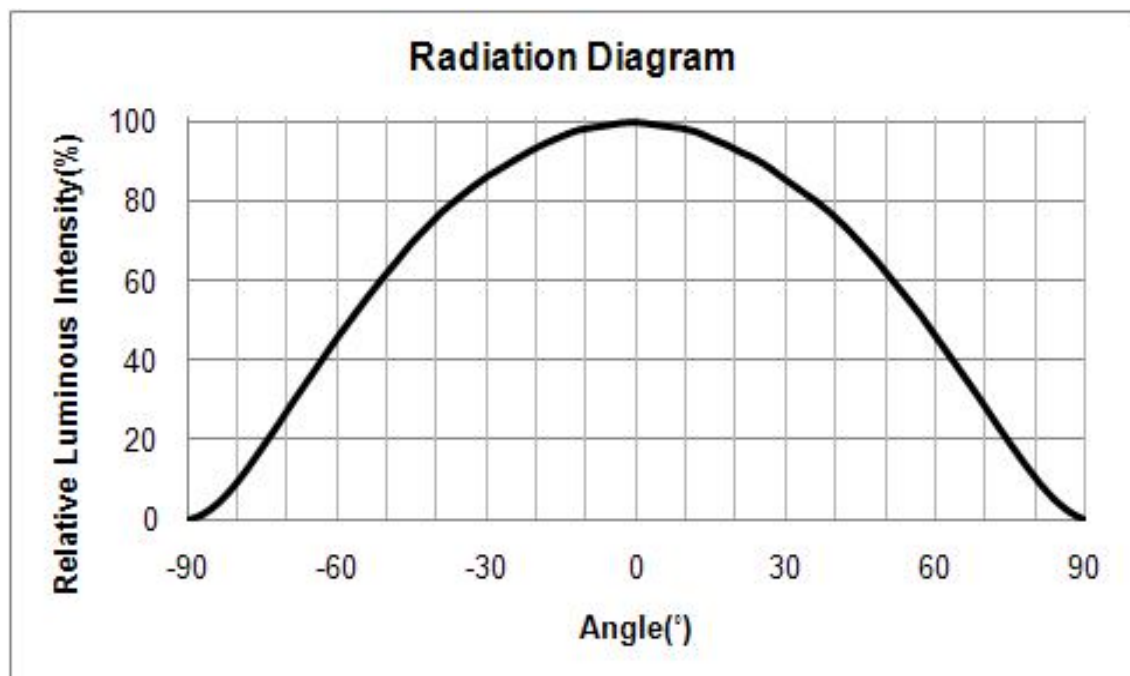
( $I_F = 65\text{mA}$ )



## 5) Derating Curve



## 6) Beam Angle Characteristics



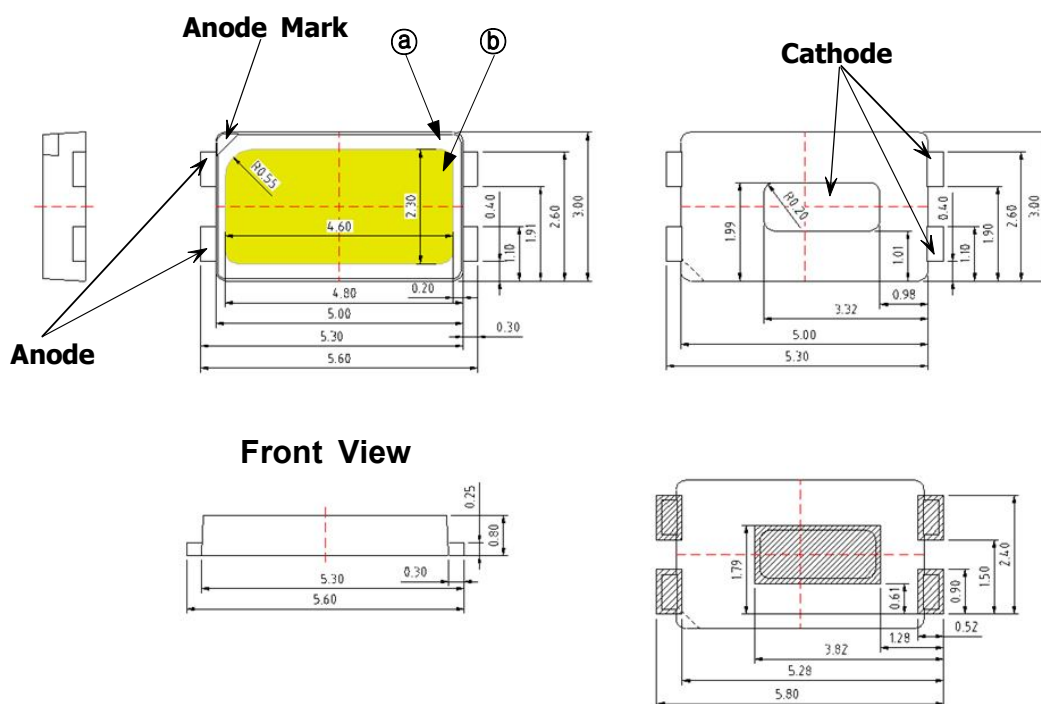
## 4. Outline Drawing & Dimension

1. Tolerance is  $\pm 0.10$  mm
2. The maximum compressing force is 15N on the body ①
3. Do not place pressure on the encapsulation resin ②

Left Side View

Top View

Bottom View



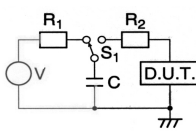
### Recommended Land Pattern

#### Notes:

- 1) This LED has built-in ESD protection device(s) connected in parallel to LED Chip(s).
- 2) Ts point & measurement method
  - ① Measure the nearest point to the thermal pad. If necessary, remove PSR of PCB to reach Ts point.
  - ② Thermal pad must be soldered to the PCB to dissipate heat properly. Otherwise, LED can be damaged.
- 3) 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.

## 5. Reliability Test Items and Conditions

### 1) Test Items

| Test Item                           | Test Conditions                                                                                | Test Hours/Cycles                                 | Sample No |   |
|-------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------|---|
| MSL Test                            | 125 °C 24hrs drying → 60 °C, 60 %RH 120hrs<br>→ 260 °C 10sec 3 cycles                          | 1 cycle                                           | 11        |   |
| Room Temperature life test          | 25 °C±3 °C, DC150 mA                                                                           | 1,000 hrs                                         | 22        |   |
| High Temperature life test          | 85 °C±3 °C, DC150 mA                                                                           | 1,000 hrs                                         | 22        |   |
| High Temperature humidity life test | 85 °C±3 °C, 85 %±2 %RH, DC150 mA                                                               | 1,000 hrs                                         | 22        |   |
| Low Temperature life test           | -40 °C±3 °C, DC150 mA                                                                          | 1,000 hrs                                         | 22        |   |
| Powered Temperature Cycle test      | -45°C/20 min ↔ 85°C/20 min, Sweep<br>100min cycle on/off: each 5 min, DC 150mA                 | 100 cycle                                         | 22        |   |
| Thermal Shock                       | -45 °C/15 min ↔ 125 °C/15 min<br>→ Hot plate 180 °C                                            | 500 cycle                                         | 100       |   |
| High Temperature Storage            | Ta=120 °C±3 °C                                                                                 | 1000 hrs                                          | 11        |   |
| Low Temperature Storage             | Ta=-40 °C±3 °C                                                                                 | 1000 hrs                                          | 11        |   |
| ESD(HBM)                            | <div></div> | R1:10 MΩ,<br>R2:1.5 kΩ,<br>C:100 pF,<br>V = ±5 kV | 5 times   | 5 |
| ESD(MM)                             |                                                                                                | R1:10 MΩ,<br>R2: 0,<br>C:200 pF,<br>V = ±0.5 kV   | 5 times   | 5 |
| Vibration Test                      | 20~2000~20 Hz 200 m/SZ, Sweep 4 min<br>X, Y, Z 3 direction, each 1 cycle                       | 4 cycles                                          | 11        |   |
| Mechanical Shock Test               | 1500G, 0.5 ms,<br>3 shocks each X-Y-Z axis                                                     | 5 cycles                                          | 11        |   |

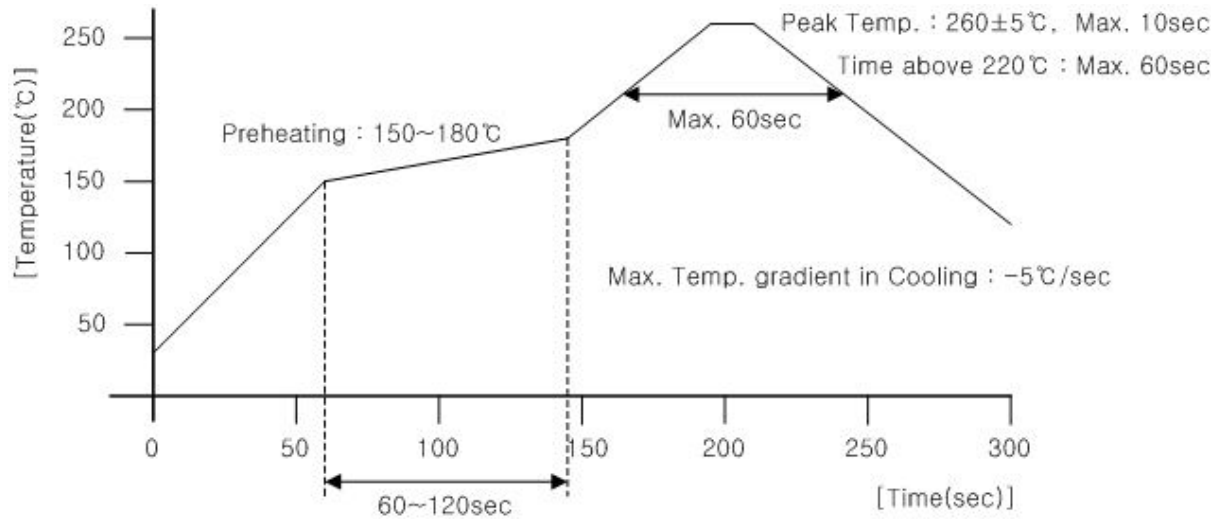
### 2) Criteria for Judging the Damage

| Item            | Symbol         | Test Condition         | Limit           |                 |
|-----------------|----------------|------------------------|-----------------|-----------------|
|                 |                |                        | Min             | Max             |
| Forward Voltage | V <sub>F</sub> | I <sub>F</sub> = 65 mA | Init. Value*0.9 | Init. Value*1.1 |
| Luminous Flux   | Φ <sub>v</sub> | I <sub>F</sub> = 65 mA | Init. Value*0.7 | Init. Value*1.2 |

## 6. Solder Conditions

### 1) Reflow Conditions ( Pb Free )

Reflow Frequency : 2 times max.



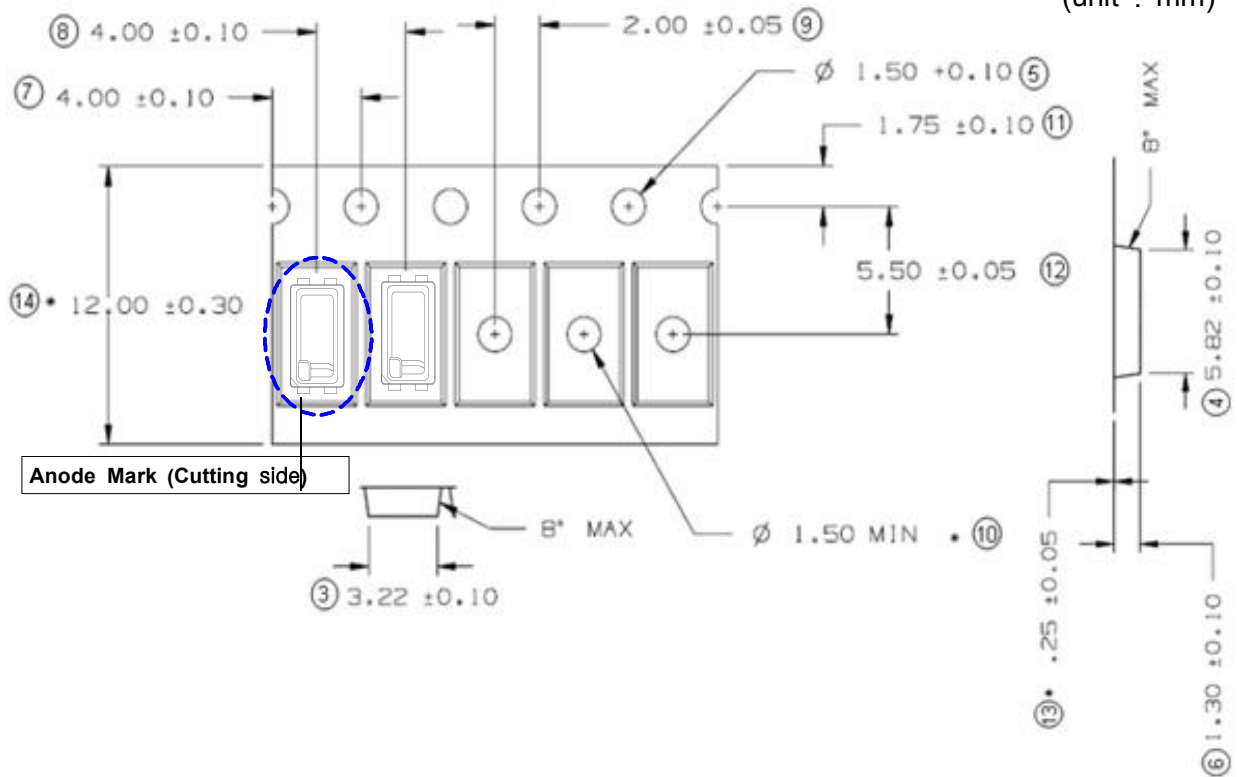
### 2) For Manual Soldering

Not more than 5 seconds @Max. 300°C, under soldering iron.

## 7. Tape & Reel

### 1) Taping Dimension

(unit : mm)



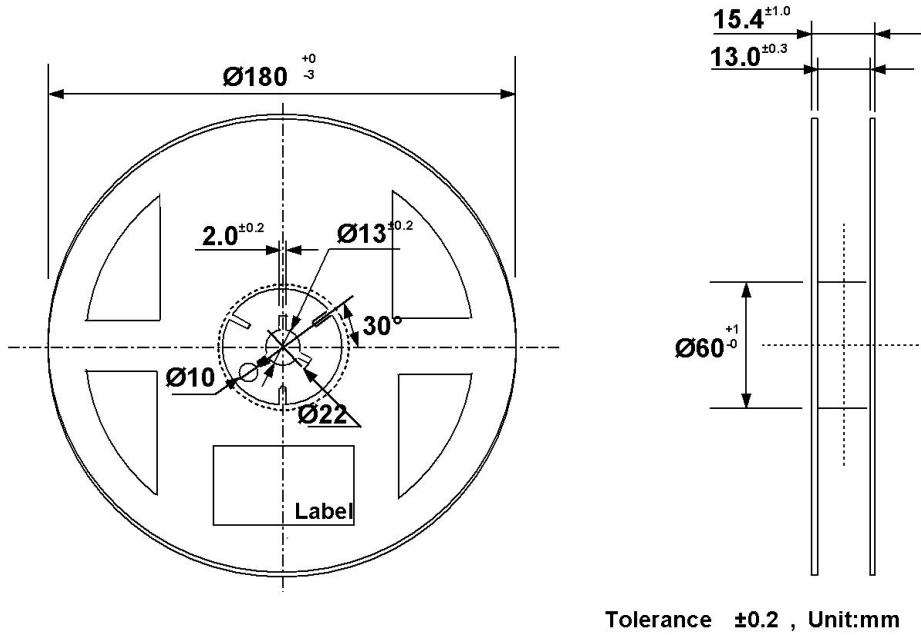
Tapping Direction



| End                              |                             |                                      | Start                           |
|----------------------------------|-----------------------------|--------------------------------------|---------------------------------|
| More than 500mm<br>Unloaded tape | Mounted with<br>LED package | More than 100~200mm<br>Unloaded tape | Leading part more than<br>500mm |

## 2) Reel

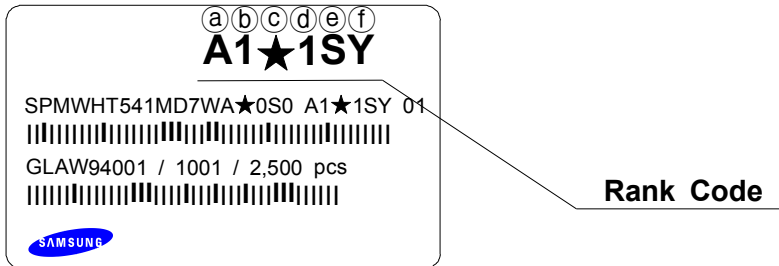
### 1) Reel Dimension (max 2,500 pcs)



- (1) Quantity : The quantity/Reel to be 2,500 pcs.
- (2) Cumulative Tolerance : Cumulative tolerance/10 pitches to be  $\pm 0.2$ mm
- (3) Adhesion Strength of Cover Tape : Adhesion strength to be 0.1-0.7N when the cover tape is turned off from the carrier tape at  $10^\circ\text{C}$  angle to be the carrier tape.
- (4) Packaging : P/N, Manufacturing data code no. and quantity to be indicated on a damp proof Package.

## 8. Label Structure

### 1) Label Structure



N.B) Denoted rank is the only example.

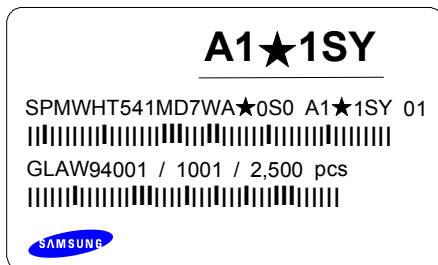
'★' means All kind of Chromaticity Coordinate Rank.

### Rank Code

- (a)(b) : Forward Voltage( $V_F$ ) Rank (refer to page. 7)
- (c)(d) : Chromaticity Coordinate Rank (refer to page. 5~6)
- (e)(f) : Luminous Flux( $\Phi_v$ , lm) Rank (refer to page. 3)

### 2) LOT Number

The Lot number is composed of the following characters



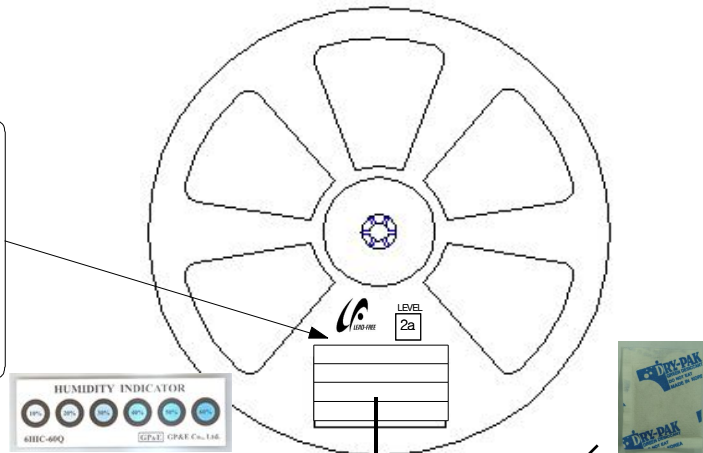
①②③④⑤⑥⑦⑧⑨ / 1(a)(b)(c) / 2,500 PCS

- ① : Production Site (S:SAMSUNG ELECTRONICS, G:TIAJIN 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 ELECTRONICS LED Product number (1 ~ 999)
- (a)(b)(c) : Reel Number (1 ~ 999)

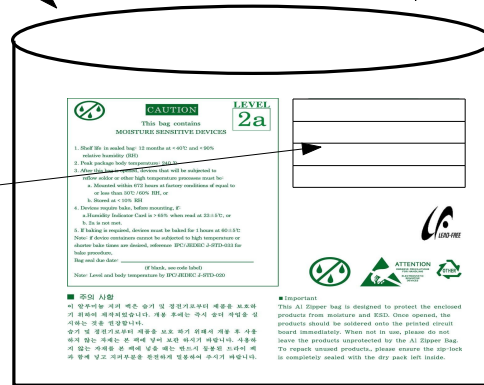
## 9. Packing Structure

### 1) Packing Process (The quantity of PKG on the Reel to be Max 2,500 pcs)

#### Reel



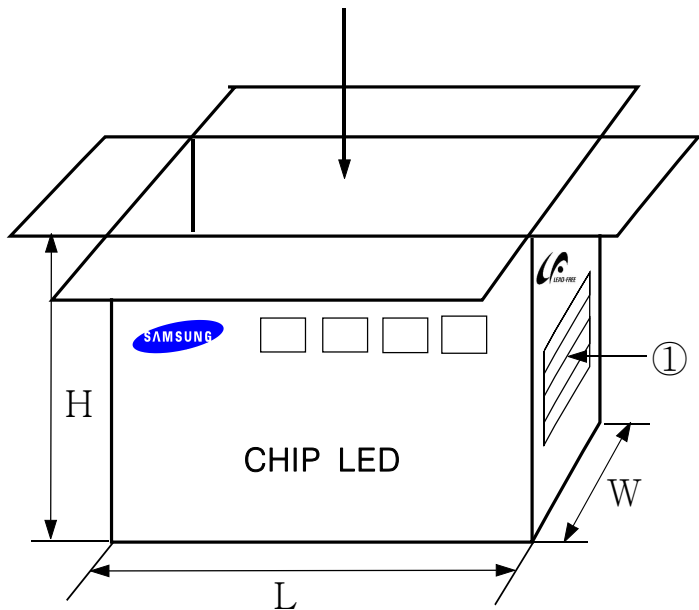
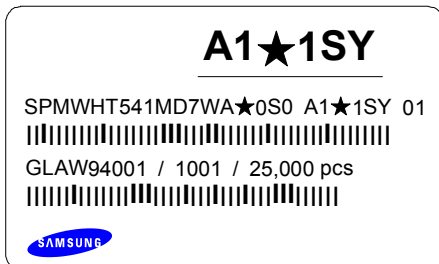
#### Aluminum Vinyl Bag



Material : Paper(SW3B(B))

| TYPE  | SIZE(mm) |       |       |
|-------|----------|-------|-------|
|       | L        | W     | H     |
| 7inch | 245±5    | 220±5 | 182±5 |

#### ① SIDE





## 10. Precaution for use

- 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 Samsung Electronics, 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 삼성전자로부터 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, 납땀이나 reflow 등의 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  $>60\%$  at  $23\pm5^{\circ}\text{C}$ .  
만약 습도표시카드의 수치가  $23\pm5^{\circ}\text{C}$ 에서  $60\%$  이상이라면, 제품 실장 전 baking해야 함.

8) Devices must be baked for 1 hour at  $60\pm5^{\circ}\text{C}$ , if baking is required.  
만약 baking이 필요하다면, 제품은  $60\pm5^{\circ}\text{C}$ 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) VOCs (volatile organic compounds) can be generated from adhesives, flux, hardener or organic additives used in luminaires (fixtures).

Transparent LED silicone encapsulant is permeable to those chemicals and they may lead a discoloration of encapsulant when they expose to heat or light.

VOCs(휘발성 유기 화합물)는 등기구에 사용되는 접착제, Flux, 경화제, 유기물 첨가제에서 발생하여 LED 실리콘 봉지제를 투과하고, 빛 또는 열에 노출되었을 때 변색이 발생 할 수 있음.

This phenomenon can cause a significant loss of light emitted(output) from the luminaires(fixture).

이러한 현상은 등기구로부터 나오는 빛의 중대한 손실을 줄 수 있음.

In order to prevent these problems, we recommend you to know the physical properties of the materials used in luminaires, They must be selected carefully.

이러한 문제 발생 방지를 위해서, 등기구에 사용되는 자재에 대한 물성을 알고 주의하여 선택 되어야함.

### 11) Risk of Sulfurization (or Tarnishing)

The LED from Samsung Electronics uses a silver-plated lead frame and its surface color may change to black(or dark colored) when it is exposed to sulfur(S), chlorine (Cl) or other halogen compound.

삼성전자의 LED는 Ag(은)을 도금한 리드프레임을 사용함. 이 리드프레임의 표면이 황(S), 염소(Cl), 또는 다른 할로겐 화합물들에 노출시 Ag(은)은 검정(또는 어두운색)으로 바뀔 수 있음.

Sulfurization of lead frame may cause intensity degradation, change of chromaticity coordinates and, in extreme cases, open circuit. It requires caution.

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

Due to possible sulfurization of lead frame, LED should not be used and stored together with oxidizing substances made of materials in a following list,  
: Rubber, plain paper, lead solder cream and so on.

리드 프레임 황화(Sulfurization)의 근원이 될 수 있으니 LED는 아래의 목록으로 만들어진 산화성 물질들과 함께 저장, 사용이 불가함 : 고무, 일반 종이, 납땜 크림 등



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|                    |                    |
|--------------------|--------------------|
| Sample No.         | : AYAA13-34757.001 |
| Sample Description | : 5630 G2 CRB0     |
| Item No./Part No.  | : N/A              |
| Materials          | : N/A              |

## Heavy Metals

| Test Item                   | 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.    |
| Antimony (Sb)               | mg/kg | With reference to EPA3052(1996), US EPA 6010B(1996), ICP | 10  | N.D.    |
| Arsenic (As)                | mg/kg | With reference to EPA3052(1996), US EPA 6010B(1996), ICP | 10  | N.D.    |
| Beryllium (Be)              | mg/kg | With reference to EPA3052(1996), US EPA 6010B(1996), ICP | 0.5 | N.D.    |

### Flame Retardants-PBBs/PBDEs

| Test item                | Unit  | Test Method                             | MDL | Results |
|--------------------------|-------|-----------------------------------------|-----|---------|
| Mondrobromobiphenyl      | 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.    |
| Mondbromodiphenyl 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.    |

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 Cr(VI) coating  
 Positive = Presence of Cr(VI) coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm<sup>2</sup> sample surface area.

[illegible]

**Test Report No.** F690101/LF-CTSA/AA13-34757

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Sample No. : AYAA13-34757.001

Sample Description : 5630 G2 CR190

Item No /Part No. : N/A

Materials : N/A

### Flame Retardants-P BBs/PBDEs

| Test item                | Unit  | Test Method                             | MDL | Results |
|--------------------------|-------|-----------------------------------------|-----|---------|
| 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.    |

### Halogen Content

| Test Item    | Unit  | Test Method           | MDL | Results |
|--------------|-------|-----------------------|-----|---------|
| Bromine(Br)  | mg/kg | BS EN 14582:2007 , IC | 30  | N.D.    |
| Chlorine(Cl) | mg/kg | BS EN 14582:2007 , IC | 30  | N.D.    |
| Fluorine(F)  | mg/kg | BS EN 14582:2007 , IC | 30  | 68      |
| Iodine(I)    | mg/kg | BS EN 14582:2007 , IC | 50  | N.D.    |

### Organotin Compounds

| Test Item                     | Unit  | Test Method         | MDL | Results |
|-------------------------------|-------|---------------------|-----|---------|
| Tributyltin (TBT)             | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |
| Triphenyltin (TPhT)           | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |
| Dibutyltin (DBT)              | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |
| Dioctyltin (DOT)              | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |
| Monobutyltin (MBT)            | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |
| Bis (tributyltin)oxide (TBTO) | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |
| Monooctyltin(MOT)             | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |
| Tetrabutyltin (TeBT)          | mg/kg | DIN 38407-13, GC/MS | 1   | N.D.    |

Other(s)

| Test Item                                               | Unit  | Test Method                | MDL | Results |
|---------------------------------------------------------|-------|----------------------------|-----|---------|
| PFOS (Perfluorooctane Sulfonates-Acid/Metal Salt/Amide) | mg/kg | US EPA3540 C/3550 C, LC/MS | 1   | N.D.    |

NOTE:

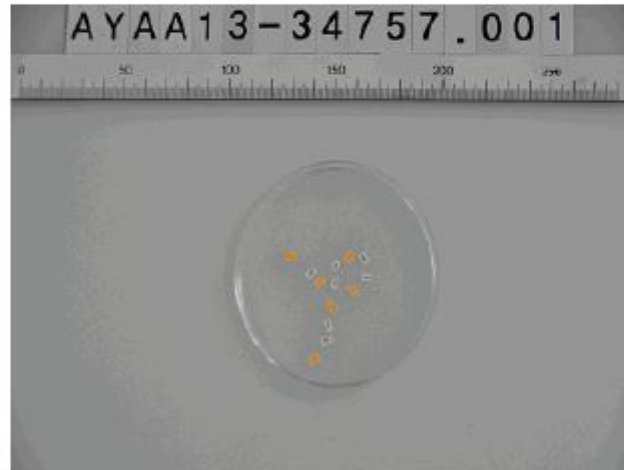
- (1) N.D. = Not detected.( $<MDL$ )  
(2) mg/kg = ppm  
(3) MDL = Method Detection Limit  
(4) - = No regulation  
(5) Negative = Undetectable / Positive = Detectable  
(6) \*\* = Qualitative analysis (No Unit)  
(7) \* = Boiling-water-extraction:  
Negative = Absence of Cr(VI) coating  
Positive =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

[illegible]

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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 cm<sup>2</sup> sample surface area.

[illegible]

838 Kure Co., Ltd.

522, The G valley, 555-2, Hoggae-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Korea 431-030  
 E-mail: joo@4.000.000 - 132 1061 4803 059 <http://www.janaboo.co.kr>, [www.janaboomusic.net](http://www.janaboomusic.net)

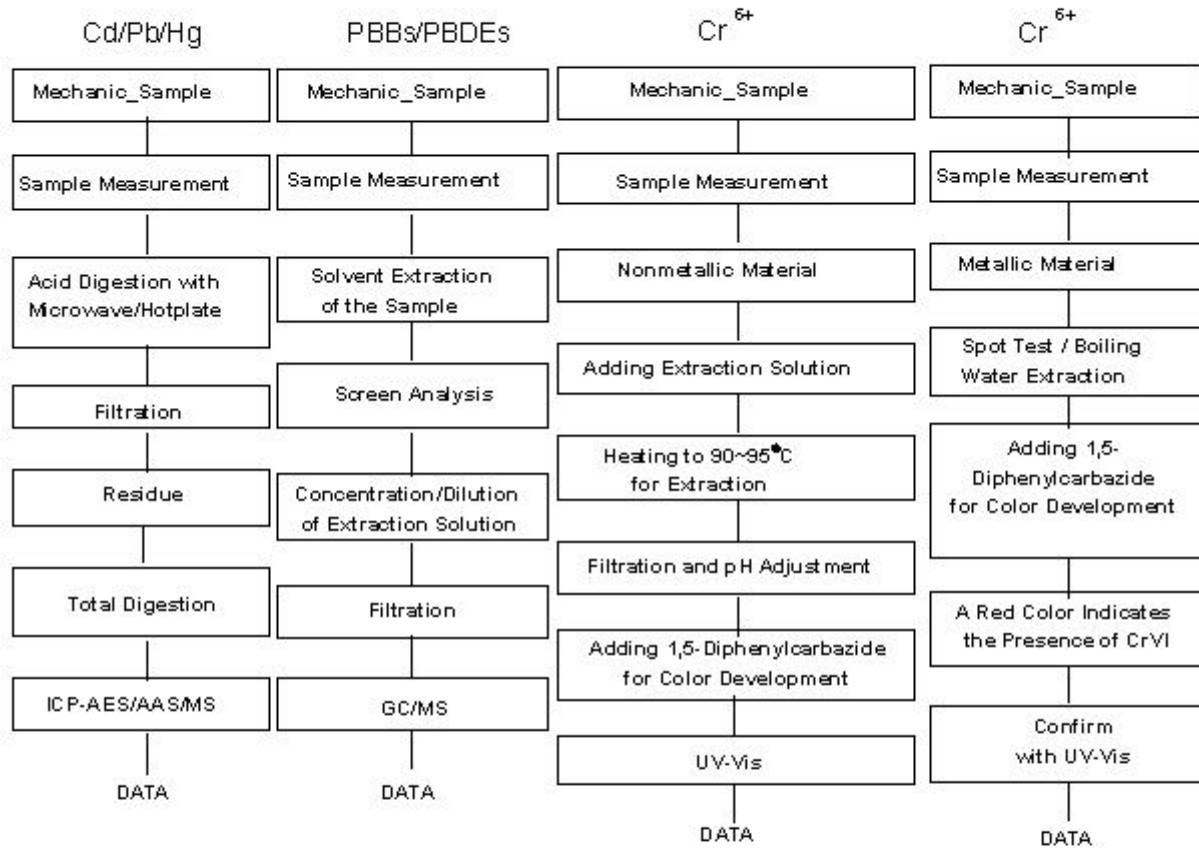
Members of the SCG Group Société Générale de Surveillance SA

FD-52 (Rev. 3-6-65)

**Test Report No.** F690101/LF-CTSA/A13-34757

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### Testing Flow Chart for RoHS:Cd/Pb/Hg/Cr<sup>6+</sup> /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 cm<sup>2</sup> sample surface area.

[illegible]

838 Korea Co., Ltd

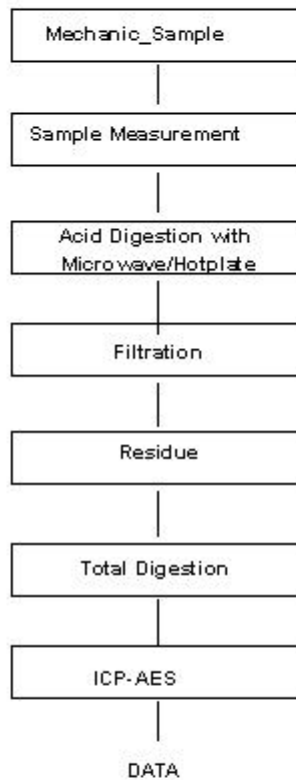
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FD-52 (Rev. 5-22-64)

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Issued Date: 2013. 07. 25      Page 6 of 7

## Inorganic Elements



(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 cm<sup>2</sup> sample surface area.

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graph TD
    A[Sample screening using XRF.] --> B{Liquid containing water(>80%)?}
    B -- Yes --> D[Dilute the solution (EPA300)]
    B -- No --> C[Weigh the samples into the combustion boat.]
    C --> E[Add absorption solution into the bomb or tube.]
    E --> F[Admit O2 gas or O2 + Ar2 gas and start the combustion.]
    F --> G[Allow during absorption of the burnt gas.]
    G --> H[Analyze absorbed solution using Ion Chromatography.]
    H --> I[Data]
    D --> I
    I --> J[*** End ***]
  
```

(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 cm<sup>2</sup> sample surface area.

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## 2) REACH (SVHC)



**Test Report No.** F690101/LF-CTSAYAA13-34756    **Issued Date:** 2013. 07. 25    **Page** 1 of 15

To. **SAMSUNG ELECTRONICS CO., LTD.**  
129 Samsung-ro  
Youngtong-gu  
Suwon-si  
Gyeonggi-do  
Korea

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

|                       |                                                                                                                                                                                                                                                         |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product Name</b>   | : 5630 G2 CR190                                                                                                                                                                                                                                         |
| <b>Item/Part Name</b> | : N/A                                                                                                                                                                                                                                                   |
| <b>SGS File No.</b>   | : AYAA13-34756                                                                                                                                                                                                                                          |
| <b>Received Date</b>  | : 2013. 07. 18                                                                                                                                                                                                                                          |
| <b>Test Period</b>    | : 2013. 07. 19 ~ 2013. 07. 25                                                                                                                                                                                                                           |
| <b>Test Performed</b> | : SGS Korea tested the sample(s) selected by applicant with following results                                                                                                                                                                           |
| <b>Test Requested</b> | : One hundred-forty four (144) substances in the Candidate List of Substances of Very High Concern (SVHC) for authorization published by European Chemicals Agency (ECHA) on June 20, 2013 regarding Regulation (EC) No 1907/2006 concerning the REACH. |
| <b>Test Method</b>    | : Please refer to next page(s).                                                                                                                                                                                                                         |
| <b>Test Result(s)</b> | : Please refer to next page(s).                                                                                                                                                                                                                         |

Timothy Jeon  
Cindy park  
Jinhee Kim  
Sophia Kim  
/Testing Person

SGS Korea Co., Ltd

Jeff Jang

Jeff Jang / Chemical Lab Mon

[illegible]

FD52 Version 5

YGG Kasei Co., Ltd.

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Member of the SEC Executive Council of Surveillance

**Test Method:**

SGS In-House method - Analyzed by ICP-OES, PLM, UVMS, LCMS, GCMS 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>  
This list is 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/comreach/documents/SGS-CTS\\_SVHC-paper-EN-11.pdf](http://webstage.contribute.sgs.net/comreach/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 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.

[illegible]

## Test Result(s)

| 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-ethylhexyl)phthalate (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<br>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 ( $\alpha$ -HBCDD, $\beta$ -HBCDD, $\gamma$ -HBCDD) | 25637-99-4<br>3194-55-6<br>(134237-51-7,<br>134237-50-6,<br>134237-52-8) | 247-148-4<br>221-695-9 | N.D.              | 0.05                | PBT                                             |
| Lead hydrogen arsenate*                                                                                                      | 7784-40-9                                                                | 232-064-2              | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction            |
| Sodium dichromate* (Sodium dichromate, dehydrate)                                                                            | 10588-01-9<br>(7789-12-0)                                                | 234-190-3              | N.D.              | 0.005               | Carcinogen<br>Mutagen<br>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 measurement by the Company is subject to the General Conditions of Service printed on the back of this report, available on request from [www.sgs.com](http://www.sgs.com). For substances listed in the table, the measurement is subject to the General Conditions of Service printed on the back of this report, available on request from [www.sgs.com](http://www.sgs.com). For substances listed in the table, the measurement is subject to the General Conditions of Service printed on the back of this report, available on request from [www.sgs.com](http://www.sgs.com). For substances listed in the table, the measurement is subject to the General Conditions of Service printed on the back of this report, available on request from [www.sgs.com](http://www.sgs.com).

FD52 Version 5

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## Page 4 of 15

| 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<br>Carcinogen              |
| Anthracene oil, anthracene paste; distr. Lights             | 91995-17-4 | 295-278-5 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Anthracene oil, anthracene paste, anthracene fraction       | 91995-15-2 | 295-275-9 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Anthracene oil, anthracene-low                              | 90640-82-7 | 292-604-8 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Anthracene oil, anthracene paste                            | 90640-81-6 | 292-603-2 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen<br>Mutagen   |
| Coal tar pitch, high temperature                            | 65996-93-2 | 266-028-2 | N.D.              | 0.05                | PBT; vPvB<br>Carcinogen              |
| Lead sulfochromate yellow (C.I. Pigment Yellow 34)*         | 1344-37-2  | 215-693-7 | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Lead chromate molybdate sulfate red (C.I. Pigment Red 104)* | 12656-85-8 | 235-759-9 | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Lead chromate*                                              | 7758-97-6  | 231-846-0 | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Acrylamide                                                  | 79-06-01   | 201-173-7 | N.D.              | 0.05                | Carcinogen<br>Mutagen                |

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## Page 5 of 15

| Substance Name                           | CAS number                           | EC number              | Concentration (%) | Reporting Limit (%) | Classification                                  |
|------------------------------------------|--------------------------------------|------------------------|-------------------|---------------------|-------------------------------------------------|
| Boric acid*                              | 10043-35-3<br>11113-50-1             | 233-139-2<br>234-343-4 | N.D.              | 0.005               | Toxic for Reproduction                          |
| Disodium tetraborate, anhydrous*         | 1330-43-4<br>12179-04-3<br>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<br>Mutagen<br>Toxic for Reproduction |
| Ammonium dichromate*                     | 7789-09-5                            | 232-143-1              | N.D.              | 0.005               | Carcinogen<br>Mutagen<br>Toxic for Reproduction |
| Potassium dichromate*                    | 7778-50-9                            | 231-906-6              | N.D.              | 0.005               | Carcinogen<br>Mutagen<br>Toxic for Reproduction |
| Potassium chromate*                      | 7789-00-6                            | 232-140-5              | N.D.              | 0.005               | Carcinogen<br>Mutagen                           |

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Membre du 1<sup>er</sup> SCC Groupement Général de Surveillance

| Substance Name                                                                                                                                                     | CAS number                   | EC number                   | Concentration (%) | Reporting Limit (%) | Classification                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------|-------------------|---------------------|--------------------------------------|
| Cobalt(II) sulphate*                                                                                                                                               | 10124-43-3                   | 233-334-2                   | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Cobalt(II) dinitrate*                                                                                                                                              | 10141-05-6                   | 233-402-1                   | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Cobalt(II) carbonate*                                                                                                                                              | 513-79-1                     | 208-169-4                   | N.D.              | 0.005               | Carcinogen<br>Toxic for Reproduction |
| Cobalt(II) diacetate*                                                                                                                                              | 71-48-7                      | 200-755-8                   | N.D.              | 0.005               | Carcinogen<br>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<br>Mutagen                |
| Acids generated from chromium trioxide and their oligomers:<br><br>Chromic acid<br>Dichromic acid<br><br>Oligomers of chromic acid and dichromic acid <sup>1</sup> | 7738-94-5<br>13530-68-2<br>- | 231-801-5<br>236-881-5<br>- | 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<br>Toxic for Reproduction |
| Hydrazine                                                                                                                                                          | 7803-57-8<br>302-01-2        | 206-114-9                   | N.D.              | 0.05                | Carcinogen                           |
| Strontium chromate*                                                                                                                                                | 7789-06-2                    | 232-142-6                   | N.D.              | 0.005               | Carcinogen                           |

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F052 Version 5

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| 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<br>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 diarsenate*                                                     | 3687-31-8                | 222-979-5  | N.D.              | 0.005               | Carcinogenic<br>Toxic for reproduction                                         |
| Zirconia Aluminosilicate Refractory Ceramic Fibres (Zr-RCF)*            | 650-017-00-8 (Index no.) | -          | N.D.              | 0.005               | Carcinogenic                                                                   |

Member of the SES Council, Comité de Surveillance

| Substance Name                                                                                                                            | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification         |
|-------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-------------------|---------------------|------------------------|
| 1,2-bis(2-methoxyethoxy) ethane (TEGDME; triglyme)                                                                                        | 112-49-2   | 203-977-3 | N.D.              | 0.05                | Toxic for reproduction |
| 1,2-dimethoxyethane; ethylene glycol dimethyl ether (E GDME)                                                                              | 110-71-4   | 203-794-9 | N.D.              | 0.05                | Toxic for reproduction |
| Diboron trioxide*                                                                                                                         | 1303-86-2  | 215-125-8 | N.D.              | 0.005               | Toxic for reproduction |
| Formamide                                                                                                                                 | 75-12-7    | 200-842-0 | N.D.              | 0.05                | Toxic for reproduction |
| Lead(II) bis(methanesulfonate)*                                                                                                           | 17570-76-2 | 401-750-5 | N.D.              | 0.005               | Toxic for reproduction |
| TGIC(1,3,5-tris(oxiranyl methyl)-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione)                                                                  | 2451-62-9  | 219-514-3 | N.D.              | 0.05                | Mutagenic              |
| β-TGIC (1,3,5-tris(2S and 2R)-2,3-epoxypropyl]-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione)**                                                  | 59653-74-6 | 423-400-0 | N.D.              | 0.05                | Mutagenic              |
| 4,4'-bis(dimethylamino) benzophenone (Michler's ketone)                                                                                   | 90-94-8    | 202-027-5 | N.D.              | 0.05                | Carcinogenic           |
| N,N,N',N'-tetramethyl-4,4'-methylenedianiline (Michler's base)                                                                            | 101-61-1   | 202-959-2 | N.D.              | 0.05                | Carcinogenic           |
| [4-[4,4'-bis(dimethylamino) benzhydrylidene]cyclohexa-2,5-dien-1-ylidene] dimethylammonium chloride (C.I. Basic Violet 3)                 | 548-62-9   | 208-953-6 | N.D.              | 0.05                | Carcinogenic           |
| [4-[[4-anilino-1-naphthyl][4-(dimethylamino)phenyl]methylene]cyclohexa-2,5-dien-1-ylidene] dimethylammonium chloride (C.I. Basic Blue 26) | 2580-56-5  | 219-943-6 | N.D.              | 0.05                | Carcinogenic           |
| α,α-Bis[4-(dimethylamino) phenyl]-4 (phenylamino) naphthalene-1-methanol (C.I. Solvent Blue 4)                                            | 6786-83-0  | 229-851-8 | N.D.              | 0.05                | Carcinogenic           |
| 4,4'-bis(dimethylamino)-4''-(methylamino)trityl alcohol                                                                                   | 561-41-1   | 209-218-2 | N.D.              | 0.05                | Carcinogenic           |

[illegible]

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| Substance Name                                                                                                                                                                                                                                                                     | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-------------------|---------------------|---------------------------------------------------------------------------|
| Bis(pentabromophenyl) ether (DecaBDE)                                                                                                                                                                                                                                              | 1163-19-5  | 214-604-9 | N.D.              | 0.05                | PBT<br>vP vB                                                              |
| Pentacosafuorotridecanoic acid                                                                                                                                                                                                                                                     | 72629-94-8 | 276-745-2 | N.D.              | 0.05                | vP vB                                                                     |
| Tricosafuorododecanoic acid                                                                                                                                                                                                                                                        | 307-55-1   | 206-203-2 | N.D.              | 0.05                | vP vB                                                                     |
| Henicosafuoroundecanoic acid                                                                                                                                                                                                                                                       | 2058-94-8  | 218-165-4 | N.D.              | 0.05                | vP vB                                                                     |
| Heptacosafuorotetradecanoic acid                                                                                                                                                                                                                                                   | 376-06-7   | 206-803-4 | N.D.              | 0.05                | vP vB                                                                     |
| 4-(1,1,3,3-tetramethylbutyl) phenol, ethoxylated - covering well-defined substances and UVCB substances, polymers and homologues                                                                                                                                                   | -          | -         | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on the environment |
| 4-Nonylphenol, branched and linear – substances with a linear and/or branched alkyl chain with a carbon number of 9 covalently bound in position 4 to phenol, covering also UVCB- and well-defined substances which include any of the individual isomers or a combination thereof | -          | -         | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on the environment |
| Diazene-1,2-dicarboxamide (C,C'-azodi(formamide))                                                                                                                                                                                                                                  | 123-77-3   | 204-650-8 | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on human health    |
| Cyclohexane-1,2-dicarboxylic anhydride (Hexahydrophthalic anhydride - HHPA)                                                                                                                                                                                                        | 85-42-7    | 201-604-9 | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on human health    |

[illegible]

| Substance Name                                                                                                                                      | CAS number                                     | EC number                                  | Concentration (%) | Reporting Limit (%) | Classification                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------|-------------------|---------------------|------------------------------------------------------------------------------------------------------------------|
| Hexahydromethylphthalic anhydride, Hexahydro-4-methylphthalic anhydride, Hexahydro-1-methylphthalic anhydride, Hexahydro-3-methylphthalic anhydride | 25550-51-0, 19438-60-9, 48122-14-1, 57110-29-9 | 247-094-1, 243-072-0, 256-356-4, 260-566-1 | N.D.              | 0.05                | Equivalent level of concern - probable serious effects on human health                                           |
| Methoxy acetic acid                                                                                                                                 | 625-45-6                                       | 210-894-6                                  | N.D.              | 0.05                | Toxic for reproduction equivalent level of concern -probable serious effects on human health and the environment |
| 1,2-Benzenedicarboxylic acid, dipentylester, branched and linear                                                                                    | 84777-06-0                                     | 284-032-2                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| Diisopentylphthalate (DIPP)                                                                                                                         | 605-50-5                                       | 210-088-4                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| N-pentyl-isopentylphthalate                                                                                                                         | -                                              | -                                          | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| 1,2-Diethoxyethane                                                                                                                                  | 629-14-1                                       | 211-076-1                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| N,N-dimethylformamide; dimethyl formamide                                                                                                           | 68-12-2                                        | 200-679-5                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| Dibutyltin dichloride (DBT)                                                                                                                         | 683-18-1                                       | 211-670-0                                  | N.D.              | 0.05                | Toxic for reproduction                                                                                           |
| Acetic acid, lead salt, basic*                                                                                                                      | 51404-69-4                                     | 257-175-3                                  | N.D.              | 0.005               | Toxic for reproduction                                                                                           |
| Basic lead carbonate (trilead bis(carbonate)dihydroxide)*                                                                                           | 1319-46-6                                      | 215-290-6                                  | 0.0081            | 0.005               | Toxic for reproduction                                                                                           |
| Lead oxide sulfate (basic lead sulfate)*                                                                                                            | 12036-76-9                                     | 234-853-7                                  | 0.0083            | 0.005               | Toxic for reproduction                                                                                           |
| [Phthalato(2-)]dioxotrilead (dibasic lead phthalate)*                                                                                               | 69011-06-9                                     | 273-688-5                                  | 0.0086            | 0.005               | Toxic for reproduction                                                                                           |

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| Substance Name                         | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification         |
|----------------------------------------|------------|-----------|-------------------|---------------------|------------------------|
| Dioxobis(stearato)trilead*             | 12578-12-0 | 235-702-8 | 0.0128            | 0.005               | Toxic for reproduction |
| Fatty acids, C16-18, lead salts*       | 91031-62-8 | 292-966-7 | 0.0243            | 0.005               | Toxic for reproduction |
| Lead bis(tetrafluoroborate)*           | 13814-96-5 | 237-486-0 | 0.012             | 0.005               | Toxic for reproduction |
| Lead cyanamidate*                      | 20837-86-9 | 244-073-9 | 0.0078            | 0.005               | Toxic for reproduction |
| Lead dinitrate*                        | 10099-74-8 | 233-245-9 | 0.0104            | 0.005               | Toxic for reproduction |
| Lead oxide (lead monoxide)*            | 1317-36-8  | 215-267-0 | 0.0070            | 0.005               | Toxic for reproduction |
| Lead tetroxide (orange lead)*          | 1314-41-6  | 215-235-6 | 0.0072            | 0.005               | Toxic for reproduction |
| Lead titanium trioxide*                | 12060-00-3 | 235-038-9 | 0.0095            | 0.005               | Toxic for reproduction |
| Lead Titanium Zirconium Oxide*         | 12626-81-2 | 235-727-4 | N.D.              | 0.005               | Toxic for reproduction |
| Pentalead tetraoxide sulphate*         | 12065-90-6 | 235-067-7 | 0.0075            | 0.005               | Toxic for reproduction |
| Pyrochlore, antimony lead yellow*      | 8012-00-8  | 232-382-1 | N.D.              | 0.005               | Toxic for reproduction |
| Silicic acid, barium salt, lead-doped* | 68784-75-8 | 272-271-5 | N.D.              | 0.005               | Toxic for reproduction |
| Silicic acid, lead salt*               | 11120-22-2 | 234-363-3 | 0.0089            | 0.005               | Toxic for reproduction |
| Sulfurous acid, lead salt, dibasic*    | 62229-08-7 | 263-467-1 | 0.0083            | 0.005               | Toxic for reproduction |
| Tetraethyllead*                        | 78-00-2    | 201-075-4 | N.D.              | 0.005               | Toxic for reproduction |
| Tetralead trioxide sulphate*           | 12202-17-4 | 235-380-9 | 0.0076            | 0.005               | Toxic for reproduction |

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| Substance Name                                     | CAS number  | EC number | Concentration (%) | Reporting Limit (%) | Classification            |
|----------------------------------------------------|-------------|-----------|-------------------|---------------------|---------------------------|
| Trilead dioxide phosphonate*                       | 12141-20-7  | 235-252-2 | N.D.              | 0.005               | Toxic for reproduction    |
| Furan                                              | 110-00-9    | 203-727-3 | N.D.              | 0.05                | Carcinogenic              |
| Propylene oxide; 1,2-epoxypropane; methyloxirane   | 75-56-9     | 200-879-2 | N.D.              | 0.05                | Carcinogenic<br>Mutagenic |
| Diethyl sulphate                                   | 64-67-5     | 200-589-6 | N.D.              | 0.05                | Carcinogenic<br>Mutagenic |
| Dimethyl sulphate                                  | 77-78-1     | 201-058-1 | N.D.              | 0.05                | Carcinogenic              |
| 3-ethyl-2-methyl-2-(3-methylbutyl)-1,3-oxazolidine | 143860-04-2 | 421-150-7 | N.D.              | 0.05                | Toxic for reproduction    |
| Dinoseb                                            | 88-85-7     | 201-861-7 | N.D.              | 0.05                | Toxic for reproduction    |
| 4,4'-methylenedi-o-toluidine                       | 838-88-0    | 212-658-8 | N.D.              | 0.05                | Carcinogenic              |
| 4,4'-oxydianiline and its salts                    | 101-80-4    | 202-977-0 | N.D.              | 0.05                | Carcinogenic<br>Mutagenic |
| 4-Aminoazobenzene;<br>4-Phenylazoaniline           | 60-09-3     | 200-453-6 | N.D.              | 0.05                | Carcinogenic              |
| 4-methyl-m-phenylenediamine (2,4-toluene-diamine)  | 95-80-7     | 202-453-1 | N.D.              | 0.05                | Carcinogenic              |
| 6-methoxy-m-toluidine (p-cresidine)                | 120-71-8    | 204-419-1 | N.D.              | 0.05                | Carcinogenic              |
| Biphenyl 4-ylamine                                 | 92-67-1     | 202-177-1 | N.D.              | 0.05                | Carcinogenic              |
| o-aminoazotoluene                                  | 97-56-3     | 202-591-2 | N.D.              | 0.05                | Carcinogenic              |
| o-Toluidine; 2-Aminotoluene                        | 95-53-4     | 202-429-0 | N.D.              | 0.05                | Carcinogenic              |
| N-methylacetamide                                  | 79-16-3     | 201-182-6 | N.D.              | 0.05                | Toxic for reproduction    |
| 1-bromopropane;<br>n-propyl bromide                | 106-94-5    | 203-445-0 | N.D.              | 0.05                | Toxic for reproduction    |

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| Substance Name                                                                                                                                                                                                                                                                                                                      | CAS number | EC number | Concentration (%) | Reporting Limit (%) | Classification                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|-------------------|---------------------|--------------------------------------------------------------------------------|
| Cadmium                                                                                                                                                                                                                                                                                                                             | 7440-43-9  | 231-152-8 | N.D.              | 0.005               | Carcinogenic                                                                   |
| Cadmium oxide                                                                                                                                                                                                                                                                                                                       | 1306-19-0  | 215-146-2 | N.D.              | 0.005               | Carcinogenic                                                                   |
| Dipentyl phthalate (DPP)                                                                                                                                                                                                                                                                                                            | 131-18-0   | 205-017-9 | N.D.              | 0.05                | Toxic for reproduction                                                         |
| 4-Nonylphenol, branched and linear, ethoxylated [substances with a linear and/or branched alkyl chain with a carbon number of 9 covalently bound in position 4 to phenol, ethoxylated covering UVCB- and well-defined substances, polymers and homologues, which include any of the individual isomers and/or combinations thereof] | -          | -         | N.D.              | 0.05                | Equivalent level of concern having probable serious effects to the environment |
| Ammonium pentadecafluorooctanoate (APFO)                                                                                                                                                                                                                                                                                            | 3825-26-1  | 223-320-4 | N.D.              | 0.05                | Toxic for reproduction                                                         |
| Pentadecafluorooctanoic acid (PFOA)                                                                                                                                                                                                                                                                                                 | 335-67-1   | 206-397-9 | N.D.              | 0.05                | Toxic for reproduction                                                         |

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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>

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](http://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

5. <sup>aa</sup>.β-TGIC is one of the isomers for TGIC compounds and hence, tested together. The reported test result is based the proposed ratio as according to ECHA dossier.



\*\*\* End of Report \*\*\*

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

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Carcinogen<br>Category 1:               | <u>Substances known to be carcinogenic to man.</u> There is sufficient evidence to establish a causal association between human exposure to a substance and the development of cancer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Carcinogen<br>Category 2:               | <u>Substances which should be regarded as if they are carcinogenic to man.</u> There is sufficient evidence to provide a strong presumption that human exposure to a substance may result in the development of cancer.<br>Generally on the basis of:<br>- appropriate long-term animal studies<br>- other relevant information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Mutagen<br>Category 1:                  | <u>Substances known to be mutagenic to man.</u> There is sufficient evidence to establish a causal association between human exposure to a substance and heritable genetic damage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Mutagen<br>Category 2:                  | <u>Substances which should be regarded as if they are mutagenic to man.</u> 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:<br>- appropriate animal studies,<br>- other relevant information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Toxic to<br>Reproduction<br>Category 1: | <u>Substances known to impair fertility in humans.</u> There is sufficient evidence to establish a causal relationship between human exposure to the substance and impaired fertility.<br><u>Substances known to cause developmental toxicity in humans.</u> 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<br>Reproduction<br>Category 2: | <u>Substances which should be regarded as if they impair fertility in humans.</u> There is sufficient evidence to provide a strong presumption that human exposure to the substance may result in impaired fertility on the basis of:<br>- 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,<br>- other relevant information.<br><u>Substances which should be regarded as if they cause developmental toxicity to humans.</u> 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:<br>- 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,<br>- 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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|------------------|
| Revision History |
|------------------|

| Date         | No. | Revision History | Writer   |          |
|--------------|-----|------------------|----------|----------|
|              |     |                  | Drawn    | Approved |
| 2013. 11. 07 | 01  | New Version      | W.H Jung | S.B Yun  |
|              |     |                  |          |          |
|              |     |                  |          |          |
|              |     |                  |          |          |
|              |     |                  |          |          |