ISA Recommendation

Performance Requirements for LED Road Lighting Products in Cold Region

SN: ISA-S-0004-2016

2016-11-17

International Solid State Lighting Alliance

Technical Committee on Standardization

Contents

Introduction

As one of the essential parts in a modern city, LED road lighting products are required to produce uniform and bright light when needed, such as the night, cloudy days. However, their work performance is significantly by the local usage environment. In the cold and super-cold region, in addition to the common failures such as the lumen decay and color shift, problems including the extreme embrittlement, icicles, icy haze/fog and tin pest also appear occasionally in the LED road lighting products. Accordingly, specific performance requirements should be addressed and adapted for the detection of these failures.

In order to guide and promote the application and development of the LED road lighting products in cold region, this standard specifies performance requirements combining with current city road lighting norms. For ensuring a long period of stable work, the specified performance requirements include the product classification, basic optical characteristics such as initial luminous flux, initial luminous efficacy, and luminous flux maintenance, electrical and mechanical safety requirements; radio disturbance characteristics, and the test methods and marks.

The proposed standard is applicable to the design, production and usage of the LED road lighting products in cold region. Furthermore, it also has important significance on standardizing and guiding the application and development of LED road lighting technologies in cold region.

Proposed definitions

LED Road Lighting Products in Cold Region
All-weather LED road lighting products that are able to work properly in cold region below - 20℃.

Rated Value
The parameter value of the LED road lighting product under specified operating conditions, which is specified by the manufacturer or responsible vendor.

Rated Luminous Flux
The rated value of the luminous flux of the LED road lighting product, which is specified by the manufacturer or responsible vendor.

Rated Color Temperature
The rated value of the correlated color temperatures (CCT) of the LED road lighting product, which is specified by the manufacturer or responsible vendor.

Initial Value
The parameter value of the LED road lighting products measured at steady working

state after 1000h (hours) seasoning.

Initial Luminous Flux
The initial value of the luminous flux of the LED road lighting product. unit: lumen *(Lm)*.

Initial Luminous Efficiency
The initial value of the luminous efficiency of the LED road lighting product. unit: *lm/W*.

Initial Color Rendering Index
The initial value of the general color rendering index Ra of the LED road lighting product.

Initial Color
The initial values of the color characteristics of the LED road lighting product, including the CIE 1976 of color coordinates (u', v') and the correlated color temperature (CCT).

Luminous Flux Maintenance Rate
The value of the luminous flux at a given time divided by the initial luminous flux, and expressed in a percentage.

Proposed technical requirements

1 General technical requirements

1.1 Working environment

According to the ambient temperature range in which the luminaire and power supply controller are able to light up normally, and operate properly, the LED road lighting products in cold region are classified into the following two categories:

A: able to light up normally under the condition of - 40℃～+40℃, and operate properly under the condition of -50℃～+40℃;

B: able to light up normally under the condition of -20℃～+40℃, and operate normally under the condition of -30℃～+40℃.

1.2 Normal working conditions

The rated voltage of the LED road lighting product in cold region is AC 220V/50Hz, ranging from AC 187V to AC 242V.

The LED road lighting product should be able to light up normally within the input voltage range, and the illuminance values measured at a specified distance under power conditions of the highest voltage (AC 242V),the lowest voltage (AC 220V) after 1 hour steady operation differ less than 10%.

1.3 Appearance

The surface of the LED road lighting product in cold region shall be smooth and flattening in order to prevent accumulation of dust, and snow, so avoid the formation of icicles.

2 Requirements for photoelectric properties

2.1 Initial luminous flux

The initial luminous flux of the LED road lighting products in cold region shall neither be less than 90% nor more than 120% of the rated luminous flux.

2.2 Initial luminous efficiency

The initial luminous efficiency shall not be less than the specified values in Table 1.

Table 1- Requirement for the Initial Luminous Efficiency of the LED Road Lighting Products in Cold Region

Rated CCT(K)	**CCT≤3500**	**3500＜CCT≤6500**
Initial luminous efficiency shall not be less than (lm/W)	80	90

2.3 Correlated color temperature

The rated correlated color temperature of the LED road lighting product in cold region shall not be more than 6500K with the increment of 100K.

The initial correlated color temperature shall conform to the rated color temperature specified by the manufacturer or responsible vendor, and the maximum deviation (ΔT) between the initial color temperature and the rated color temperature (T) meets the following requirements:

$\Delta T=0.0000108\times T^2+0.0262\times T+8$

2.4 Initial color rendering index

The initial color rendering index (Ra) of the LED road lighting product in cold region shall not be less than 65.

2.5 Luminous flux maintenance rate

Luminous flux maintenance rate of the LED road lighting product in cold region should not be less than 96% after 3000 hours of lighting.

NOTE: The luminous flux maintenance rate is calculated from the life time of 3000 hours with a slight relaxation, according to relevant literature.

2.6 Luminance distribution

The luminance distribution of the LED road lighting product in cold region shall comply

with the standard values for road lighting specified in CJJ45. The light interception performance, light distribution type and light luminous intensity table shall be marked by the manufacturer.

2.7 Power

The actually measured power of the LED road lighting product in cold region shall not be higher than 110% of its rated power.

2.8 Power factor

The power factor of the LED road lighting product in cold region shall not be less than 0.95.

2.9 Number of power cycles

Taking a 30s-on and 30s-off cycle as a power cycle, the LED road lighting product in cold region shall pass 15000 power cycles.

3 Safety requirements

The LED road lighting products in cold region shall comply with the safety requirements of the GB 7000.5-200 and GB 7000.1.

4 Requirements for electromagnetic compatibility (EMC)

4.1 Radio interference Performance

The radio interference performance of the LED road lighting product in cold region shall comply with the requirements of GB 17743-2007.

4.2 EMC anti-interference performance

The EMC anti-interference performance of the LED road lighting product in cold region shall comply with the requirements of GB/T 18595-2001.

4.3 Harmonic current

The harmonic current of the LED road lighting product in cold region shall comply with the requirements of GB 17625.1-2012.

5 Requirements for ingress protection

The ingress protection of the LED road lighting product in cold region shall reach at least IP65.

6 Requirements for vibration resistance

The LED road lighting products in cold region shall pass the vibration test specified in Article 4.20 of GB 7000.1-2007 and shall continue to work properly after the test.

Proposed Test methods

1 Working environment

Implement as the following specifications.

1.1 Adaptability

This test aims to determine the resistance capability and working capability to temperature change of the LED road lighting product in cold region.

1.2 Test equipment

High-low temperature test chamber or multi-functional climate test chamber.

1.3 Test conditions

1.3.1 The optical properties, dust-proof and water-proof performance, and resistance to tin pest of the test sample shall be examined before and after the test.

1.3.2 A full air circulation shall be guaranteed in the test chamber, and the velocity of the air flow around the test sample shall not be more than 2m/s.

1.3.3 The distance between the surface of the test sample and test chamber wall be more than 200mm.

1.4 High-low temperature cycling test

1.4.1 Place the test sample into the installation position of the test chamber.

1.4.2 The test sample shall be tested under the low-high temperature cycle 5 times. As shown in Figure 1, each cycle shall last for 5 hours (h).In summary:

Test cycle: 5 times;

Each cycle period: 5 hours;

Temperature curve: specified in Figure 1;

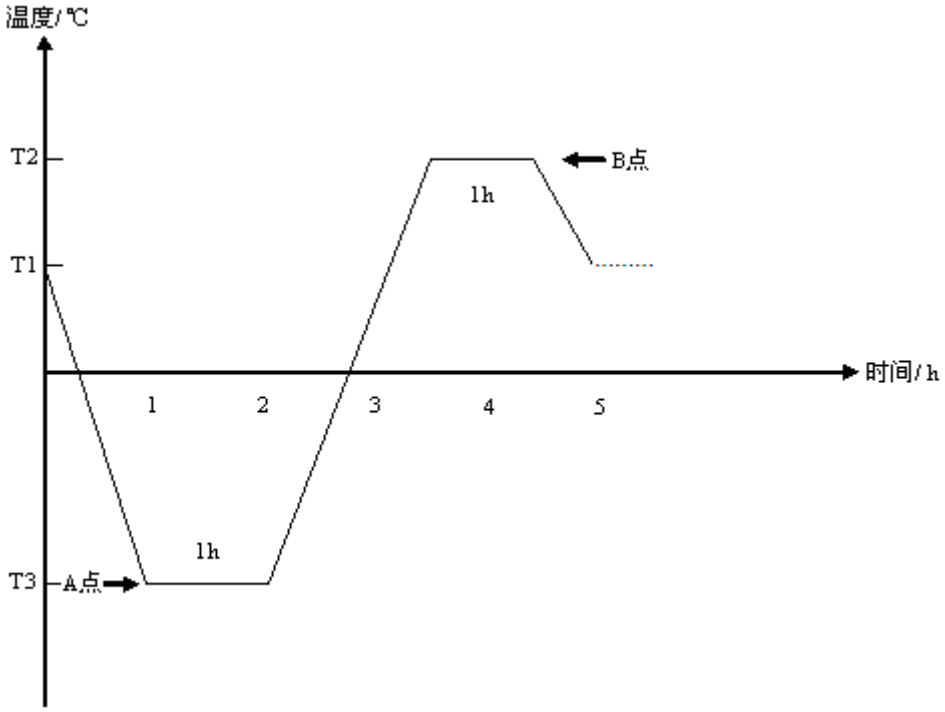

Figure1- Temperature-Time Curve of low-high temperature cycling test for the LED Road Lighting Products

Temperature ramp rate: 0.5℃／min~4.0℃／min;

Initial temperature (T1): 20℃;

Low temperature (T3): A: -40℃, maintain for 1 hour; B: -20℃, maintain for 1 hour;

High temperature (T2): 40℃, maintain for 1 hour;

Power-on mode: powered on from point “A” to point “B” as shown in Figure 1;

Test voltage: AC 220V±10%.

1.4.3 When the test is completed, take the test sample out of the test chamber, and recover at rom temperature (i.e. 23℃±5℃) and relative humidity of 20%～75% RH for hour.

1.5 Judgment

1.5.1 Visually inspect the optical lens and reflector of the test sample for deformation and blistering;

1.5.2 Visually inspect all solders of the test sample to ensure there is no crack ;

1.5.3 The IP grade of the test sample should reach at least IP65;

1.5.4 The optical properties of the test sample should meet the requirements of Article 5.2 in this standard.

2 Photoelectric properties

2.1 Initial luminous flux

The test should be conducted according to the method specified in Article 6.3 of CSA 001-2009.

2.2 Initial luminous efficiency

The test should be conducted according to the method specified in Article 6.3 of CSA 001-2009.

2.3 Correlated color temperature

The test should be conducted according to the method specified in Article 6.6 of CSA 001-2009.

2.4 Initial color rendering index

The test should be conducted according to the method specified in Article 6.6 of CSA 001-2009.

2.5 Luminous flux maintenance rate

The test should be conducted according to the method specified in Article 6.10 of CSA 001-2009.

2.6 Luminance distribution

The test should be conducted according to the method specified in GB/T 9468.

2.7 Power

The test should be conducted according to the method specified in Article 6.1 of CSA 001-2009.

2.8 Power factor

The test should be conducted according to the method specified in Article 6.1 of CSA 001-2009.

2.9 Number of power cycles

The test should be conducted according to the method specified in Article 5.5 of GB/T 24824.

3 Electromagnetic compatibility

3.1 Radio interference performance

The test should be conducted according to the method specified in GB 17743-2007.

3.2 EMC anti-interference performance

The test should be conducted according to the method specified in GB/T 18595-2001.

3.3 Harmonic current

The test should be conducted according the method specified in the GB 17625.1-2003.

4 Ingress protection

The test should be conducted according to the method specified in Article 9.2 of GB 7000.1-2007.

5 Vibration resistance

The test should be conducted according to the method specified in Article 4.20 of GB 7000.1-2007.