

ISA Recommendation



Interface Requirements for Application of LED Lighting: Street Light Consisting of LED Module with Heatsink and Separated Control Gear

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International Solid State Lighting Alliance
Technical Committee on Standardization

This recommendation is prepared by ISA Technical Committee on Standardization
Working Group M2:

“Research on the interface requirements for application of LED lighting”

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Introduction

LED light sources have been extensively implemented in the field of street lighting. Enormous variety and flexibility of LED lighting sources provide many choices for designers. However, the great variety of products becomes a formidable barrier to standardization. Meanwhile, the mismatch of interfaces and specifications creates problems with production delay, customer adoption, and slow market proliferation. Subsequently, there may be difficulties with maintenance or even complete lamp failure caused by partial failure between individual components.

In order to meet the aims of conformity, market standardization, component interchangeability, simplified maintenance, and cost effectiveness, the China Solid State Lighting Alliance (CSA) has issued this LED lighting interfaces recommendation to alleviate the present contradictions between technical innovation and high volume production.

At present, modularization design becomes an important trend for street light based on the consideration of replacement, maintenance and stock. However, modules made by different manufacturers prevent the development of products from interchangeability or compatibility. Therefore, with demand of manufacturers, this specification for street light is compiled by integrating the parameters of photometric, mechanical, electrical and thermal properties to define the interfaces of LED modularization. It will be the reference for R&D, production and actual application to ensure the realization of interchangeability.

Proposed definitions

LED Street light

an integrated LED light fixture that meets the requirement of street lighting. In addition to using a LED as a light source, a LED street light may also contain other parts such as the optical, mechanical, electrical and electronic components to be combined to form an integrated fixture.

LED module

unit supplied as a light source that is interchangeable. In addition to one or more LEDs, it may contain mechanical, optical, electrical, and thermal components.

NOTE: In this standard, LED module is applied to street light.

luminaire

apparatus provides an adaptive working circumstances for one or more LED modules.

T_{n_max}

the highest temperature allowable to locate LED module to work normally.

T_nX

temperature in the housing or similar space of a luminaire where LED module(s) mounted. And meanwhile the luminaire is in the environment of the maximum allowable temperature to work.

NOTE: T_n35 means the value of T_nX of LED module matching with a rated luminous flux of 3000lm or 3500lm; T_n45 means the value of T_nX of LED module matching with a rated luminous flux of 4500lm; T_n54 means the value of T_nX of LED module matching with a rated luminous flux of 5400lm.

compliance

properties to meet relevant requirements of interfaces in order to fulfill interchangeability for products.

thermal test module

a specific unit with steady thermal output, used for thermal properties measurement for a LED module or a luminaire.

Proposed interface requirements

As part of street light, the design and manufacture for interchangeable LED module, control gear or luminaire shall guarantee the safety of street lighting. The product shall meet the specifications of declared performance.

The street light combined with control gear and LED module(s) shall conform with standard IEC 60598-1 and IEC 60598-2-3.

When replacing, the LED module or the control gear, it shall be complied with corresponding interchangeable markings.

1 Mechanical interface

A luminaire of street light provides both the support and connections for LED module(s). LED module(s) can be fixed onto install-bracket. There exists luminaires with one or more LED modules.

The mechanical interface includes the interface between LED module and luminaire, and the interface between control gear and luminaire.

NOTE: Annex A gives details of possible internal installation arrangements and the position of install-brackets.

1.1 Structure of a LED module

A LED module shall contain light source, optical component(s), heat sink and electrical connector(s).

The outline of a LED module is shown in Figure 1. The dimensions are specified in Table 1. The install-brackets shall be flat and without obstruction which could affect the installation or removal of the LED modules.

For dimension tolerances, refer to standard ISO 286-2.

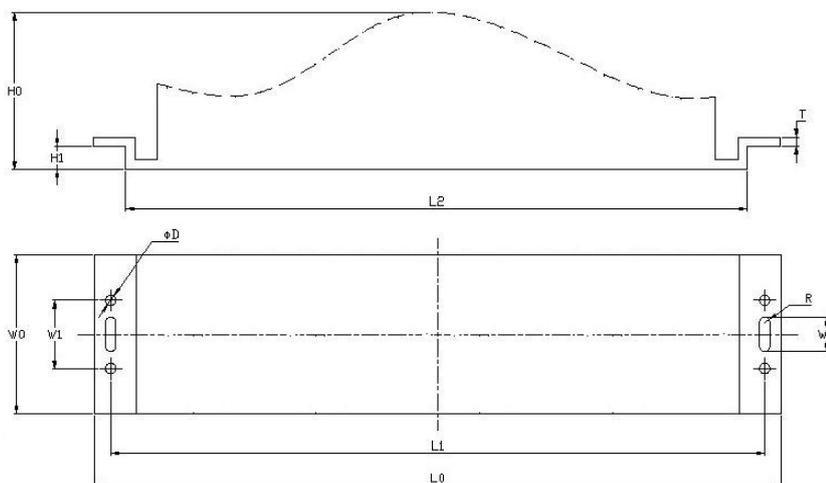


Figure 1 - Shape and dimensions of a LED module

Table 1 - Dimensions of LED module

Dimension code	Type A				Type B			
	mm				mm			
	Min	Typical	Max	Tolerance	Min	Typical	Max	Tolerance
L0	/	/	300	/	/	/	200	/
L1	/	286	/	±0.30	/	186	/	±0.30
L2	/	/	272	/	/	/	172	/
R	2.5	/	2.75	/	2.5	/	2.75	/
W0	/	/	70	/	/	/	150	/
W1	/	30	/	±0.20	/	60	/	±0.30
W2	/	15	/	±0.18	/	15	/	±0.18
H0	/	/	80	/	/	/	80	/
H1	/	10	/	±0.18	/	10	/	±0.18
D	5.0	/	5.5	/	5.0	/	5.5	/
T	/	/	4	/	/	/	4	/

NOTE: The dimension codes of a LED module in table 1 explain as below.

- L0- maximum length of LED module.
- L1- fixing screw hole centre-spacing for LED module installation.
- L2- dimension of the light emitting surface.
- R and W2- reserved slot for locating hole.
- W0- maximum width of LED module.

- W1- screw hole spacing of LED module.
- H0- maximum height of LED module (when there is cross cable over the module, the height of cable shall be taken into account.)
- H1- the height from the underside of install-bracket of the LED module to the install-surface of baseboard of LEDs.
- D- diameter of the screw-holes.
- T- thickness of the install-bracket of the LED module.

1.2 Structure of a Luminaire

A luminaire shall include cable and connector(s) for connections of control gear and connections of LED module(s).

1.2.1 Mounting dimensions between luminaire and LED module(s) are shown in figure 2 and table 2.

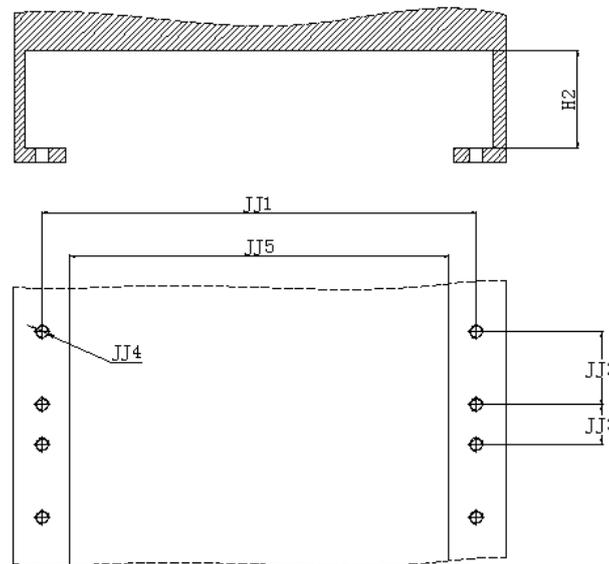


Figure 2 - Mounting holes on the luminaire to install LED module

Table 2 - Structural dimensions

Dimension code	Type A				Type B			
	Min	Typical	Max	Tolerance	Min	Typical	Max	Tolerance
JJ1	/	286	/	±0.20	/	186	/	±0.20
JJ2	/	30	/	±0.20	/	60	/	±0.20
JJ3	45	/	80	/	95	/	100	/
JJ4	/	M4	/	/	/	M4	/	/
JJ5	/	275	/	±0.52	/	175	/	±0.40
H2	80	/	/	/	80	/	/	/

NOTE: Figure 2 and Table 2 show dimensions to install a LED module.

- JJ1 and JJ2 - hole pitch for LED module installation.
- JJ3 - hole pitch between two adjacent LED modules.
- JJ4 - threaded hole on luminaire.
- JJ5 - distance between mounting grooves on luminaire.
- H2 – height of the space in luminaire for LED module(s) installation.

1.2.2 The mounting dimensions of luminaire to fit control gear are shown in Figure 3 and table 3.

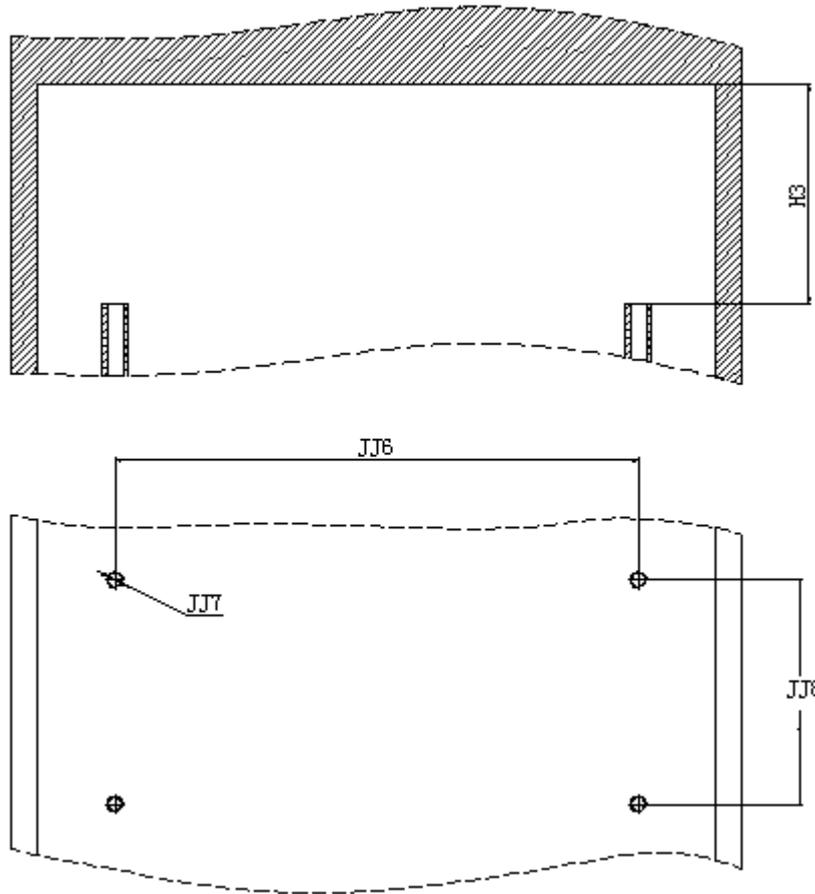


Figure 3 Mounting holes on the Luminaire to install control gear

Table 3 - Structural dimensions

Dimension code	Min mm	Typical mm	Max mm	Tolerance mm
JJ6	/	260	/	±0.20
JJ7	/	M4	/	/
JJ8	/	120	/	±0.20/
H3	80	/	/	/

NOTE: Figure 3 and Table 3 show mounting dimensions to install control gear.

- JJ6 and JJ8 - the hole pitch to install control gear inside the luminaire,
- JJ7- threaded hole to install control gear.
- H3 –height of the space in luminaire for control gear installation.

1.3 Structure of control gear

The dimensions of control gear shall be ensured to mount into the luminaire. If the cable outlet applies electrical connector, the length of the cable (including connector itself) shall comply to the requirements in figure 4 and table 4.

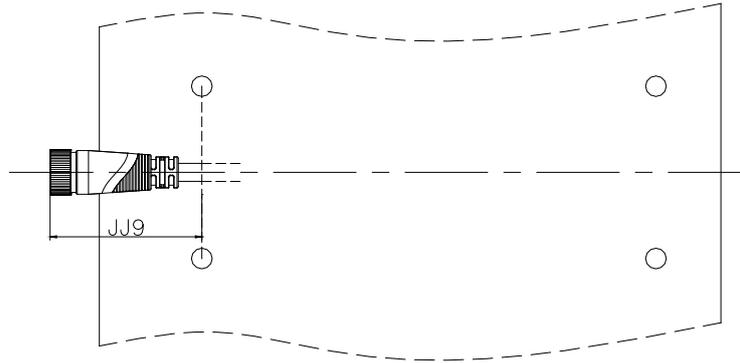


Figure 4 Sketch of cable outlet of control gear

Table 4 - Dimension of cable outlet of control gear

Dimension code	Minimum mm	Maximum mm	Tolerance mm
JJ9	40	60	/

NOTE: An adapting part may be used. As part of control gear, the length and width of adapting part shall be less than 270mm and 130mm respectively.

1.4 Installation and connection

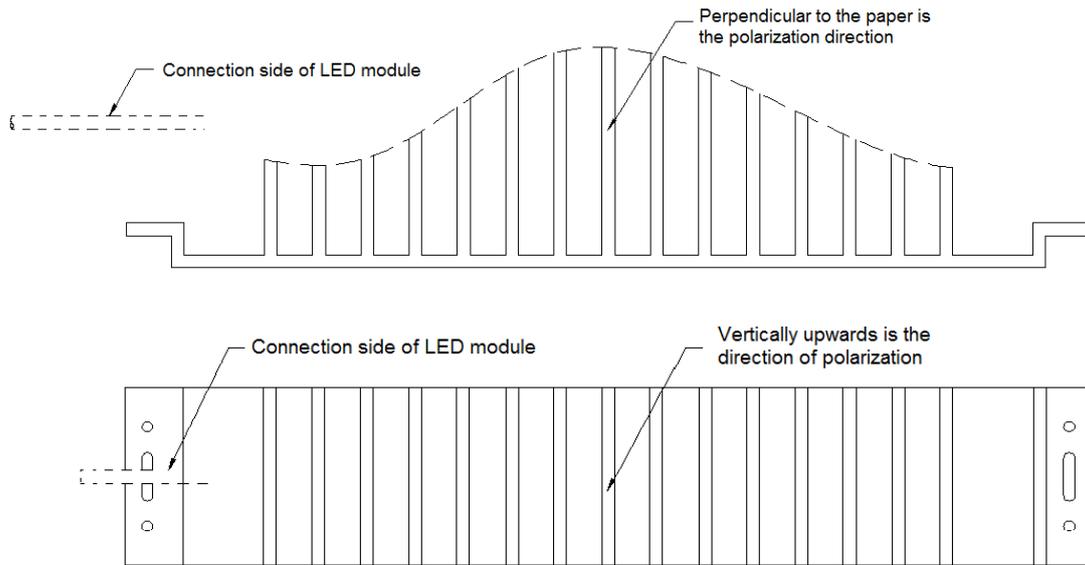
1.4.1 A LED module may be mounted into luminaire with screw or other means. The connection shall be tight and reliable.

1.4.2 If the luminaire contains a chamber for control gear, the control gear connects with the output of the chamber by terminals. At this time, the connector of the chamber output is the socket and the connector of the LED module is the plug. If the luminaire does not contain a chamber for control gear, the output of control gear is taken use of electrical connector(s). Meanwhile, the connector of the control gear output is the socket and the connector of the LED module is the plug. Wiring cable in a luminaire shall guarantee adequate installation for both of LED module(s) and control gear(s). For wiring, refer to annex C. Led modules are connected in series.

1.4.3 For a LED module, the relationship of the position between direction of polarized light emitting surface and direction of cable lead-out port is that, for LED

module with non-symmetric light distribution, when the direction of light emitting surface pointing downward, the non-symmetric light distribution polarization direction is defined as the positive direction. If the position where rotating this positive direction anticlockwise with 90 degree pointing to left-hand, this side is the lead-out port for the wire. Otherwise, right-hand is the lead-out port. For details refer to figure 5.

These definitions do not apply to LED module with symmetric light distribution design.



NOTE: In figure 5, the connector is on the side of left-hand of LED module.

1.4.4 Wiring layout in the luminaire shall be arranged at one side as shown in figure 6.

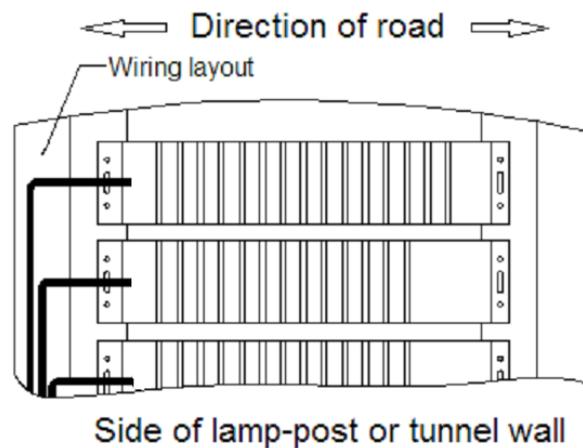


Figure 6 - Wiring arrangement in a luminaire

2 Photometric interface

2.1 Luminous flux

The rated luminous flux is defined as 3000lm, 3500lm, 4500lm and 5400lm respectively.

The measured value shall not be less than 90% and not higher than 120% of the rated luminous flux.

2.2 Spatial luminous intensity distribution

Manufacturers of LED modules for street light shall provide the luminous intensity distribution and working conditions, including the height of the pole and the installation requirements. The luminous intensity distribution of the product shall comply with the specifications.

The spatial luminous intensity distribution of a LED module intended for street lighting shall meet the requirements of standard for lighting design of urban road.

The spatial luminous intensity distribution of a LED module intended for street lighting shall conform to one of the types of I, II, III or IV as defined in IESNA PR-8-00. Table 5 indicates the types of luminous distribution of typical LED modules for street lighting. The values in bold belong to common application types.

Table 5 - luminous distribution for street lights

Type of latitudinal light spread	Type of distribution with different longitudinal projection		
	Short projection $45^{\circ} \leq \gamma < 66^{\circ}$	Medium projection $66^{\circ} \leq \gamma < 75^{\circ}$	Long projection $75^{\circ} \leq \gamma < 80^{\circ}$
Type I	1S	1M	1L
Type II	2S	2M	2L
Type III	3S	3M	3L
Type IV	4S	4M	4L

2.3 Chromaticity requirements

For a LED module, the Ra shall not be less than 60.

For a LED module, the chromaticity shall meet the requirements defined in Table 6.

Table 6 - CCT requirements for LED module

Nominal CCT	Centre point		Tolerance quadrangle	
	x	y	x	y
2700K	0.4578	0.4101	0.4813	0.4319
			0.4562	0.4260
			0.4373	0.3893
			0.4593	0.3944
3000K	0.4338	0.4030	0.4562	0.4260

			0.4299	0.4165
			0.4147	0.3814
			0.4373	0.3893
3500K	0.4073	0.3917	0.4299	0.4165
			0.3996	0.4015
			0.3889	0.3690
			0.4147	0.3814
4000K	0.3818	0.3797	0.4006	0.4044
			0.3736	0.3874
			0.3670	0.3578
			0.3898	0.3716
4500K	0.3611	0.3658	0.3736	0.3874
			0.3548	0.3736
			0.3512	0.3465
			0.3670	0.3578
5000K	0.3447	0.3553	0.3551	0.3760
			0.3376	0.3616
			0.3366	0.3369
			0.3515	0.3487
5700K	0.3287	0.3417	0.3376	0.3616
			0.3207	0.3462
			0.3222	0.3243
			0.3366	0.3369
6500K	0.3123	0.3282	0.3205	0.3481
			0.3028	0.3304
			0.3068	0.3113
			0.3221	0.3261

3 Electrical interface

3.1 Input voltage and current for LED modules

The rated input current and voltage of LED module with 3000lm shall comply with Table 7.

Table 7 - Requirements of Input voltage and current for LED modules with 3000lm

Input current mA	Range of input voltage V	
I_{rated}	U_{min}	U_{max}
350	66	95
530	44	63
700	33	48
860	28	41
1050	23	34

The rated input current and voltage of LED module with 3500lm shall comply with Table 8.

Table 8 - Requirements of Input voltage and current for LED modules with 3500lm

Input current mA	Range of input voltage V	
I_{rated}	U_{min}	U_{max}
350	77	111
530	51	73
700	38	56
860	33	48
1050	27	39

The rated input current and voltage of LED module with 4500lm shall comply with Table 9.

Table 9 - Requirements of Input voltage and current for LED modules with 4500lm

Input current mA	Range of input voltage V	
I_{rated}	U_{min}	U_{max}
350	99	143
530	65	94
700	49	71
860	42	62
1050	34	50

The rated input current and voltage of LED module with 5400lm shall comply with Table 10.

Table 10 - Requirements of Input voltage and current for LED modules with 5400lm

Input current mA	Range of input voltage V	
	I_{rated}	U_{min}
350	119	171
530	78	113
700	59	86
860	50	74
1050	41	61

LED modules shall work normally when the difference between rated and actual current values is less than 10%. The actual input voltage shall be within the specified range.

3.2 Output requirements for control gear

The output of the control gear shall meet the input requirements of the LED module. The output current of control gear shall not vary by more than $\pm 10\%$ of the LED module nominal input value. The output voltage shall conform to the allowable range of the LED module.

Table 11 The minimum output of control gear matching with 3000lm LED module

Output current (I)	Output voltage (U)
350mA	66V~95V
	132V~190V
	198V~285V
	264V~380V
	330V~475V
	396V~570V
530mA	44V~63V
	88V~126V
	132V~189V
	176V~252V
	220V~315V
	264V~378V
700mA	33V~48V
	66V~96V
	99V~144V
	132V~192V
	165V~240V

	198V~288V
860mA	28V~41V
	56V~82V
	84V~123V
	112V~164V
	140V~205V
	168V~246V
1050mA	23V~34V
	46V~68V
	69V~102V
	92V~136V
	115V~170V
	138V~204V

Table 12 The minimum output of control gear matching with 3500lm LED module

Output current (I)	Output voltage (U)
350mA	77V~111V
	154V~222V
	231V~333V
	308V~444V
	385V~555V
	462V~666V
530mA	51V~74V
	102V~148V
	153V~222V
	204V~296V
	255V~370V
	306V~444V
700mA	39V~56V
	78V~112V
	117V~168V
	156V~224V
	195V~280V
	234V~336V
860mA	33V~48V
	66V~96V
	99V~144V

	132V~192V
	165V~240V
	198V~288V
1050mA	27V~39V
	54V~78V
	81V~117V
	108V~156V
	135V~195V
	162V~234V

Table 13 The minimum output of control gear matching with 4500lm LED module

Output current (I)	Output voltage (U)
350mA	99V~143V
	198V~286V
	297V~429V
	396V~572V
	495V~715V
	594V~858V
530mA	65V~94V
	130V~188V
	195V~282V
	260V~376V
	325V~470V
	390V~564V
700mA	49V~71V
	98V~142V
	147V~213V
	196V~284V
	245V~355V
	294V~426V
860mA	42V~62V
	84V~124V
	126V~186V
	168V~248V
	210V~310V
	252V~372V
1050mA	34V~50V

	68V~100V
	102V~150V
	136V~200V
	170V~250V
	204V~300V

Table 14 The minimum output of control gear matching with 5400lm LED module

Output current (I)	Output voltage (U)
350mA	119V~171V
	238V~342V
	357V~513V
	476V~684V
	595V~855V
	714V~1026V
530mA	78V~113V
	156V~226V
	234V~339V
	312V~452V
	390V~565V
	468V~678V
700mA	59V~86V
	118V~172V
	177V~258V
	236V~344V
	295V~430V
	354V~516V
860mA	50V~74V
	100V~148V
	150V~222V
	200V~296V
	250V~370V
	300V~444V
1050mA	41V~61V
	82V~122V
	123V~183V
	164V~244V
	205V~305V

3.3 Electrical connector

3.3.1 Structure and dimension of the Electrical Connector

The connection between LED module(s) and luminaire or the connection between control gear and luminaire is engaged by pluggable water-proof connectors. The polarity wiring for plug and socket shall comply with that shown in figure 7.

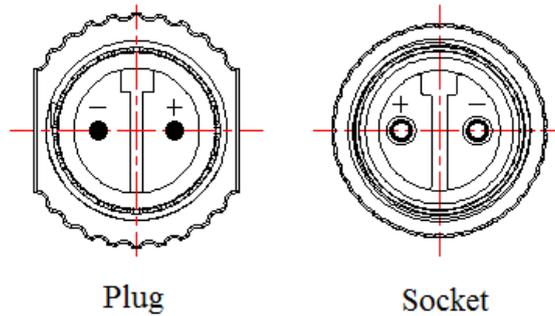


Figure 7 - Plug and socket polarity

The color of positive lead-wire is defined as brown, and negative lead-wire is defined as light blue.

The cable is dual core. The pins of the plug and the jacks of socket are shown in Figure 8. For dimensions refer to Table 15.

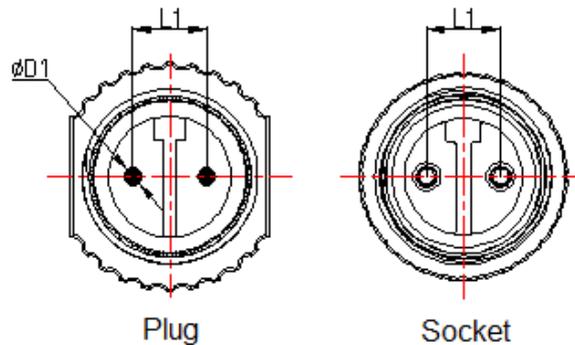


Figure 8 - Plug pin and socket jack

Table 15 - Dimensions of plug pin and socket jack

Dimension code	Typical mm	Tolerance mm
L1	6.3	±0.05
D1	1.5	±0.03

3.3.2 Requirement of the placement of positioning grooves for the electrical connectors

Structure and fitting dimensions between plug and socket are shown in figure 9, figure 10, table 16 and table 17.

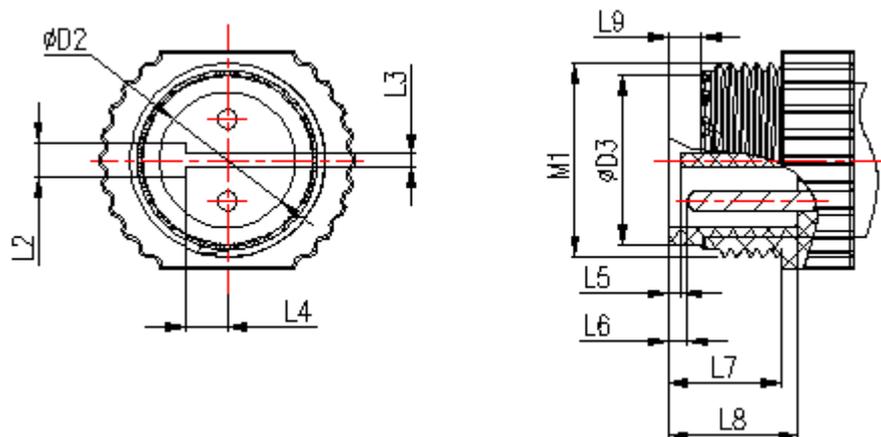


Figure 9 - Fitting dimensions of plug

Table 16 - Dimensions of plug

Dimension code	Minimum mm	Typical mm	Maximum mm	Tolerance mm
D2	10.20	/	/	/
D3	/	13.00	/	± 0.10
L2	/	2.70	/	± 0.10
L3	/	1.00	/	± 0.10
L4	/	3.20	/	+0.25
L5	/	1.00	/	± 0.20
L6	/	1.50	/	± 0.30
L7	8.60	/	/	/
L8	9.00	/	/	/
L9	/	/	3.00	/
M1	/	M15	/	/

NOTE: Thread pitch of M1 is 1mm.

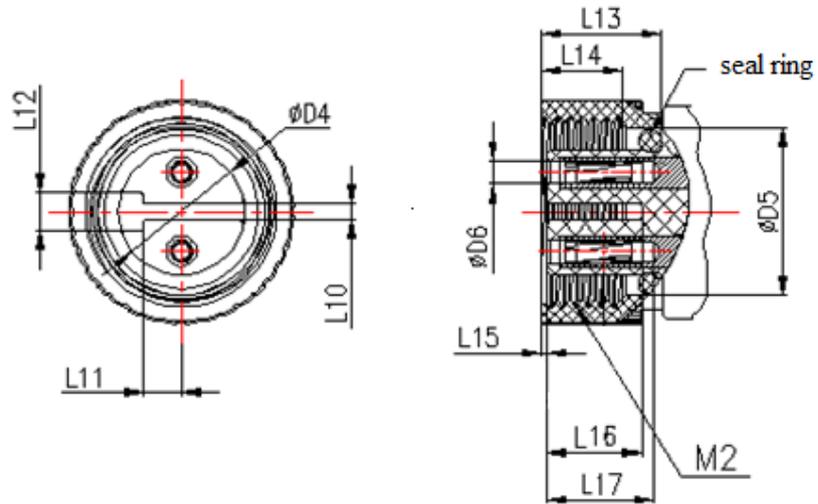


Figure 10 - Fitting dimensions of socket

Table 17 - Dimensions of socket

Dimension code	Minimum mm	Typical mm	Maximum mm	Tolerance mm
D4	/	/	10.10	/
D5	/	13.30	/	± 0.10
D6	/	1.80	/	± 0.20
L10	/	1.30	/	± 0.15
L11	/	3.00	/	± 0.15
L12	/	3.00	/	+0.15 -0.10
L13	/	9.50	/	± 0.20
L14	6.40	/	/	/
L15	/	0.50	/	± 0.15
L16	7.40	/	/	/
L17	7.50	/	/	/
M2	/	M15	/	/

NOTE: Thread pitch of M2 is 1mm.

3.3.3 The outline dimension of the electrical connector

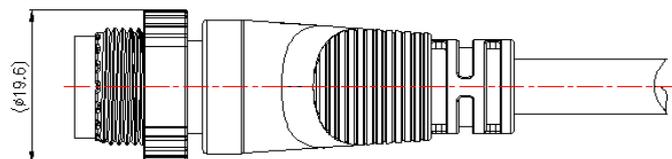


Figure 11 – Outline of Plug

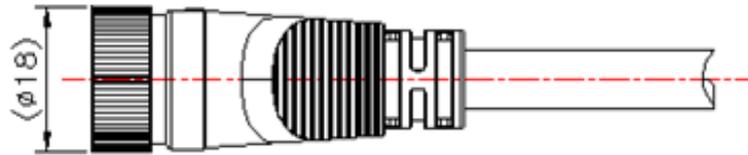


Figure 12 – Outline of socket

3.3.4 Specific requirements for the electrical connector

The length of the lead-wire (L_3) from the LED module is defined as 50mm~70mm as shown in figure 13.

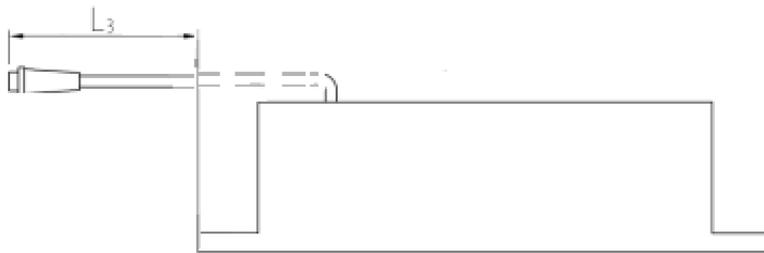


Figure 13 –Input connection of the LED module

4 Thermal interface

4.1 Requirements of T_{n_max} for LED module

T_{n_max} is provided by manufacturer. For calibration of declared value, refer to annex B.

4.2 Interchangeability requirements between LED modules and luminaire

For a LED module, if its T_{n_max} is higher than T_nX of luminaire (corresponding to rated luminous flux of LED module), the LED module matches with this luminaire. Otherwise, it does not match with the luminaire.

4.3 Requirements of thermal power for LED module

For a LED module with 3000lm or 3500lm, its thermal power shall not higher than 32W. For a LED module with 4500lm, its thermal power shall not higher than 40W. And for a LED module with 5400lm, its thermal power shall not higher than 48W.

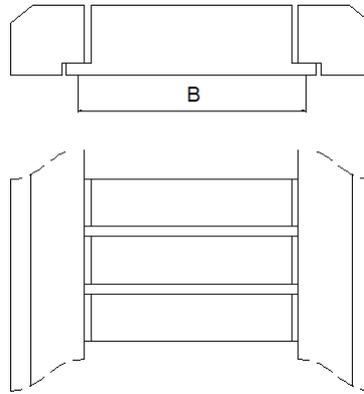
NOTE: thermal power = electric power – light radiant power.

5 Control interface

An additional input may be reserved on the control gear for the purposes of intelligent control.

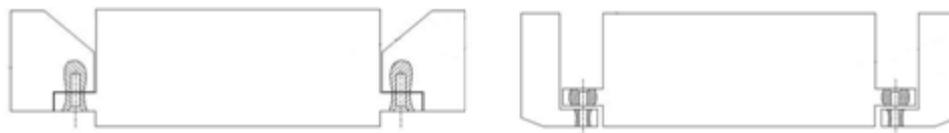
Annex A
(Informative)
Application examples of LED module(s) and luminaire

Figure A.1 shows the LED modules assembled as an array arrangement. This is for illustrative purposes only. Individual or artistic design other than this recommendation is also encouraged.



Parallel distribution array

Figure A 1 - LED module array

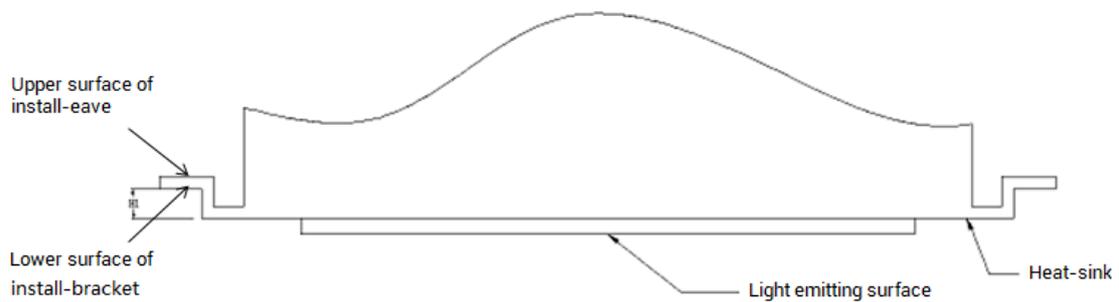


(A) Installed from below

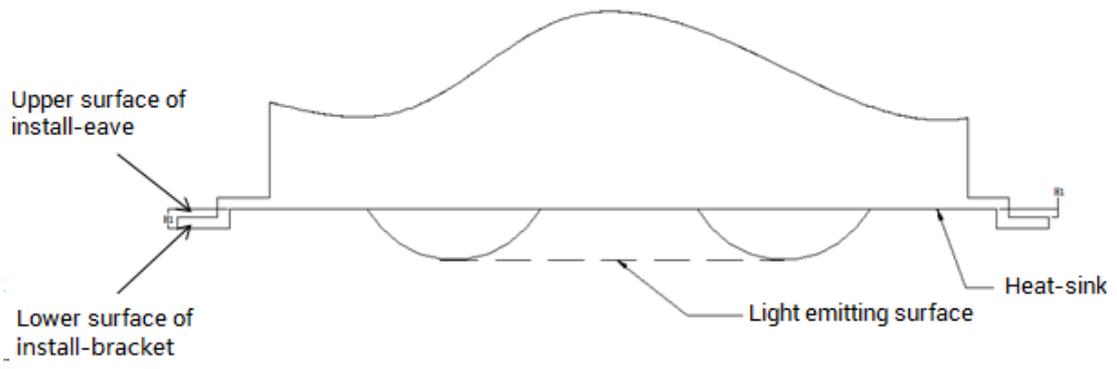
(B) Installed from above

Figure A.2 - Methods of installing LED module onto luminaire

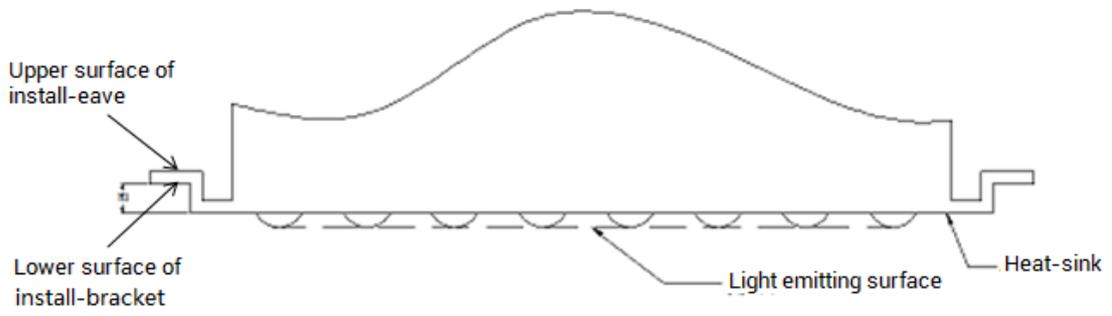
In order to avoid misunderstanding, in figure A.3, examples show the relationship between light emitting surface and install-bracket.



Type 1



Type 2



Type 3

Figure A.3 - The position of install-bracket of LED module

Annex B
(Informative)
Test methods for thermal interface

B.1 Instructions for T_{n_max} calibration

For luminaire with single LED module, test method of T_{nX} is shown in figure B.1.

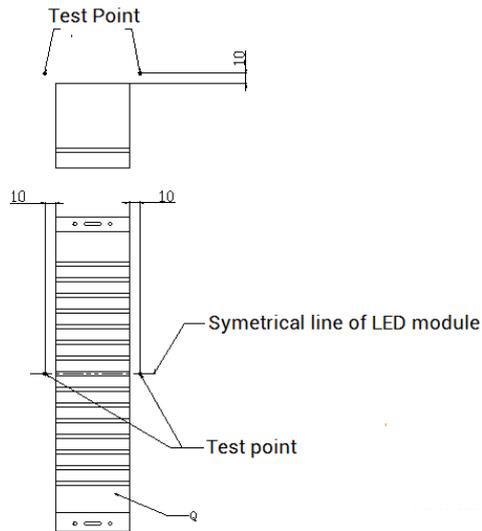


Figure B.1 - T_{nX} test for luminaire with single LED module

For luminaire with two LED modules, test method of T_{nX} is shown in figure B.2.

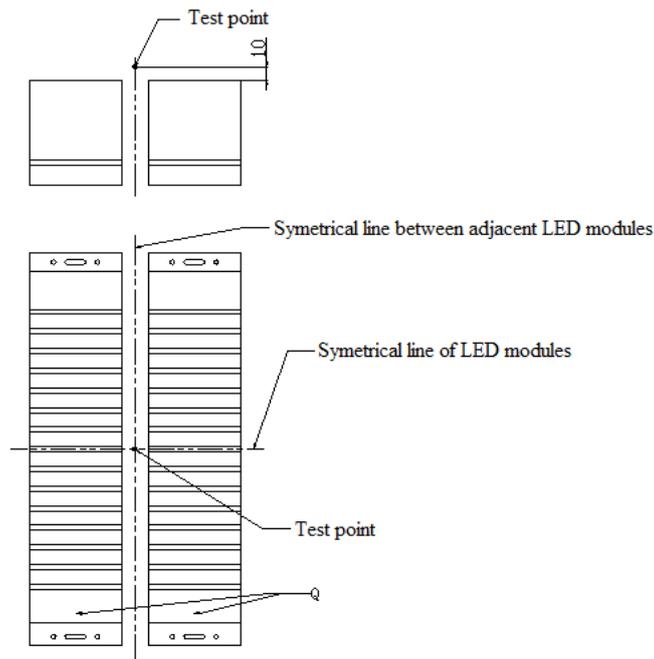


Figure B.2 - T_{nX} test for luminaire with two LED modules

For Luminaire with three or more than three LED modules, test method of T_nX is shown in figure B.3.

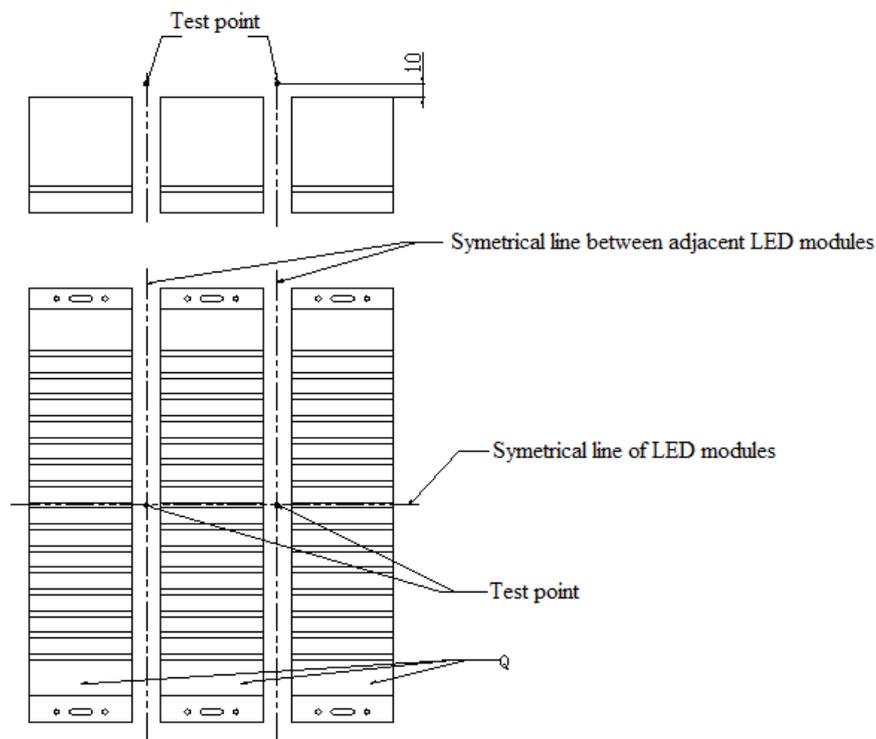


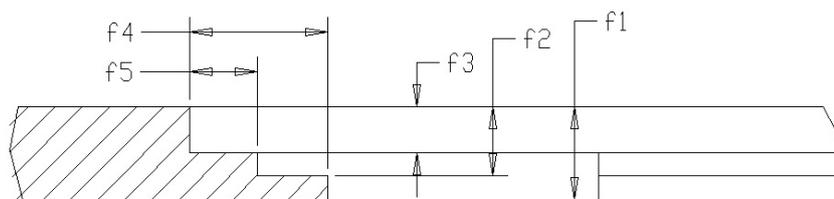
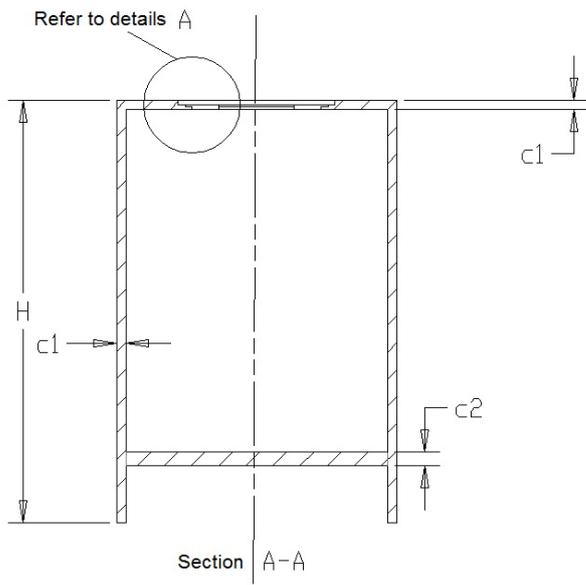
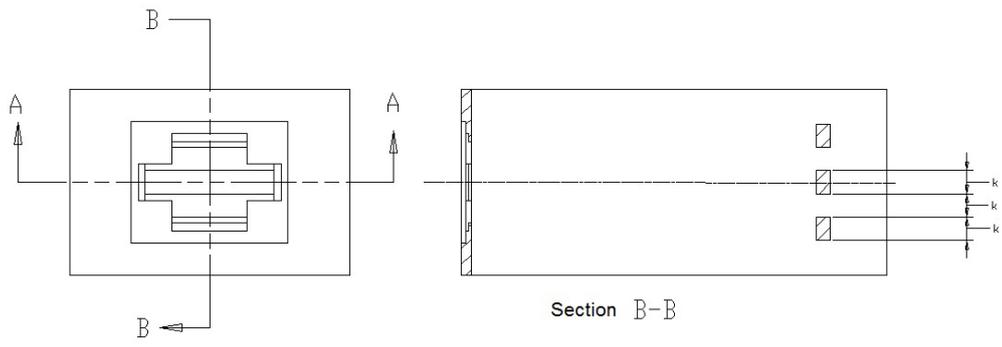
Figure B.3 - T_nX test for luminaire with three or more than three LED modules

NOTE: In figure B.3, if test T_nX , Q would be thermal test module, and the test points would be the positions for T_nX to measure. If check T_{n_max} , the module in the middle would be LED module and two sides of it would be two thermal test modules, and the test points would be the positions for T_{n_max} to measure.

B.2 Instructions for T_{n_max} calibration

Put the LED module(s) which is(are) under test into a test device and the test device is in an anti-air convection room where the environment temperature is $25^{\circ}\text{C}\pm 1^{\circ}\text{C}$. The light emitting surface of LED module(s) is (are) downward vertically. According to nominal luminous flux of LED module(s), the values of thermal power are set as 32W, 40W and 48W corresponding to 3500lm, 4500lm and 5400lm respectively. The point of T_c to be controlled is marked by manufacturer. Check and record T_{n_max} (refer to the position shown in figure B.1), the temperature shall be deemed stable if the difference between two consecutive temperature measurements is less than 1°C within 15 minutes.

B.2 Temperature rise test box



Details of A

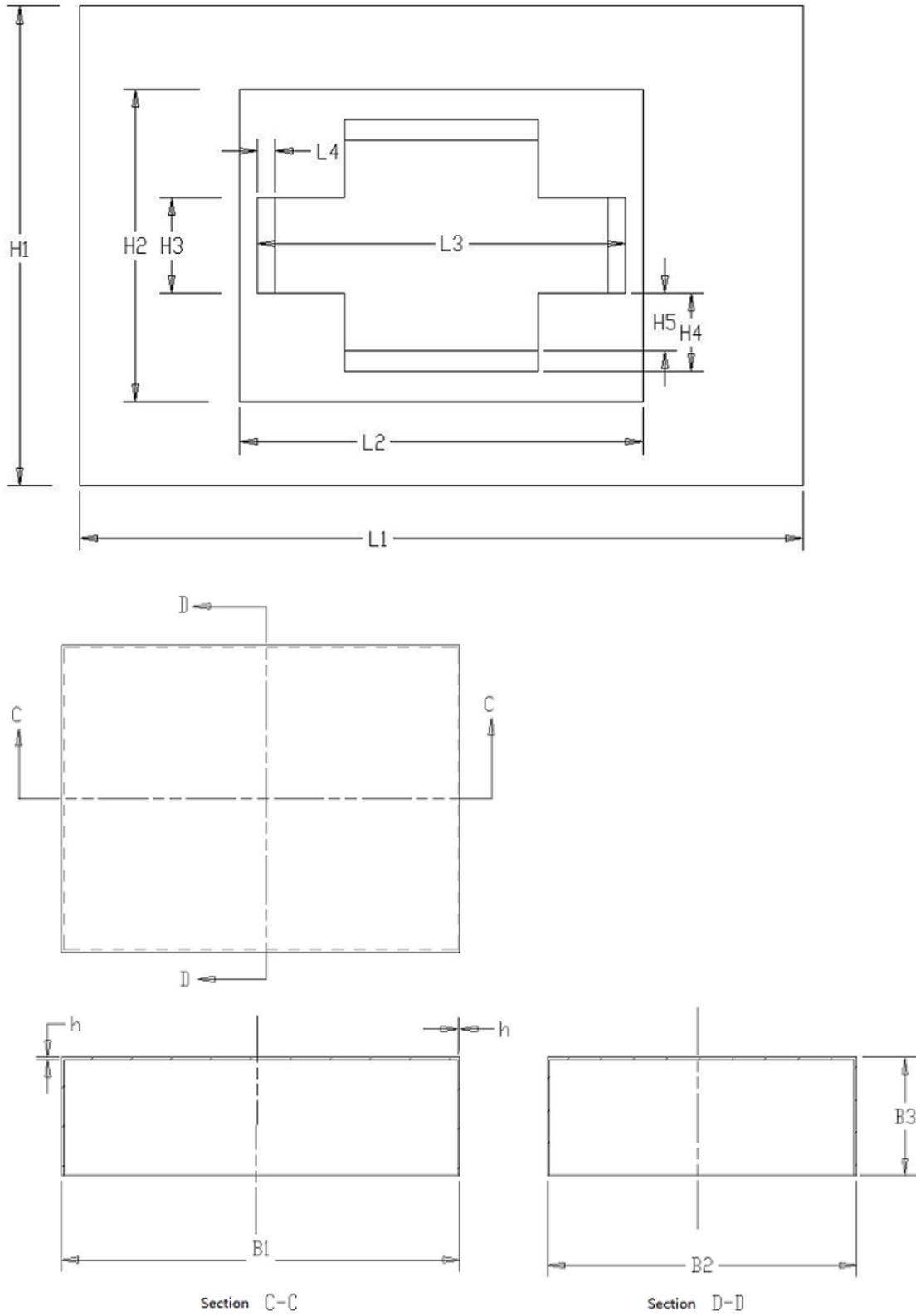


Figure B.4 - Dimensions of temperature test box

Table B.1 - Dimensions of temperature test box

Dimension code	Typical mm	Dimension code	Typical mm
R	50	L4	15
c1	20	L1	400
c2	30	h2	260
f1	20	h3	80
f2	15	h4	65
f3	10	h5	48
f4	30	h	2
f5	15	B1	335
L1	600	B2	260
L2	335	B3	100
L3	306	H	910

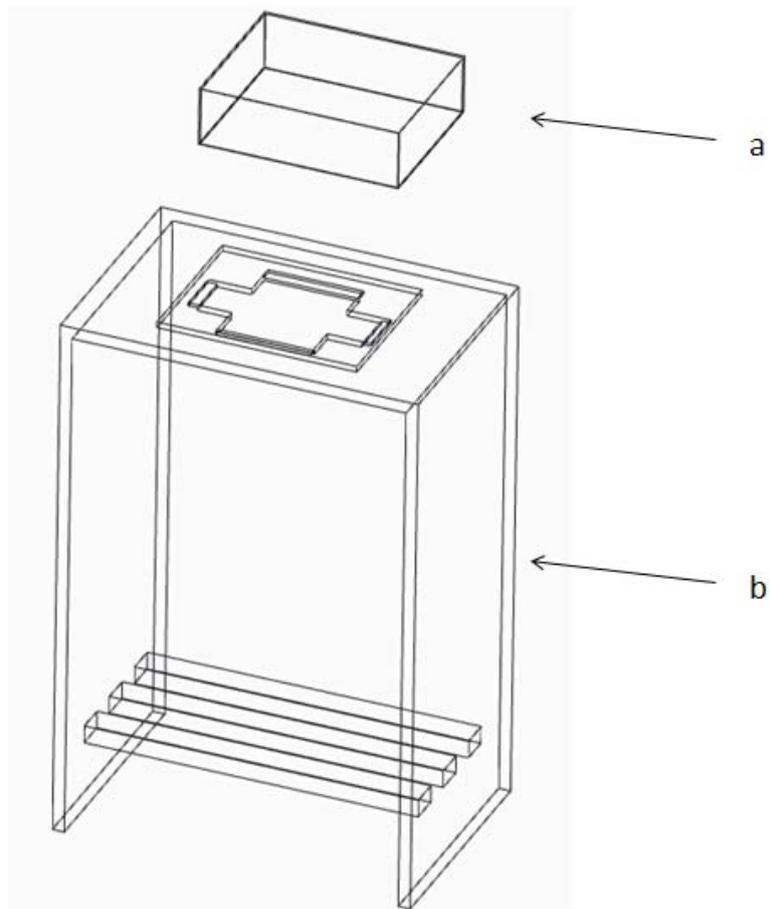


Figure B.5 – Sketch of temperature test box

Table B.2 – Material of temperature test box5

Code	Material
a	Metal
b	Plastic

**Annex C
(Informative)**

Wiring layout between LED modules and control gear

There are four methods of wiring layout for luminaire as shown in figures C.1 and C.2.

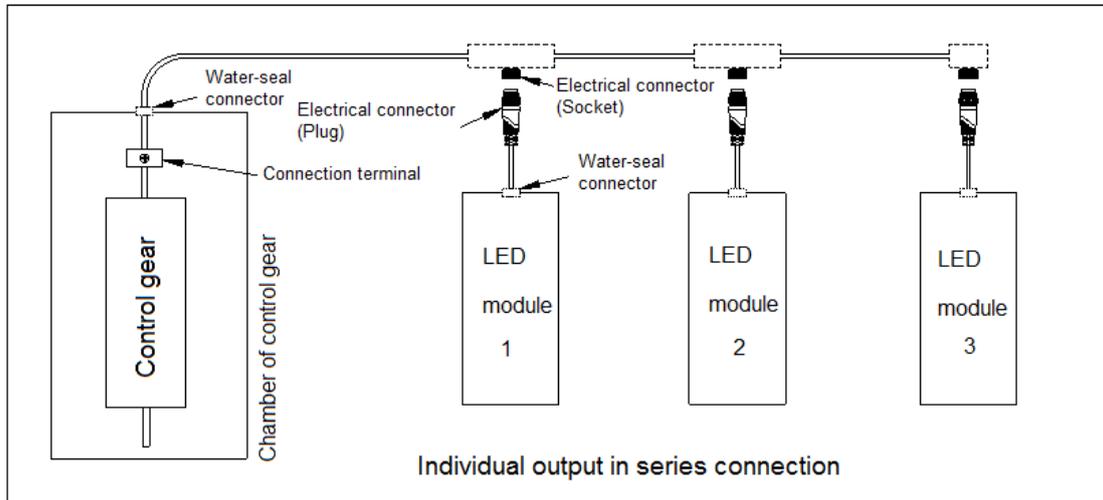


Figure C.1 – Control gear with individual output connected to LED modules in series

NOTE

- The luminaire contains chamber for control gear.
- Control gear supplies single way of output.

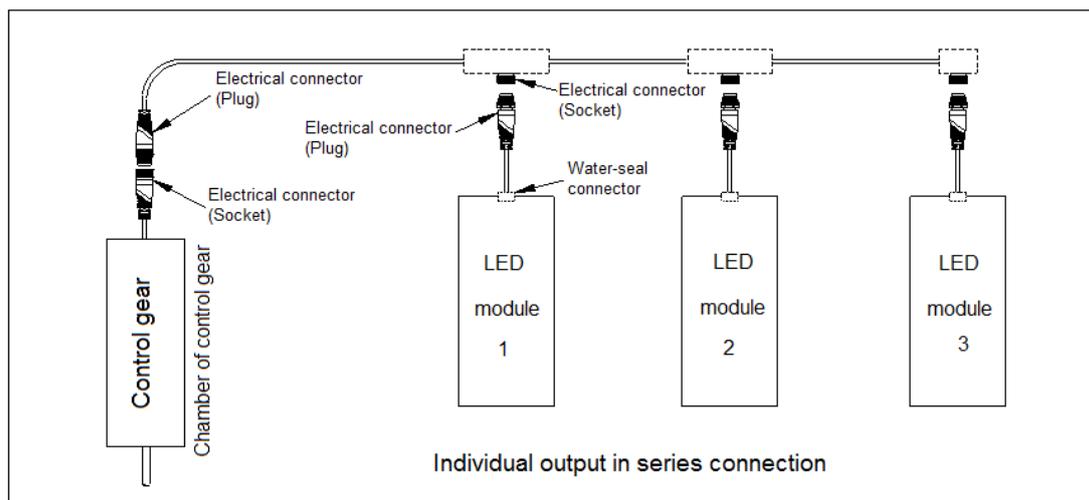


Figure C.2 – Control gear with individual output connected to LED modules in series

NOTE

- The luminaire does not contain chamber for control gear.
- Control gear supplies single way of output.
