

Public Lighting Equipment – LED Luminaires

Technical Specification

Ausgrid / Endeavour Energy / Essential Energy

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1. INTRO

NNSW recognises that the current suite of AS1158 standards does not acknowledge solid state lighting (SSL) as an acceptable lighting source for use with public lighting luminaires. NNSW is also aware that the revision of AS1158.6 to include SSL will not be published as a standard but will be published as a non compulsory Technical Specification which may be called upon by purchasers of public lighting luminaires.

The principle difference between the Technical Specification and AS/NZS 1158.6:2010 is the separation of the safety requirements to IEC 60598.2.3, the recognition of SSL as an acceptable source of light for public lighting luminaires and the inclusion of minimum performance requirements for SSL light sources.

As Standards Australia have not yet published this Technical Specification there is no reference to it in this specification. This specification refers to the existing AS1158.6:2010 and where that standard is silent on SSL light sources, additional performance requirements have been included.

2. PURPOSE

To set out in detail the requirements for manufacturing, testing and delivery of Category V and P solid state lighting (SSL) road lighting luminaires for use on Ausgrid, Endeavour Energy and Essential Energy electrical networks. This specification does not apply to decorative type luminaires

3. SCOPE

This specification has been prepared in conjunction with Ausgrid, Endeavour Energy and Essential Energy.

This specification covers the items detailed in table 1.

Table 1: Scope

Category	Sub-category
Luminaires	Category V LED Road Lighting Luminaires
	Category P LED Road Lighting Luminaires
	Floodlights: Pedestrian and Lighting Solutions/Nightwatch/Night Vision

4. REFERENCES

All items shall be designed and manufactured in accordance with the following industry standards detailed in table 2.

Table 2: Industry Standards

Standard	Description
AS/NZS 1158.0:2005	Part 0: Road Lighting introduction
AS/NZS 1158.1.1:2005	Lighting for roads and public spaces - Vehicular traffic (Category V) lighting - Performance and design requirements
AS/NZS 1158.2:2010	Part 2: Computer Procedures for the calculation of light technical parameters for Category V and Category P lighting
AS/NZS 1158.3.1:2005	Part 3.1: Pedestrian area (Category P) lighting – Performance and design requirements
AS/NZS 1158.6:2010	Part 6: Luminaires
IES TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources
IES LM-79-08	IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80-08	IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
IEC 61347-2-13	Particular requirements for d.c. or a.c. supplied electronic control gear for LED modules
IEC 61547:2009	Equipment for general lighting purposes - EMC immunity requirements
AS 3100:2009	Approval and test specification - General requirements for electrical equipment

5. DEFINITIONS AND ABBREVIATIONS

5.1 Document control

Employees who work with printed copies of document must check the BMS regularly to monitor version control. Documents are considered “uncontrolled if printed”, as indicated in the footer.

5.2 Recordkeeping

Making and maintaining complete, accurate and reliable evidence of business transactions in the form of recorded information (Source: AS records classification handbook – HB5031 – 2011.)

5.3 Review date

The review date is displayed in the header of the document, is the future date for review of this document. The default period is three years from the date of approval however a review

may be mandated at any time where a need is identified due to changes in legislation, organisational changes, restructures, occurrence of an incident or change in technology or work practice.

Table 3: Abbreviations

Abbreviation	Definition
ARR	Arrangement – The layout, in plan, of the luminaires in a lighting scheme, e.g. single sided, staggered, opposite or central. As per AS1158.2 Figure 5.1
AS	Australian Standard
BS	British Standard
CIE	International Commission on Illumination
H	The vertical distance in meters between the photometric centre of a luminaire and the surface which is to be illuminated
HID	high intensity discharge
HPS	high pressure sodium
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Organisation for Standardisation
LED	light emitting diode
Lm	lumens
MOV	metal oxide varistor
NEMA	National Electrical Manufacturers Association
NZS	New Zealand Standard
O.D.	Outer Diameter
O/H	Overhang (offset): The distance, measured horizontally, between the photometric centre of a luminaire and the adjacent kerb or carriageway edge.
SSL	A group of devices that embody p-n junctions that emit visible radiation when excited by an electric current. They can be further defined by the type of technology used, i.e. light-emitting diodes (LEDs), organic light-emitting diodes (OLEDs) or polymer light-emitting diodes (PLEDs).
RRW	Road Reserve Width: The width of the entire way, between property lines, devoted to public travel.
Wk	The width of a carriageway that is used for the determination of the performance of any given Category V road lighting scheme

6. SPECIFICATION

The specification covers the supply and delivery of the following Category P LED Road Lighting Luminaires as detailed in Table 4:

Table 4: Category P schedule of goods

Item	Description	Max power consumption
F10.1a	P3	70W
F10.2a	P3 Aeroscreen	70W
F10.3a	P4/P5	29W
F10.4a	P4/P5 Aeroscreen	29W
F10.5a	P4/P5 Reduced RRW	20W

The specification covers the supply and delivery of the following Category V LED Road Lighting Luminaires as detailed in Table 5:

Table 5: Category V schedule of goods

Item	Specification requirements	Max power consumption
F11.1a	Table 7 – Cat V5	120 W
F11.2a	Table 8 – Cat V5 Aeroscreen	120 W
F11.3a	Table 9 – Cat V3	130 W
F11.4a	Table 10 – Cat V3 Aeroscreen	130 W
F11.5a	Table 11 – Cat V1	199 W
F11.6a	Table 12 – Cat V1 Aeroscreen	199 W
F11.7a	Table 13 – Cat V1 High	326 W
F11.8a	Table 14 – Cat V1 High Aeroscreen	326 W

Note: NSW is seeking to replace its existing default High Pressure Sodium (HPS) and Metal Halide (MH) category V luminaires with SSL equivalents. SSL luminaires must meet the spacing requirements as set out in tables 8 – 15, whilst reducing power consumption compared to the incumbent luminaire.

The specification covers the supply and delivery of the following LED floodlights (bi-symmetrical and asymmetrical) as detailed in Table 6. Table 6 lists the current NSW inventory of floodlights. LED floodlights offered shall meet all requirements of this specification. Lumen output of floodlights should be comparable to their HID equivalent whilst reducing the total system power consumption.

Table 6: Floodlight schedule of goods

Item	Specification requirements (HID Equivalent)	Type	System power consumption (W)
F12.1a	150 Watt High Pressure Sodium / Metal Halide – Narrow beam	Asymmetrical	173
F12.2a	150 Watt High Pressure Sodium / Metal Halide	Bi-symmetrical	168
F12.3a	250 Watt High Pressure Sodium / Metal Halide – Narrow beam	Asymmetrical	273

Item	Specification requirements (HID Equivalent)	Type	System power consumption (W)
F12.4a	250 Watt High Pressure Sodium / Metal Halide	Bi-symmetrical	268
F12.5a	400 Watt High Pressure Sodium / Metal Halide – Narrow beam	Asymmetrical	440
F12.6a	400 Watt High Pressure Sodium / Metal Halide	Bi-symmetrical	440
F12.7a	1000 Watt High Pressure Sodium / Metal Halide	Bi-symmetrical	1040

6.1 Purpose of Equipment

The luminaires will be connected to low voltage distribution network with nominal voltage of 230V +10% to -6% at 50Hz as per AS 60038 on either dedicated street lighting mains or directly connected to the low voltage distribution network. They will be mounted on steel or concrete lighting poles or on steel or aluminium street lighting brackets on timber poles. The arm projection of supporting structures may be up to 6m.

6.2 Construction

The luminaires shall comply with all relevant requirements of AS/NZS 1158.6 and this specification. Luminaires shall be designed such that compliance is maintained throughout the design life. Where there is conflict between AS/NZS 1158.6 and this specification, the latter applies.

All items shall:

- a) Be constructed with integral control gear,
- b) have no cable entry glands, washers, grommets or other device to restrict the cable entry in order to meet the minimum diameter of the cable entry hole required by clause 3.7(a) of AS/NZS 1158.6.
- c) Have no moving parts (for example fans for thermal management)
- d) Surge protectors, i.e. metal oxide varistors (MOV), shall be fitted and installed. The minimum MOV unit value shall be 320 J. MOVs shall meet the requirements of IEEE/ANSI C62.41.2. Other forms of surge protection will be considered.
- e) Individual LEDs shall be connected such that a catastrophic loss or failure of one LED will not result in the loss of the entire LED module.
- f) Be single insulated.

Items 12.1a – 12.7a shall:

- a) Have a clear toughened glass visor.
- b) NEMA type photoelectric base
- c) shall incorporate a trunnion arm which is able to rotate around the body of the luminaire allowing for over and under slinging of the luminaire. The trunnion arm will also be provided with a M12 clearance hole to allow for the mounting of the luminaire to the appropriate fixing bracket.

6.3 LED Module/array requirements

- LED Module(s)/array(s) shall deliver a guaranteed minimum of 70% (L_{70}) of the initial lumens after a continuous service life of 80,000 hours at an operating temperature of 25°C ambient; and

- Manufacturer's data shall be provided in accordance with the requirements of IES LM-79-08, IES LM-80-08 and IES TM-21-11 and provide information on the extrapolated lumen depreciation.
- The luminaire shall have a minimum Colour Rendering Index (CRI) of not less than 70
- Correlated colour temperature (CCT)¹ shall be nominal 4000K (i.e. 3985K ± 275K).

6.4 Variations and minor additions to the requirements of AS/NZS 1158.6 (Should be read in conjunction with the associated clauses in AS1158.6)

Clause 1.5 "Environmental Conditions"

Additionally all items shall be capable of operating in areas of coastal sea spray and industrial pollution with an equivalent salt deposit density of 3g/m².

Clause 1.6.3 "Coded information on exterior of luminaire"

LED luminaires shall be marked with the letter "L" and total system power shall be indicated.

Clause 2.2.2 "Required Ingress Protection"

Luminaires shall be provided with not less than the following degrees of protection;

- The light-emitting module, optical and control gear chambers shall be IP65
- If the control gear is IP65, the control gear chamber may be IP24, however in this case the luminaire must be designed such that any water that enters the control gear chamber will naturally drain out.

LED luminaires that do not have an external supplementary visor are subject to the IP requirements outlined above.

Clause 2.3.1 "Resistance to vandalism"

All relevant parts and surfaces shall achieve a rating of resistance to external impact of not less than IK06 (moderate level of resistance) as per the IEC 62262 (2002).

Clause 2.4.2 "Component Fixing Devices"

Toggle latches, catches, clips and hinges shall be stainless steel of not less than grade 304.

In order to avoid electrolysis corrosion, brass and other copper alloys shall not be used in contact with aluminium or aluminium alloy.

Control gear / terminal block chamber shall be accessible without the use of tools.

Where toggle latches are used to secure an external supplementary visor, they shall be capable of maintaining the IP rating of the optical chamber throughout the design life of the luminaire as well as being capable of resisting inadvertent opening by animals.

Clause 2.9 "Fixing Spigot Entry"

Category P luminaires shall be suitable for mounting on a 34mm O.D. side entry spigot to AS 1798.

Category V luminaires shall be suitable for mounting on a 42mm O.D. spigot as per AS 1798.

Luminaires must have fixing spigot entry designed for zero degree upcast.

¹ The degree to which the colours of objects illuminated by a given lamp conform to those of the same objects illuminated by the appropriate reference light source for that lamp.

Clause 2.10

In addition to the mass requirements specified in this clause the luminaire shall not exceed a sail area of 0.18m²

Clause 3.2.4 "Electronic control gear"

LED module control gear shall meet the requirements of AS/NZS 61347.2.13 and;

- a) Power supply will have a minimum Power Factor of 0.85,
- b) The total harmonic distortion (THD) should be limited in accordance with AS61000.3.2 Part 3.2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase),
- c) Radio Frequency Interference (RFI) should be limited in accordance with limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment standard AS/NZS CISPR 15:2011, and
- d) The electronic control gear shall meet the immunity requirements of IEC 61547.
- e) The operating temperature of the luminaire as per the thermal testing requirements of AS/NZS 60598.2.3 does not exceed the maximum case and/or operating temperature of the electronic control gear.

Clause 3.8 "Terminal Block"

The terminal block shall be placed suitable for use with 4.0mm² two or three core PVC supply cables. An insulated clamp shall be provided near this terminal block to enable the incoming supply cable to be anchored in position without causing pinching of the cable or imposing mechanical strain on the terminal block.

Clause 3.10 "Socket for Photoelectric (PE) Cell Switch"

Category P luminaires shall include either a NEMA 3 contact pattern, NEMA 7 contact pattern or D2 PE cell base.

Category V luminaires shall include either a NEMA 3 contact pattern or NEMA 7 contact pattern PE Cell base.

Permanently wired PE cell switches may be used as an alternative to socket base type PE cell switches.

Where a PE cell base is used, the base shall be so positioned that the cell "window" faces the fixing spigot.

Clause 5.5 "Vibration Testing"

All luminaires shall be tested in accordance with this clause with the following amendments:

5.5.2 – Vibration stress test to ANSI 136.31 is acceptable

5.5.2 (d) Amplitude: 80 mm (160 mm peak to peak).

NOTE: The above amplitude corresponds to an acceleration of 3 G (or 29.4 m/s²), as per the higher test requirement of ANSI C136.31 for luminaires for application on bridges.

Clause 5.8 "Impulse Voltage Test"

Impulse voltage tests are required for all luminaires.

Clause 5.9 "Thermal endurance and thermal testing requirements"

The thermal endurance and thermal testing requirements of AS/NZS 60598.2.3 shall apply:

- (a) For Australia $t_a = 40^\circ\text{C}$.

(b) For New Zealand $t_a = 25^\circ\text{C}$.

6.5 Requirements beyond the scope of AS/NZS 1158.6

Insulation Tests

Every luminaire shall be routinely tested after manufacture and before packaging to ensure compliance with the following electrical tests

(i) Insulation Resistance Test – Clause 8.3.1 of AS 3100

Insulation resistance shall be measured at a voltage of 500 V d.c.

The resistance between live parts and the external metallic body shall be not less than 10 M Ω .

(ii) High Voltage (Electric Strength Test) – Clause 8.4.2 of AS 3100

Test shall be applied as per clause 8.4.5 of AS 3100 and there shall be no disruptive discharges, that is, flashovers or insulation punctures during any high voltage test.

Photometric test requirements for SSL luminaires

Photometric measurements shall either be in accordance with the requirements of LM-79-08: 2008 (excluding Clause 12.5) or comply with the following:

(a) The measurements shall be made in an ambient temperature of 25°C . If the measurements are made in an ambient temperature other than at 25°C , the results shall be corrected to equivalent performance at 25°C or this shall be accounted for in the measurement uncertainty;

(b) The measurements shall be made in still air;

(c) The measurements shall be made in the designed burning position of the test item. If the measurements are made in position other than in the designed burning position, the results shall be corrected to equivalent performance in the designed burning position or this shall be accounted for in the measurement uncertainty; and

NOTE: For much of the time that road lighting luminaires operate, i.e. during the hours of darkness, the ambient temperature will commonly be under 40°C . Therefore the criteria in other than Section 12 of LM-79-08 2008 should be assessed at $t_a = 25^\circ\text{C}$.

Manufacturer's data shall be provided in accordance with the requirements of IES LM 80-08 and IES TM 21-11 and provide information on the extrapolated lumen depreciation. The time period over which the luminous flux of the luminaire falls to 70% of its initial value, L70 shall be at least 80,000 hours at an ambient temperature of 25°C .

6.6 Shading Devices to Minimise the Effects of Obtrusive Light

The ability to limit the amount of light from the luminaire at certain angles to minimise the effects of obtrusive light may be required. Traditionally this has been achieved by replacing a standard visor with a visor that has been modified to block the light output at the desired angles. As SSL luminaires may or may not be fitted with a supplementary visor the tenderer shall include details as well as some quantification of their effect, of options that may be used to accommodate this requirement. Luminaires with an essential "semi-cut-off" distribution may be required to partially or severely restrict light emitted into the azimuthal

sector C45° to C135° above a gamma angle of 75° and in the azimuthal sector C225° to C315° above a gamma angle of 60°.

6.7 Specified Installation Parameters

Luminaires will be used typically for the lighting categories and geometrical configurations indicated in the tables below.

The light technical parameters given in AS/NZS 1158.1.1 table 2.2 and AS1158.3.1 table 2.6 for V and P lighting categories respectively shall be calculated in the manner prescribed by AS/NZS 1158.2 when luminaires are used above dry road surfaces having reflecting properties as prescribed for the CIE standard road surface R3 in CIE Publication No. 30-2.

Luminaires are required to meet the minimum spacings as detailed in the tables below and tenderers are to indicate the achieved minimum spacings.

6.8 Glare Requirements

Category P luminaires shall comply with light distribution, glare criteria and Upward Light Waste Ratio for a Type 4 luminaire as detailed in Table 2.10 of AS/NZS 1158.3.1. Where an “Aeroscreen” luminaire is specified, Type 6 distribution glare criteria and Upward Waste Light Ratio (UWLR) shall be achieved.

Category V luminaires are required to meet all requirements of AS1158.1.1 table 2.2. In addition to this requirement and where an “Aeroscreen” visor is specified the Upward Waste Light Ratio (UWLR) shall be 0%.

6.9 Spacing Analysis

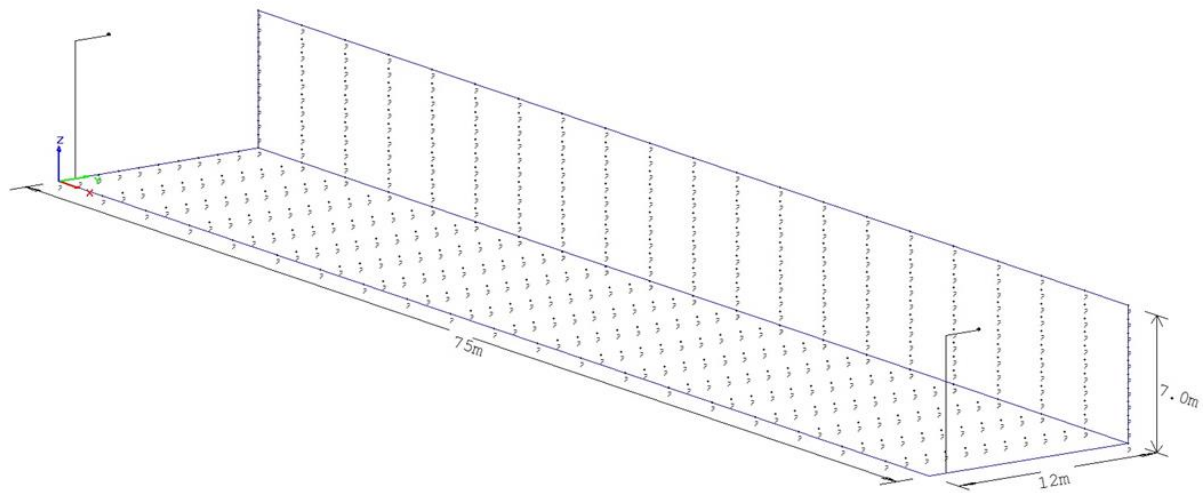
The contractor will assume a cleaning cycle of 10 years, corresponding to a luminaire maintenance factor (LMF) of 0.88.

The Contractor is to calculate a maintenance factor (MF) for the purpose of performing spacing analysis by multiplying extrapolated IES TM-21-11 data at 88,000 hours (LLMF, 20 years) by the luminaire maintenance factor above. Spacing analysis shall then be performed using this calculated MF, i.e. $MF = LMF \times LLMF$

Tables 7a and 7b refer to category P luminaires. Category P luminaires must comply with the requirements specified in both tables. Luminaires in compliance with one table only do not meet the minimum requirements of this specification.

Item F10.5a will be used for narrow roads and pathway lighting and is required to minimise obtrusive light on surrounding properties. In addition to the requirements in table 7a and AS1158.3.1 the point vertical illuminance on a plane at the edge of the 12m RRW shall not exceed 1 lux at any point. Refer figure 1 for illustrative representation.

Figure 1: Vertical illuminance configuration



Tables 8 – 15 refer to category V luminaires.

Table 7a: Category P Specified Installation Parameters – Part A

Item No.	Luminaire type	Category P3 7.5m mounting height (H) – Minimum Spacing (m)	Category P4 7.5m mounting height (H) – Minimum Spacing (m)	Category P5 7m mounting height (H) – Minimum Spacing (m)
F10.1a	P3 LED luminaire	59	-	-
F10.2a	P3 LED luminaire "Aeroscreen"	40	-	-
F10.3a	P4/P5 LED luminaire	-	65	80
F10.4a	P4/P5 LED luminaire Aeroscreen	-	40	55
F10.5a	P4/P5 Reduced RRW	-	65	75
<p>Note: The following parameters are assumed: Item F10.1a – F10.4a RRW (Road Reserve Width) = 20m Item F10.5a RRW (Road Reserve Width) = 12m Offset distance (O/H) = ¼ of RRW Upcast angle = 5 degrees</p>				

Table 7b: Category P Specified Installation Parameters – Part B

Item No.	Luminaire type	Category P3 7.5m mounting height (H) – Minimum Spacing (m)	Category P4 6m mounting height (H) – Minimum Spacing (m)	Category P5 6m mounting height (H) – Minimum Spacing (m)
F10.1a	P3 LED luminaire	59	-	-
F10.3a	P4/P5 LED luminaire	-	54	65
Note: The following parameters are assumed: RRW (Road Reserve Width) = 16m Offset distance (O/H) = 1.85m Upcast angle = 5 degrees				

Table 8: Item F11.1a Spacing

Lighting category	ARR	W _k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V5	3	13	9	2	5	31
	3	13	10.5	3		35
	4	23	9	2		63
	4	23	10.5	3		68

Table 9: Item F11.2a Spacing (0% UWLR)

Lighting category	ARR	W _k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V5	3	13	9	2	5	26
	3	13	10.5	3		30
	4	23	9	2		53
	4	23	10.5	3		55

Table 10: Item F11.3a Spacing

Lighting category	ARR	W _k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V3	3	13	9	2	5	29
	3	13	10.5	3		32
	4	23	9	2		45
	4	23	10.5	3		44

Table 11: Item F11.4a Spacing (0% UWLR)

Lighting category	ARR	W _k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V3	3	13	9	2	5	26
	3	13	10.5	3		27
	4	23	9	2		37
	4	23	10.5	3		37

Table 12: Item F11.5a Spacing

Lighting category	ARR	W _k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V1	3	13	10.5	3	5	33
	3	13	12	3		30
	4	23	10.5	3		42
	4	23	12	3		40

Table 13: Item F11.6a Spacing (0% UWLR)

Lighting category	ARR	W _k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V1	3	13	10.5	3	5	25
	3	13	12	3		24
	4	23	10.5	3		34
	4	23	12	3		33

Table 14: Item F11.7a Spacing

Lighting category	ARR	W _k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V1	3	13	12	3	5	46
	3	13	13.5	3		46
	4	23	12	3		61
	4	23	13.5	3		65

Table 15: Item F11.8a Spacing (0% UWLR)

Lighting category	ARR	W_k m	H m	Overhang m	Upcast degrees	Required minimum spacing m
V1	3	13	12	3	5	36
	3	13	13.5	3		39
	4	23	12	3		56
	4	23	13.5	3		53

Floodlight Photometric requirements

- a) Pedestrian Crossing

Items 12.1a, 12.3a and 12.5a shall comply with AS/NZA 1158.4, section 3.2.

- b) Lighting Solutions/Nightwatch/Night Vision floodlighting

Beam pattern required (Narrow/Medium/Wide) will be determined based on specifics of the floodlight.

Test case for sample results to be based on following situation:

- Subject size: 6 metre high x 40 metre wide building
- Pole location: 30 metre away – centre of building
- Mounting height of floodlight: 7 metres
- Aiming point: middle of building

Results:

- Luminous flux of floodlight
- Luminaire wattage
- Lighting levels on the front façade of the building
- Eav (lx)
- Emin (lx)
- Emax (lx)
- Uniformity Emax/Eav
- Photometric Distribution – chart / table / simulation sketch

6.10 Dimensional Outline Drawing

Tenderers shall provide dimensional outline drawings of the luminaires offered. The drawings shall include the information specified in Clause 6.2 of AS/NZS 1158.6.

6.11 Evidence of Compliance – Documentation

Except in the case of component materials, in which case suppliers' data sheets are an acceptable alternative, compliance with this Technical Specification shall be claimed in writing by the supplier and shall be substantiated by reference to appropriate test reports from a laboratory accredited by signatories to the International Laboratory Accreditation Corporation (ILAC) through their Mutual Recognition Agreement (MRA).

Test reports demonstrating compliance with AS/NZS 1158.6 and other applicable standards shall be provided as follows:

- a) Wind force test, Clause 5.4 of AS/NZS 1158.6,
- b) Vibration Test, Clause 5.5 of AS/NZS 1158.6,
- c) Ingress Protection Test, Clause 5.6 of AS/NZS 1158.6,
- d) Resistance to external mechanical impact, Clause 5.7 of AS/NZS 1158.6,
- e) Impulse voltage test, Clause 5.8 of AS/NZS 1158.6,
- f) Thermal Endurance and Thermal Testing requirements, Clause 5.9 of AS/NZS 1158.6 respectively,
- g) Insulation tests as detailed in the specification above,
- h) Test reports specified in IES LM-79-08 section 14,
- i) Test reports specified in IES LM-80-08 section 8,
- j) A luminous intensity distribution Table (I - Table) for the luminaire in CIE and IES file formats; and an Isolux Diagram,
- k) Evidence of accreditation of the laboratory providing the photometric information as per (j) above.